United States Patent Office 2,780,579 Patented Feb. 5, 1957

2,780,579

COMPOSITION AND METHOD FOR PERMANENT WAVING OF HAIR ON THE HUMAN HEAD

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No Drawing. Application July 23, 1953, Serial No. 369,964

13 Claims. (Cl. 167—87.1)

This invention relates to permanent waving of hair on the human head.

In its preferred form, our invention pertains to that type of permanent waving, commonly known as "cold" waving, wherein the hair is treated with a softening composition containing a disulfide disrupting agent as, for example, a mercaptan or a sulfite which converts the disulfide groups of the hair keratin, and more particularly of the hair cystine, into sulfhydryl groups. The hair is shaped, for example by winding on rods, before or after the softening step. Thereafter, the disulfide bonds are substantially restored by a setting treatment so that the finished hair will have approximately its original elasticity and, accordingly, will retain its altered shape.

At present, powerful oxidants such as hydrogen peroxide, sodium bromate, sodium chlorate and sodium chlorite are employed to restore the disulfide bonds. It is recognized that the use of such oxidants is accompanied by deleterious side effects such, for instance, as porosity, embrittlement, harshening and, under certain conditions, lightening of color. It is believed that some of these effects are due to over-oxidation of the cysteine, that is to say, oxidation beyond the cystine stage.

A further complication in the use of these powerful oxidants is the selection of a proper concentration. If the concentration is low enough to avoid deleterious side effects, the re-oxidation of the cysteine may be insufficient, particularly deep within the hair strands. But if a concentration is used which is sufficiently high to insure reformation of the disulfide bond deep within the hair strand, oxidation of the cysteine, at least near the surface of the strand, will be carried too far.

It has been determined by analysis that all the cystine content of the hair is not restored as such after disulfide bond breakdown and subsequent re-oxidation in present-day commercial permanent hair waving with the powerful oxidants now used. The actual percentage of recovery is a balance between failure to re-oxidize some cysteine deep in the hair strands and over-oxidation of other cysteine near the surface of the strands. The recovery obtained commercially is considered acceptable for permanency of waving but leaves much to be desired insofar as texture and strength of hair are concerned.

It is the salient object of our invention to provide a method and setting compositions for re-oxidizing softened hair which are not subject to the foregoing drawbacks.

It is another object of our invention to provide a method and compositions of the character described for controlled oxidation of reduced keratin of hair on the human head whereby only the original state of oxidation of the hair is attained and no higher states.

It is a further object of our invention to provide a method and compositions of the character described which will restore substantially more of the original cysteine than is recovered at present and will, accordingly, leave the hair in a state far closer to its original condition, except for shape.

It is an additional object of our invention to provide

a method and compositions of the character described which will absorb the excess oxidizing potential of any powerful oxidant that may be present and release this potential slowly and at the proper energy level for converting cysteine to cystine but no more.

It is yet another object of our invention to provide a method and compositions of the character described which are sensitive to even low concentrations of any powerful oxidants that may be present so as thereby to ensure complete re-oxidation of all the cysteine.

It is yet a further object of our invention to provide compositions of the character described which are inexpensive to manufacture.

It is still another object of our invention to provide a method of the character described which is similar to present methods in its manipulative steps so that additional skill is not required to practice the same.

Other objects of our invention in part will be obvious and in part will be pointed out hereinafter.

Our invention accordingly consists in the compositions and steps which will be exemplified in the compounds and processes hereinafter described and of which the scope of application will be indicated in the appended claims.

Pursuant to our invention the restoration of the cystine is accomplished by setting softened hair with dehydroascorbic acid in water.

We have discovered that dehydroascorbic acid has the specific capacity to convert cysteine to cystine in hair on the human head, that is, to oxidize such cysteine to cystine but not to carry the oxidation to a more advanced stage. Hence, as a dehydroascorbic acid setting solution penetrates a softened hair strand it will reconvert the sulfhydryl groups back to disulfide groups. Further exposure of the disulfide groups to said oxidant will not result in the formation, for example, of cysteic acid or inorganic sulfates.

We have determined that dehydroascorbic acid is effective for the foregoing purpose over a pH range varying from 2 to 10 although at the extreme alkaline end of said range it has a marked tendency to decompose and, therefore, is difficult to employ. The best results are secured at a pH of 7.4 but from a pH of 2.2 to a pH of 8 good results are obtained, the preferred range being from 5 to 8 when dehydroascorbic acid is the only oxidant present. Insofar as hair conditioning is concerned, the peak performance is 7.4, but results at this pH are not markedly superior to results secured anywhere within the preferred range.

Dehydroascorbic acid will function in accordance with our invention at concentrations as low as 0.03 percent by weight of the setting solution. However, increasingly better results are obtained as the concentration of dehydroascorbic acid increases up to about 0.5 percent and setting is satisfactory at a concentration as high as 0.8 percent.

It is best to employ a substantial concentration of dehydroascorbic acid, e. g. 0.5 percent, inasmuch as dehydroascorbic acid tends to be unstable in water at a pH over 5, being particularly unstable at any pH well within the alkaline range, and inasmuch as during reoxidation of the softened hair the dehydroascorbic acid converts to ascorbic acid which is not effective for re-hardening (setting) of the hair.

A typical oxidizing solution for neutralizing, that is to say, setting, hair which has been softened by treatment with a disulfide reducing agent is one gram of dehydroascorbic acid, 8.3 grams of disodium hydrogen phosphate and 1.2 grams of anhydrous citric acid to a pint of water, the pH being adjusted to 7.0. This setting solution is rinsed through the hair for approximately six minutes and leaves the hair permanently waved and with a soft and

silky texture, the hair strands being strong and non-porous and having their original color.

In accordance with a feature of the present invention the dehydroascorbic acid can be formed in situ. This may be effected by providing ascorbic acid together with an active oxidizing reagent, i. e. an oxidizing reagent of sufficient strength to oxidize ascorbic acid to dehydroascorbic acid. The dehydroascorbic acid functions to oxidize cysteine to cystine and in so doing reverts to ascorbic acid thus completing a closed cycle. Typical active oxidizing reagents of sufficient strength are those which conventionally are used for neutralizing hair, such, for example, as hydrogen peroxide, sodium bromate, sodium chlorate, sodium chlorite and sodium perborate.

The ascorbic acid will convert to dehydroascorbic acid and the dehydroascorbic acid will function pursuant to my invention to set softened hair anywhere within the pH range mentioned above, i. e. from 2 to 10. However, some of the active oxidizing reagents work best within more limited ranges, and under these conditions it will be understood that the pH of the setting solution will be governed by the oxidizing reagent employed. Thus, with hydrogen peroxide the preferred pH is about 2.2; with sodium bromate and sodium chlorate the preferred pH is from 5.5 to 6.2; and with sodium chlorite the preferred pH is about 9.2. At all of these pH values ascorbic acid is oxidized by the active oxidizing reagent to dehydroascorbic acid and the dehydroascorbic acid effectively oxides cysteine to cystine. We desirably do not use the highest values of pH inasmuch as, under such circumstances, the setting solution is irritating to the scalp, and the dehydroascorbic acid tends to form inactive compounds and, therefore, does not reconvert completely to ascorbic acid so as to be ready for re-use in the closed cycle.

The concentration of ascorbic acid may vary from 0.03 to 0.5 percent, the preferred concentration being 0.05 percent by weight. It may be mentioned that in the equilibrium which is reached in the conversion of ascorbic acid to dehydroascorbic acid and back to ascorbic acid the amount of dehydroascorbic acid present at any given time is a function of the concentration of ascorbic acid, the pH of the setting composition and the concentration and the constitution of the active oxidizing reagent. Hence, it is desirable to adjust these values to obtain an optimum amount of dehydroascorbic acid with any specific active oxidizing reagent. However, the results obtained are not markedly affected by small changes in the concentrations of the active oxidizing reagent and ascorbic acid so that these may vary over a wide range. For example, satisfactory results are obtained with ascorbic acid varying from 0.03 to 0.25 percent by weight. The active oxidizing reagent can vary almost at will providing that, as is well known, said reagent is not present in such quantity as to deleteriously affect the hair, or scalp, e. g. to bleach the hair.

Set forth below are typical examples of different setting solutions utilizing ascorbic acid and an active oxidizing reagent.

I

¼ gram ascorbic acid
2 oz. 20 vol. hydrogen peroxide
4 grams citric acid
Q. s. a pint with water
Adjust pH to 2.2

II

¼ gram ascorbic acid
2 oz. 20 vol. hydrogen peroxide
3.5 grams acetic acid
0.6 gram sodium acetate
Q. s. a pint with water
Adjust pH to 3.7

III

¼ gram ascorbic acid
2 oz. 20 vol. hydrogen peroxide

8.3 grams disodium hydrogen phosphate
1.2 grams citric acid
Q. s. a pint with water
Adjust pH to 7

IV

1 gram ascorbic acid
28 grams potassium bromate
1 gram disodium hydrogen phosphate
Q. s. a quart with water
Adjust pH to 5.5

Hair treated first with a softening solution and then with a setting solution embodying the present invention is far softer, has a much better hand and is stronger, less porous and less brittle than cold waved hair which has been set with present-day commercial powerful oxidants. The improved effects are most marked when dehydroascorbic acid is used alone but are quite noticeable even when the dehydroascorbic acid is produced in situ by oxidation of ascorbic acid.

By way of example and without in any way limiting the scope of our invention, a typical hair waving process incorporating the present invention is set forth below.

A head of hair is blocked off and wetted by a typical softening composition as, for instance, a water solution of ammonium thioglycollate at a pH of 9.2 and a concentration of 7% by weight. The wet tresses are wound on curlers and re-wetted with the softening composition. After the hair has softened lukewarm water is rinsed therethrough. Now there is rinsed through the hair a setting solution embodying our invention as, for example, the solution given in Example I. The rinsing is carried on for approximately four minutes. The hair then can be unwound from the curlers; and, if desired, the setting solution applied to each curl.

Attention is called to the fact that if an unduly high percentage of a powerful oxidant is employed it will not deleteriously affect the hair inasmuch as the ascorbic acid tends to absorb the excess oxidizing potential of such oxidant and thereby ameliorates any adverse effects. Conversely, if the amount of the active oxidizing reagent is quite small, although enough stoichiometrically to complete the reaction, the solution nevertheless will function for setting inasmuch as ascorbic acid is quite sensitive to active oxidizing reagents and, therefore, will insure the complete re-setting of previously softened hair. It is for these reasons that the amount of active oxidizing reagent can be varied so widely.

It will be observed that the concentration of ascorbic acid with which suitable results can be obtained is quite small. It must, however, be remembered that the ascorbic acid constantly is being converted to dehydroascorbic acid so that the supply of dehydroascorbic acid constantly is being replenished; and it is not necessary, accordingly, to practice the invention with the same high concentration of dehydroascorbic acid as is employed when dehydroascorbic acid is utilized by itself, that is to say, not in conjunction with an active oxidizing reagent.

It will be understood that when any sodium salt is mentioned or claimed herein the corresponding potassium salt can be substituted in its place and vice versa.

It thus will be seen that there are provided compositions and processes which achieve all the objects of the invention and are well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein described is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim as new and desire to secure by Letters Patent:

1. A setting composition adapted to be used subsequently to a previously applied composition for disrupting disulfide bonds of cystine in permanently waving hair on

the human head and after said disrupting composition has been substantially removed: said setting composition comprising an aqueous carrier and dehydroascorbic acid at a pH range between 2 and 10, and a concentration between 0.03 percent and 0.8 percent by weight, said setting composition being free of a disulfide reducing agent.

2. A setting composition adapted to be used subsequently to a previously applied composition for disrupting disulfide bonds of cystine in permanently waving hair on the human head and after said disrupting composition has been substantially removed: said setting composition comprising an aqueous carrier and dehydroascorbic acid at a pH range between 2 and 10, and a concentration of about 0.05 percent, said setting composition being free of a disulfide reducing agent.

3. A setting composition adapted to be used subsequently to a previously applied composition for disrupting disulfide bonds of cystine in permanently waving hair on the human head and after said disrupting composition has been substantially removed: said setting composition comprising an aqueous carrier and dehydroascorbic acid at a pH range between 5 and 8, and a concentration of about 0.05 percent, said setting composition being free of a disulfide reducing agent.

4. A setting composition adapted to be used subsequently to a previously applied composition for disrupting disulfide bonds of cystine in permanently waving hair on the human head and after said disrupting composition has been substantially removed: said setting composition comprising an aqueous carrier, ascorbic acid and at least one active oxidizing reducing agent selected from the group consisting of hydrogen peroxide, sodium and potassium bromate, chlorate and chlorite, said setting composition being free of a disulfide reducing agent.

5. A setting composition adapted to be used subsequently to a previously applied composition for disrupting disulfide bonds of cystine in permanently waving hair on the human head and after said disrupting composition has been substantially removed: said setting composition comprising an aqueous carrier, ascorbic acid and an active oxidizing reagent, the concentration of ascorbic acid being between 0.03 and 0.25 percent by weight, said setting composition being free of a disulfide reducing agent.

6. A setting composition adapted to be used subsequently to a previously applied composition for disrupting disulfide bonds of cystine in permanently waving hair on the human head and after said disrupting composition has been substantially removed: said setting composition comprising an aqueous carrier, ascorbic acid and an active oxidizing reagent, the pH of said composition being between 2 and 10 and the concentration of the ascorbic acid being between 0.03 and 0.25 percent by weight, said setting composition being free of a disulfide reducing agent.

7. A setting composition adapted to be used subsequently to a previously applied composition for disrupting disulfide bonds of cystine in permanently waving hair on the human head and after said disrupting composition has been substantially removed: said setting composition principally comprising an aqueous carrier, ascorbic acid, an active oxidizing reagent and an acidifying reagent to impart a pH to the composition between 2 and 10, the concentration of the ascorbic acid being between 0.03 and 0.25 percent by weight, said setting composition being free of a disulfide reducing agent.

8. In a method of permanently waving hair on the human head in which the hair is shaped and treated with a softening composition for disrupting disulfide bonds of cystine: that improvement comprising the steps of subsequently substantially restoring the softened hair to its original condition by applying to the softened hair a setting composition comprising an aqueous carrier and dehydroascorbic acid.

9. In a method of permanently waving hair on the human head in which the hair is shaped and treated with a softening composition for disrupting disulfide bonds of cystine: that improvement comprising the steps of subsequently substantially restoring the softened hair to its original condition by applying to the softened hair a setting composition comprising an aqueous carrier and dehydroascorbic acid at a pH range between 2 and 10.

10. In a method of permanently waving hair on the human head in which the hair is shaped and treated with a softening composition for disrupting disulfide bonds of cystine: that improvement comprising the steps of subsequently substantially restoring the softened hair to its original condition by applying to the softened hair a setting composition comprising an aqueous carrier and dehydroascorbic acid at a pH range between 2 and 10, and a concentration between 0.03 percent and 0.8 percent by weight.

11. In a method of permanently waving hair on the human head in which the hair is shaped and treated with a softening composition for disrupting disulfide bonds of cystine: that improvement comprising the step of subsequently substantially restoring the softened hair to its original condition by applying to the softened hair a setting composition comprising an aqueous carrier, ascorbic acid and an active oxidizing agent.

12. In a method of permanently waving hair on the human head in which the hair is shaped and treated with a softening composition for disrupting disulfide bonds of cystine: that improvement comprising the step of subsequently substantially restoring the softened hair to its original condition by applying to the softened hair a composition containing dehydroascorbic acid.

13. In a method of permanently waving hair on the human head in which the hair is shaped and treated with a softening composition for disrupting disulfide bonds of cystine: that improvement comprising the step of subsequently substantially restoring the softened hair to its original condition by applying to the softened hair dehydroascorbic acid formed in situ on the hair.

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