The invention concerns a method for straightening keratinous fibers including: (i) a step of applying on the keratinous fibers a hair straightening composition containing at least one polyhydroxylated aromatic compound, (ii) a step of increasing the temperature of the keratinous fibers, using heating means, to a temperature ranging between 110 and 250° C.
METHOD FOR STRAIGHTENING KERATINOUS FIBERS USING HEATING MEANS AND AN AROMATIC COMPOUND

[0001] The invention relates to a process for relaxing keratin fibres with a heating means and at least one polyhydroxylated aromatic compound.

[0002] The relaxing process according to the invention is performed without using any reducing agent or lanthionization agent. It does not include any reducing or lanthionization step.

[0003] According to the invention, the term “keratin fibres” means fibres of human or animal origin such as head hair, bodily hair, the eyelashes, wool, angora, cashmere or fur. Although the invention is not limited to particular keratin fibres, reference will nevertheless be made more particularly to head hair.

[0004] According to the invention, the term “relaxing” covers the relaxing, straightening or uncurling of Caucasian or African hair.

[0005] The term “heating means” means any means for heating keratin fibres to a temperature of at least 110 °C, such as heating irons, for example flat or round irons, microwave generators or sources of infrared radiation.

[0006] Two techniques are used for permanently reshaping the hair. They are based on cleavage of the disulfide covalent bonds present in keratin (cystine):

[0007] the first consists, in a first stage, in performing this opening of the disulfide bonds using a composition containing a reducing agent, and then, after having preferably rinsed the hair, in reconstituting the said disulfide bonds in a second stage, by applying to the hair, which has been placed under tension beforehand with rollers or the like or shaped or straightened out by other means, an oxidizing composition also known as a fixer, so as to give the head of hair the desired shape. This technique makes it possible either to make the hair wavy or to relax it, uncurl it or straighten it out;

[0008] the second consists in performing a “lanthionization” operation using a composition containing a base belonging to the hydroxide family. This leads to replacement of the disulfide bonds (—CH2—S—S—CH2—) with lanthionine bonds (—CH2—S—CH2—).

[0009] This lanthionization operation involves two consecutive chemical reactions:

[0010] the first reaction consists of a beta-elimination on cystine brought about by a hydroxide ion, leading to the cleavage of this bond and to the formation of dehydroalanine:

[0011] the second reaction is a reaction of dehydroalanine with a thiol group. Specifically, the double bond of the dehydroalanine formed is a reactive double bond. It can react with the thiol group of the cysteine residue that has been released to form a new bond referred as a lanthionine bridge or bond or residue.

[0012] Relative to the first technique using a reducing agent, this lanthionization technique does not require a fixing step, since the formation of the lanthionine bridges is irreversible. It is thus performed in a single step and makes it possible either to make the hair wavy, or to relax it, uncurl or straighten it out. However, it is mainly used for relaxing naturally curly hair.

[0013] For the first technique, the reducing compositions generally used for the first step of a permanent-waving or hair-relaxing operation contain thiols, sulfites or bisulfites as reducing agent. These agents are generally used in essentially aqueous medium at concentrations of between 0.5 and 1 M to
obtain good opening of the disulfide bonds. Among the thiols, those commonly used are thioglycolic acid, cysteamine, glyceryl monothioglycolate, thiolaetic acid and cysteine. Thioglycolic acid is particularly efficient at reducing the disulfide bonds of keratin at alkaline pH, especially in the form of ammonium thioglycolate, and constitutes the product most frequently used in permanent waving ("hair waving"). It has been found, however, that thioglycolic acid must be used in sufficiently basic medium (in practice at a pH of between 8.5 and 9.5) if curling of satisfactory intensity is to be obtained. Besides the drawback of releasing an unpleasant odour requiring the use of more or less efficient fragrances to mask the odours, the use of a thiol at alkaline pH also results in degradation of the fibre and most particularly in impairment of artificial colorations.

Sulfites or bisulfites are mainly used for relaxing the hair. They have drawbacks similar to those of thiols, with lower efficacy.

Thiols and sulfites (or bisulfites) also have the drawback of having poor stability in aqueous solution.

In general, the durability of the reshaping effects obtained with thiols and sulfites by reduction of disulfides following by fixing is judged to be very much lower than that which may be obtained via the lanthionization technique.

For the second technique, the compositions generally used to perform lanthionization contain as base a hydroxide such as sodium hydroxide, guanidinium hydroxide or lithium hydroxide. These lanthionization active agents, which allow opening of the disulfide bonds via a beta-elimination mechanism, are generally used as a water-oil emulsion at concentrations of between 0.4 and 0.6 M, by leaving them to act generally for 10 to 15 minutes at room temperature. Sodium hydroxide remains the agent most frequently used. Guanidinium hydroxide is now the preferred compound for many compositions. These two hydroxides, sodium hydroxide and guanidinium hydroxide, are the two main agents used for the relaxing or uncurling of naturally curly hair. They have several advantages over ammonium thioglycolate and sulfites, in particular the absence of unpleasant odour, the fact that only one operating step is required (shorter treatment time) and much greater durability and efficacy of reshaping of the hair.

However, these hydroxides have the major drawback of being caustic. This causticity affects the scalp by causing irritation, which is occasionally severe. This may be partially remedied by applying beforehand to the scalp fatty protective cream often referred to as a "base" or "base cream", the word "base" in this case not having the meaning of a basic agent in the chemical sense. When the protective cream is combined with the hydroxide in a single composition, it is generally referred to as "no-base", as opposed to the above name. This "no-base" technique is preferred.

The causticity of hydroxides also affects the state of the hair by firstly giving it a coarse feel and secondly making it much more brittle, this brittleness possibly going as far as crumbling or breaking or even dissolution of the hair if the treatment is prolonged. In certain cases, hydroxides also cause decoloration of the natural color of the hair.

Formulations containing sodium hydroxide are generally referred to as "lye relaxers" and those not containing it are referred as "no-lye relaxers".

The main relaxing formulations known as "no-lye" relaxers use guanidinium hydroxide. Since guanidinium hydroxide is unstable, it is generated at the time of use by mixing guanidinium carbonate and a source of sparingly soluble hydroxide such as calcium hydroxide. The reaction between these two compounds leads to the formation of guanidinium hydroxide and calcium carbonate, which precipitates in the composition. The presence of this precipitate makes the final rinsing of the hair much more difficult and leaves mineral particles on the hair and the scalp, which give it a coarse feel and an unaesthetic appearance resembling dandruff. The recent success of guanidinium hydroxide ("no-lye") over sodium hydroxide ("lye") appears to arise from better relaxing efficacy and better skin tolerance. However, these techniques using bases of the hydroxide family remain very aggressive to the hair and the scalp and require very strict control of the duration of application to avoid excessive irritation and impairment of the hair that may go as far as breakage. This aggressiveness arising from the causticity of hydroxides is justification for not using these hair lanthionization compositions for permanent waving (hair waving), but solely for hair straightening or hair relaxing.

Furthermore, hydroxides are known to be good agents for hydrolysing amide functions (cf. for example March's Advanced Organic Chemistry, 5th edition, Wiley Interscience, New York, "Hydrolysis of Amides" page 474 et seq.), which thus lead to cleavage of peptide bonds by direct nucleophilic attack. It is thus probable that the observed impairments of the hair and of keratin materials in the broad sense are largely due to partial hydrolysis of the amide bonds of keratin.

There is thus a real need for relaxing compositions that are markedly less aggressive to the hair.

Various studies have been conducted in order to overcome both the drawbacks of reducing agents (first technique) and/or those of hydroxides (second technique).

Thus, many reducing agents have been proposed to replace thioglycolic acid, but thioglycolic acid in the form of ammonium thioglycolate remains both the reference compound and the compound most widely used in cosmetic formulations, not only for shaping but also for straightening the hair.

It has also been proposed in numerous patents to combine common reducing agents (thiols, sulfites or bisulfites) with urea or alkyl ureas to reduce the irritation and damage caused to the hair, not only for shaping but also for relaxing. Mention will be made, for example, of:

- patent application CA 1315204, which describes a composition containing ammonium thioglycolate (5.5-11.5%) and urea or a monoalkyl urea (1-3%) for shaping the hair,
- patent application U.S. Pat. No. 3,847,165, which describes a composition containing ammonium thioglycolate (1.2-1.4 M) and urea (2.0-2.7 M) for shaping the hair at an acidic pH,
- patent application NL. 6410355, which describes a composition containing a sulfite (0.8-1.5 M) and urea (0.6-3.0 M) for shaping and relaxing the hair,
- patent application JP 2000/229819, which describes a composition containing a sulfite or bisulfite (0.5-15%), urea (0.5-15%) and an alcohol (ethanol and/or isopropanol, 1-30%) for shaping and relaxing the hair.
It has also been proposed in numerous patents to combine hydroxides, serving as lanthionization active agent, with certain additives generally serving to protect the hair. Mention will be made, for example, of:

- Patent application WO 2002/003 937, which describes a composition containing C₂₃₋C₄ monosaccharides.
- Patent application WO 2001/064 171, which describes a composition containing complexing agents.
- Patent U.S. Pat. No. 5,641,477, which describes a composition containing a hydrogenated starch hydrolysate.
- Patent application WO 02/085 317, which describes a composition containing organic nucleophiles that react during the second step with the dehydroalanine formed with hydroxides, to give new bridges.

Although all these proposals lead to more or less pronounced improvements, they are not able to sufficiently reduce the damage associated with the very causticity of hydroxides.

As indicated previously, the use of reducing agents leads to poor durability of the relaxing or straightening of the hair and the use of hydroxides, on account of their causticity, limits their use in the field of hair relaxing.

The use of resorcinol at a concentration of 40% and at a pH of 7 for relaxing the hair has been reported by M. Wong et al.; M. Wong, G. Vis-surel, and J. Epps J. Soc. Cosmet. Chem. (1994), 45, 347-352. However, the tests that we have performed under these conditions on naturally curly African hair do not relax it, but lead, at the very best, to slight uncurling.

After considerable studies, it has now been discovered, entirely surprisingly and unexpectedly, that hair can be durably relaxed by combining the action of a polyhydroxylated aromatic compound and of a means of heating to a temperature above 110°C. Excellent results in terms of relaxing, cosmetic properties of the hair and fibre integrity are thus obtained.

Without being bound by theory, the Applicant considers that there is a combined action, on the keratin fibres, of a polyhydroxylated aromatic compound and of a heating means, which allows the fibres to be efficiently and durably relaxed.

The Applicant has found that it is possible to overcome the drawbacks of the prior art and to satisfy the abovementioned objectives by performing a process for relaxing keratin fibres, comprising:

- A step of applying to the keratin fibres a hair-relaxing composition containing at least one polyhydroxylated aromatic compound, the pH of the composition being less than or equal to 9,
- A step of raising the temperature of the keratin fibres, using a heating means, to a temperature of between 110 and 250°C,
- The polyhydroxylated aromatic compound not being chosen from:
  - 4,5-diamino-2,6-dihydroxyprazidine,
  - 2,4-dihydroxyprazidine-5-carboxylic acid,
  - 2,4-dihydroxyprazidine-6-methylprazidine,
  - 2,4,5-trihydroxyprazidine.
- Advantageously, the temperature is raised using a heating means to a temperature of between 120°C and 220°C, and more advantageously between 140°C and 220°C.
- Preferably, the said composition is applied to wet keratin fibres.

A step intended to remove the excess composition, for example using a towel, may also be introduced between the step of applying the composition and the step of raising the temperature.

Definition of the polyhydroxylated aromatic compounds of general formula (I):

\[
\begin{align*}
&\text{in which:} \\
&R_1, R_2, R_3 \text{ and } R_4 \text{ represent, independently of each other:} \\
&\text{H, F, Cl, Br, OH, OCH₃, OEt, CHO, COCH₃, COOH, CH₃NH₂, CH₃CH₂NH₂, CH₃OH, CH₃CH₂OH, CH₃COOH, CH₃COCH₃, CH₃CONH₂, CHOH—CH₂OH, —CH(NH₂)COOH, NHCOCH₂COCH₂CH₃, CONH₂.} \\
&\text{or alternatively a linear or branched C₃₋C₅ alkyl radical.} \\
&\text{when the two OH radicals are in a meta position and when } R_1, R_2 \text{ and } R_3 \text{ represent a hydrogen atom, } R_4 \text{ may also represent } \text{NH₃,} \\
&\text{and the stereoisomers, organic or mineral salts and solvates thereof.} \\
&\text{Preferred Compounds of Formula (I):} \\
&\text{catechol} \\
&\text{resorcinol} \\
&\text{4-methylcatechol} \\
&\text{3-methylcatechol} \\
&\text{2-methylresorcinol} \\
&\text{5-methylresorcinol} \\
&\text{4-methyresorcinol} \\
&\text{pyrogallol} \\
&\text{1,2,4-trihydroxybenzene} \\
&\text{phloroglucinol} \\
&\text{3-fluorocatechol} \\
&\text{4-fluorocatechol} \\
&\text{4-fluoresorcinol} \\
&\text{2,3-dihydroxybenzaldehyde} \\
&\text{3,4-dihydroxybenzaldehyde} \\
&\text{2,4-dihydroxybenzaldehyde}
\end{align*}
\]
3,5-dihydroxybenzaldehyde
4-ethylcatechol
4-ethyl resorcinol
2,5-dimethyresorcinol
4,5-dimethyresorcinol
2,4-dimethyl-1,3-benzene diol
3,4-dihydroxybenzylamine
3,5-dihydroxybenzylamine
3-methoxy catechol
5-methylpyrogallol
3,4-dihydroxybenzyl alcohol
5-methoxyresorcinol
2,4,6-trihydroxytoluene
3,5-dihydroxybenzyl alcohol
2-methoxyresorcinol
5-methylpyrogallol
4-methoxyresorcinol
3,5-dihydroxytoluene monohydrate
4-chlorocatechol
3-chlorocatechol
4-chlororesorcinol
2-chlororesorcinol
3',4'-dihydroxyacetophenone
2',3'-dihydroxyacetophenone
2',6'-dihydroxyacetophenone
2',4'-dihydroxyacetophenone
3',5'-dihydroxyacetophenone
2,6-dihydroxy-4'-methylacetophenone
3-isopropyl catechol
4-isopropyl catechol
4-propyresorcinol
2,4-dihydroxy-1,3,5-trimethylbenzene
3,4-dihydroxybenzamidine
2,3-dihydroxybenzoic acid
3-hydroxyxtyramine
3,4-dihydroxybenzoic acid
1,2,4-trihydroxybenzene
2,4-dihydroxybenzoic acid
1,2,4,5-tetrahydroxybenzene
2',6'-dihydroxy-4'-methylacetophenone
2',6'-dihydroxy-4-methylacetophenone
4,4'-dihydroxyacetophenone
1-(3,4,5-trihydroxyphenyl) acetic acid
1-(3,4,5-trihydroxyphenyl) propionic acid
1-(2,6-dihydroxy-3-methoxyphenyl) acetic acid
2,6-dihydroxy-4'-methylacetophenone
2,4,6-trihydroxybenzaldehyde
2,3,4-trihydroxybenzaldehyde
2,4,5-trihydroxybenzaldehyde
2,4,5-trihydroxybenzaldehyde
2,4,6-trihydroxybenzaldehyde
2,4,6,2',4'-dihydroxy-3,3'-methylpropio phenone
1-(3-ethyl-2,6-dihydroxyphenyl)ethan-1-one
3-(3,4-dihydroxyphenyl) propionic acid
1-(2,6-dihydroxy-3-methoxyphenyl) acetic acid
3(2,4-dihydroxyphenyl) propionic acid
2,4,6-trihydroxybenzaldehyde
2-fluoro-3,4-dihydroxybenzaldehyde
3,4-dihydroxy-6-fluorobenzaldehyde
2-methoxyphloroglucinol
3,5-dihydroxyanisole hydrate
4-aminoresorcinol hydrochloride
2-aminoresorcinol hydrochloride
5-amino benzen-1,3-diol hydrochloride
phloroglucinol dihydrate
3',4'-dihydroxypropohopenone
3,4-dihydroxyphenyl acetone
2',3'-dihydroxypropophenone
2',4'-dihydroxypropohopenone
2',4'-dihydroxy-3'-methylacetophenone
(2,4-dihydroxyphenyl)acetone
(3,5-dihydroxyphenyl) acetone
2,6-dihydroxy-4'-methylacetophenone
4-tert-butyl catechol
4-N-butyl resorcinol
2,4-diethyl-1,3-benzene diol
3,4-dihydroxyphenylacetamide
3-hydroxyacetaminophen
2',3',4'-trihydroxyacetophenone
3,4-dihydroxyphenylacetic acid
2,3-dihydroxy-4-methoxybenzaldehyde
3,4-dihydroxy-5-methoxybenzaldehyde
2',3',4'-trihydroxyacetophenone
2',4',6'-trihydroxyacetophenone
3,5-dihydroxy-4-methylbenzoic acid
2,6-dihydroxy-4-methylbenzoic acid
2,4-dihydroxy-6-methylbenzoic acid
3,5-dihydroxyphenylacetic acid
2-ethyl-5-methoxybenzene-1,3-diol
3,4,5-trihydroxybenzamide
4-amino-3,5-dihydroxybenzoic acid
2,3,4-trihydroxybenzoic acid
2,3,4-trihydroxybenzoic acid
gallic acid
2,4,6-trihydroxybenzoic acid
3,4-dihydroxyphenyl glycol
1,2-dihydroxy-4,5-dimethoxybenzene
3,5-dihydroxyacetophenone monohydrate
3,4-dihydroxybenzoic acid monohydrate
hexahydrobenzene
3,5-dihydroxybenzylamine hydrochloride
4,6-diaminoresorcinol hydrochloride
4,5-dichlorocatechol
3,5-dichlorocatechol
4,6-dichlororesorcinol
2',4'-dihydroxy-3'-methylpropiophenone
1-(3-ethyl-2,6-dihydroxyphenyl) ethan-1-one
3-(3,4-dihydroxyphenyl) propionic acid
1-(2,6-dihydroxy-3-methoxyphenyl) acetic acid
3(2,4-dihydroxyphenyl) propionic acid
2,4,6-trihydroxybenzaldehyde
(2,4-dihydroxyphenyl) acetone
(3,4,5-trihydroxyphenyl) acetone
2,4-trihydroxyacetophenone
3,4-trihydroxybenzamide hydrate
4-hromocatechol
and the stereoisomers, organic or mineral salts and solvates thereof.
Particularly Preferred Compounds of Formula (I):

resorcinol
2-methylresorcinol
5-methylresorcinol
4-methyl resorcinol
pyrogallol
1,2,4-trihydroxybenzene
4-ethyl resorcinol
2,5-dimethyl resorcinol
and the stereoisomers, organic or mineral salts and solvates thereof.

Working Concentrations:

[0263] The working molar concentration is advantageously between 1 and 8 M, more advantageously between 1 and 4 M and even more advantageously between 1.5 and 3 M.

[0264] The working pH is preferably less than or equal to 7.

[0265] The compositions according to the invention are either in the form of an aqueous solution or in the form of a thickened cream so as to keep the hair as straight as possible. These creams are prepared in the form of "heavy" emulsions.

[0266] These compositions contain at least one polyhydroxylated aromatic compound of formula (I) and/or mixtures of several polyhydroxylated aromatic compounds of formula (I) in all proportions.

[0267] Advantageously, the compositions of the invention contain the polyhydroxylated aromatic compound as sole hair-relaxing active agent.

[0268] For the purpose of improving the cosmetic properties of keratin fibres or to attenuate or avoid their degradation, the composition used according to the invention may also comprise one or more additional cosmetic active agents.

[0269] Generally, the said additional cosmetic active agent(s) represent(s) from 0.01% to 30% and preferably from 0.1% to 10% by weight relative to the total weight of the cosmetic composition.

[0270] Generally, the composition applied to the keratin fibres is applied in an amount of from 0.05 to 20 g and preferably from 0.1 to 10 g of composition per gram of dry keratin fibre.

[0271] After applying the composition, and before raising the temperature of the keratin fibres using a heating means, the said composition may be left to act, generally for 30 seconds to 60 minutes and preferably 5 to 45 minutes.

[0272] The process according to the invention includes, after the step of applying the composition, a step of raising the temperature of the keratin fibres, using a heating means, to a temperature of between 110°C and 250°C.

[0273] Advantageously, an iron is used as heating means.

[0274] For the purposes of the present invention, the term "iron" means a device for heating keratin fibres that places the said fibres and the heating device in contact.

[0275] The end of the iron that comes into contact with the hair generally having two flat surfaces. These two flat surfaces may be metallic. They may be smooth or crinkled.

[0276] As examples of irons that may be used in the process according to the invention, mention may be made of flat irons of any type, and in particular, in a non-limiting manner, those described in patents U.S. Pat. No. 5,957,140 and U.S. Pat. No. 5,046,516.

[0277] The iron may be applied by successive separate touches of a few seconds, or by gradually moving or sliding it along the locks.

[0278] Preferably, in the process according to the invention, the iron is applied by continuous movement from the root to the end, in one or more passes.

[0279] The process according to the invention may also include an additional step of partial predrying of the keratin fibres before the step of raising the temperature, so as to avoid substantial evaporation of steam that might burn the stylist's hands and the individual's scalp. This predrying step may take place, for example, using a hairdryer, a hood or alternatively by drying in the open air.
The invention also relates to a kit comprising at least:
one heating means that affords a temperature of between 110° C. and 250° C.,
one hair-relaxing composition containing at least one polyhydroxylated aromatic compound, the pH of the composition being less than or equal to 9, the polyhydroxylated aromatic compound not being chosen from:
4,5-diamino-2,6-dihydroxy pyrimidine, and
2,4-dihydroxy pyrimidine-5-carboxylic acid.
Advantageously, in the kit, the hair-relaxing composition contains at least one polyhydroxylated aromatic compound of formula (I) as defined above.
The invention may be understood more clearly with the aid of the non-limiting examples that follow, which constitute preferential embodiments of the compositions according to the invention.

EXAMPLE 1
A simplified hair-relaxing composition is prepared, containing resorcinol at a concentration of 8 M in water, as hair-relaxing active agent. This composition is applied to naturally curly African hair for 15 minutes at a temperature of 40° C., and the hair is then rapidly towel-dried.
Lock-by-lock straightening of the head of hair is then performed using a flat iron heated to 180° C., for 10 to 15 seconds. The hair is efficiently relaxed and feels soft.

EXAMPLE 2
A simplified hair-relaxing composition is prepared, containing resorcinol at a concentration of 4 M in water, as hair-relaxing active agent. This composition is applied to naturally curly African hair for 15 minutes at a temperature of 40° C., and the hair is then rapidly towel-dried.
Lock-by-lock straightening of the head of hair is then performed using a flat iron heated to 180° C., for 10 to 15 seconds. The hair is efficiently relaxed and feels soft.

EXAMPLE 3
A simplified hair-relaxing composition is prepared, containing resorcinol at a concentration of 2 M in water, as hair-relaxing active agent. This composition is applied to naturally curly African hair for 25 minutes at a temperature of 40° C., and the hair is then rapidly towel-dried.
Lock-by-lock straightening of the head of hair is then performed using a flat iron heated to 180° C., for 10 to 15 seconds. The hair is efficiently relaxed and feels soft.

1-11. (canceled)
12. A process for relaxing keratin fibers, comprising:
applying to the keratin fibers a hair-relaxing composition comprising at least one polyhydroxylated aromatic compound, wherein the pH of said hair-relaxing composition is less than or equal to 9, and
heating the keratin fibers to a temperature ranging from 110° C. to 250° C., wherein the polyhydroxylated aromatic compound is not chosen from:
4,5-diamino-2,6-dihydroxy pyrimidine,
2,4-dihydroxy pyrimidine-5-carboxylic acid,
2,4-dihydroxy-6-methyl pyrimidine,
dihydroxynorotic acid, and
2,4,5-trihydroxy pyrimidine.
13. A process according to claim 12, wherein said keratin fibers are heated to a temperature ranging from 120° C. to 220° C.
14. A process according to claim 13, wherein said keratin fibers are heated to a temperature ranging from 140° C. to 220° C.
15. A process according to claim 12, wherein the hair-relaxing composition is applied to wet keratin fibers.
16. A process according to claim 12, wherein the keratin fibers are partially predried.
17. A process according to claim 12, wherein the molar concentration of the at least one polyhydroxylated aromatic compound ranges from 1 to 8 M.
18. A process according to claim 17, wherein the molar concentration of the at least one polyhydroxylated aromatic compound ranges from 1 to 4 M.
19. A process according to claim 17, wherein the molar concentration of the at least one polyhydroxylated aromatic compound ranges from 1.5 to 3 M.
20. A process according to claim 12, wherein the pH of the hair-relaxing composition is less than or equal to 7.
21. A process according to claim 12, wherein the at least one polyhydroxylated aromatic compound corresponds to the formula (I):

wherein:
R₁, R₂, R₃, and R₄, which may be identical or different are chosen from: H, F, Cl, Br, OH, OCH₃, OEt, CHO, COCH₃, COOH, CH₃NH₂, CH₃CH₂NH₂, CH₂OH, CH₃CH₂OH, CH₂COOH, CH₃COOH, CH₃CH₂COOH, CH₃CONH₂, CHO—CH₂OH, —CH(NH₂)COOH, —NCOCH₃, COCH₃CH₂, CONH₂, and a linear or branched C₂–C₅ alkyl radical when the two OH radicals are in a meta position and when R₁, R₂, and R₃ represent a hydrogen atom, R₄ may also represent NH₂, and the stereoisomers, and organic or mineral salts thereof.
22. A process according to claim 21, wherein the compound of formula (I) is chosen from:
catechol,
resorcinol,
4-methyl catechol,
3-methyl catechol,
2-methyl resorcinol,
5-methyl resorcinol,
4-methyl resorcinol,
pyrogallol,
1,2,4-trihydroxy benzene,
phloroglucinol,
3-fluorocatechol,
4-fluorocatechol,
4-fluororesorcinol,
2,3-dihydroxy benzaldehyde,
3,4-dihydroxy benzaldehyde,
2,4-dihydroxy benzaldehyde,
3,5-dihydroxybenzaldehyde, 4-ethylcatechol, 4-ethylresorcinol, 2,5-dimethylresorcinol, 4,5-dimethylresorcinol, 2,4-dimethyl-1,3-benzene-diol, 3,4-dihydroxybenzaldehyde, 3,5-dihydroxybenzaldehyde, 3-methoxyacetophenone, 5-methylpyrogallol, 3,4-dihydroxybenzyl alcohol, 5-methoxyresorcinol, 2,4,6-trihydroxytoluene, 3,5-dihydroxybenzyl alcohol, 2-methoxyresorcinol, 5-methylpyrogallol, 4-methoxyresorcinol, 3,5-dihydroxytoluene monohydrate, 4-chlorocatechol, 3-chlorocatechol, 4-chlororesorcinol, 2-chlororesorcinol, 3',4'-dihydroxyacetophenone, 2',5'-dihydroxyacetophenone, 2',6'-dihydroxyacetophenone, 2',4'-dihydroxyacetophenone, 3',5'-dihydroxyacetophenone, 2,6-dihydroxy-4-methylacetophenone, 3-isopropylacetochol, 4-isopropylacetochol, 4-propylresorcinol, 2,4-dihydroxy-1,3,5-trimethylbenzene, 3,4-dihydroxybenzamide, 3,5-dihydroxybenzamide, 2,6-dihydroxybenzamide, 2,4-dihydroxybenzamide, 3-hydroxytyramine, 2,3-dihydroxybenzoic acid, 3,4-dihydroxybenzoic acid, 2,4-dihydroxybenzoic acid, 2,6-dihydroxybenzoic acid, 3,5-dihydroxybenzoic acid, 2,3,4-trihydroxybenzaldehyde, 2,4,6-trihydroxybenzaldehyde, 3,4,5-trihydroxybenzaldehyde, 2,4,6,7-tetrahydroxybenzaldehyde, 4-methoxychlorophenol, 5,3-dihydroxyanisole hydrate, 4-aminoresorcinol hydrochloride, 2-aminoresorcinol hydrochloride, 5-aminobenzene-1,3-diol hydrochloride, phloroglucinol dihydrate, 3',4'-dihydroxypropionophenone, 3,4-dihydroxyphenylacetone, 2,3-dihydroxyphenylacetone, 2',4'-dihydroxypropionophenone, 2',4'-dihydroxy-3'-methylacetophenone, (2,4-dihydroxyphenyl)acetone, (3,5-dihydroxyphenyl)acetone, 2,6-dihydroxy-4'-methyacetophenone, 4-tert-butylcatechol, 4-N-butylresorcinol, 2,4-diethyl-1,3-benzene-diol, 3,4-dihydroxyphenylacetamide, 3-hydroxyacetaminophen, 2,3,4-trihydroxyacetophenone, 3,4-dihydroxyphenylacetic acid, 2,5-dihydroxy-4-methoxybenzaldehyde, 3,4-dihydroxy-5-methoxybenzaldehyde, 2',3',4'-trihydroxyacetophenone, 2',4',6'-trihydroxyacetophenone, 3,5-dihydroxy-4-methybenzoic acid, 2,6-dihydroxy-4-methybenzoic acid, 2,4-dihydroxy-6-methybenzoic acid, 3,5-dihydroxyphenylacetic acid, 2-ethyl-5-methoxybenzene-1,3-diol, 3,4,5-trihydroxybenzamide, 4-amino-3,5-dihydroxybenzoic acid, 2,3,4-trihydroxybenzoic acid, 2,3,4-trihydroxybenzoic acid, gallic acid, 2,4,6-trihydroxybenzoic acid, 3,4-dihydroxyphenyl glycol, 1,2-dihydroxy-4,5-dimethoxybenzene, 3,5-dihydroxyacetophenone monohydrate, 3,4-dihydroxybenzoic acid monohydrate, 3,4,5-trihydroxybenzaldehyde, hexahydroxybenzene, 3,5-dihydroxybenzylamine hydrochloride, 4,6-diaminoresorcinol hydrochloride, 4,5-dichlorocatechol, 3,5-dichlorocatechol, 4,6-dichlororesorcinol, 2',4'-dihydroxy-3'-methylpropionophenone, 1-(3-ethyl-2,6-dihydroxyphenyl)ethan-1-one, 3-(3,4-dihydroxyphenyl)propionic acid, (2,3,4-trihydroxyphenyl)acetone, (2,4,5-trihydroxyphenyl)acetone, (3,4,5-trihydroxyphenyl)acetone, 2',6'-dihydroxy-4'-methoxycacetophenone, 1-(2,6-dihydroxy-3-methoxyphenyl)ethan-1-one, 3-(2,4-dihydroxyphenyl)propionic acid, 2,4-dihydroxy-3,6-dimethylbenzoic acid, (2,3,4-trihydroxyphenyl)acetone, (2,4,5-trihydroxyphenyl)acetone, (2,4,6-trihydroxyphenyl)acetone, (3,4,5-trihydroxyphenyl)acetone, 3,4-dihydroxymandelic acid, 5-hydroxyisovanillic acid, 3,4,5-trihydroxybenzamide hydrate, and 4-bromocatechol, and the stereoisomers and organic or mineral salts thereof.

23. A process according to claim 21, wherein the compound of formula (I) is chosen from:
resorcinol, 2-methylresorcinol, 5-methylresorcinol, 4-methylresorcinol, pyrogallol, 1,2,4-trihydroxybenzene, 4-ethyl resorcinol, 2,5-dimethylresorcinol, 4,5-dimethylresorcinol,
2,4-dimethyl-1,3-benzenediol,
3,4-dihydroxybenzylamine,
3,5-dihydroxybenzylamine,
5-methylpyrogallol,
3,4-dihydroxybenzyl alcohol,
5-methoxyresorcinol,
2,4,6-trihydroxyltoluene,
3,5-dihydroxybenzyl alcohol,
2-methoxyresorcinol,
5-methylpyrogallol,
4-methoxyresorcinol,
3,5-dihydroxytoluene monohydrate,
4-propylresorcinol,
2,4-dihydroxy-1,3,5-trimethylbenzene,
3,4-dihydroxybenzamide,
3,5-dihydroxybenzamide,
2,6-dihydroxybenzamide,
2,4-dihydroxybenzamide,
3-hydroxytramine,
2,3-dihydroxybenzonic acid,
3,4-dihydroxybenzonic acid,
2,6-dihydroxybenzonic acid,
3,5-dihydroxybenzonic acid,
2-(3,4-dihydroxyphenyl)ethanol,
2,4,6-trihydroxy-1,3-dimethylbenzene,
2,6-dihydroxy-4-methylbenzyl alcohol,
2-methoxychlorogluconic acid,
3,5-dihydroxyanisole hydrate,
4-aminoresorcinol hydrochloride,
2-aminoresorcinol hydrochloride,
5-aminobenzene-1,3-diol hydrochloride,
chlorogluconic dihydrate,
2,4-diethyl-1,3-benzenediol,
3,4-dihydroxyphenylacetamide,
3,4-dihydroxyphenylacetic acid,
3,5-dihydroxy-4-methylbenzoic acid,
2,6-dihydroxy-4-methylbenzoic acid,
2,4-dihydroxy-6-methylbenzoic acid,
3,5-dihydroxyphenylacetic acid,
2-ethyl-5-methoxybenzene-1,3-diol,
3,4,5-trihydroxybenzamide,
4-amino-3,5-dihydroxybenzoic acid,
3,4-dihydroxybenzoic acid,
gallic acid,
2,4,6-trihydroxybenzoic acid,
DL-3,4-dihydroxyphenyl glycol,
1,2-dihydroxy-4,5-dimethoxybenzene,
3,4-dihydroxybenzoic acid monohydrate,
hexahydroxybenzene,
3,5-dihydroxybenzylamine hydrochloride,
sodium γ-resorcylate,
sodium β-resorcylate,
4,6-diaminoresorcinol hydrochloride,
3-(3,4-dihydroxyphenyl)propionic acid,
2,4-dihydroxy-3,6-dimethylenzoic acid,
DL-3,4-dihydroxymandelic acid,
hydroxyisovanillic acid,
3,4,5-trihydroxybenzamide acid hydrate, and
gallic acid monohydrate,
and the stereoisomers and organic or mineral salts thereof.

A process for relaxing keratin fibers, comprising:
applying to the keratin fibers a hair-relaxing composition
comprising resorcinol, wherein the pH of said hair-re-
 laxing composition is less than or equal to 9, and heating
the keratin fibers to a temperature ranging from 110°C.
to 250°C.

A kit comprising at least:
one heating apparatus that provides a temperature ranging
from 110°C. to 250°C.,
at least one hair-relaxing composition comprising at least
one polyhydroxylated aromatic compound, wherein the pH
of said hair-relaxing composition is less than or equal to
9, and
wherein the polyhydroxylated aromatic compound is not
chosen from:
4,5-diamino-2,6-dihydroxy pyrimidine,
and
2,4-dihydroxy pyrimidine-5-carboxylic acid.

A kit according to claim 25, wherein the at least one
hair-relaxing composition comprises at least one poly-
hydroxylated aromatic compound chosen from:
catechol,
resorcinol,
4-methylcatechol,
3-methylcatechol,
2-methy1resorcinol,
5-methylresorcinol,
4-methylresorcinol,
pyrogallol,
1,2,4-trihydroxy benzene,
phloroglucinol,
3-fluorocatechol,
4-fluorocatechol,
4-fluororesorcinol,
2,3-dihydroxybenzaldehyde,
3,4-dihydroxybenzaldehyde,
2,4-dihydroxybenzaldehyde,
3,5-dihydroxybenzaldehyde,
4-ethylcatechol,
4-ethylresorcinol,
2,5-dimethylresorcinol,
4,5-dimethylresorcinol,
2,4-dimethyl-1,3-benzenediol,
3,4-dihydroxybenzylamine,
3,5-dihydroxybenzylamine,
3-methoxy catechol,
5-methylpyrogallol,
3,4-dihydroxybenzyl alcohol,
5-methoxyresorcinol,
2,4,6-trihydroxytoluene,
3,5-dihydroxybenzyl alcohol,
2-methoxyresorcinol,
5-methylpyrogallol,
4-methoxyresorcinol,
3,5-dihydroxytoluene monohydrate,
3-chlorocatechol,
3-chlorocatechol,
4-chlorocatechol,
4-chlororesorcinol,
2-chlororesorcinol,
3,4'-dihydroxy acetophenone,
2,3'-dihydroxyacetophenone,
2,6'-dihydroxyacetophenone,
2,4'-dihydroxyacetophenone,
3,5'-dihydroxyacetophenone,
2,6-dihydroxy-4-methylbenzaldehyde,
3-isopropy1catechol,
4-isopropy1catechol,
4-propylresorcinol,
2,4-dihydroxy-1,3,5-trimethylbenzene, 3,4-dihydroxybenzamide, 3,5-dihydroxybenzamide, 2,6-dihydroxybenzamide, 2,4-dihydroxybenzamide, 3-hydroxytyramine, 2,3-dihydroxybenzoic acid, 3,4-dihydroxybenzoic acid, 2,4-dihydroxybenzoic acid, 2,6-dihydroxybenzoic acid, 3,5-dihydroxybenzoic acid, 2,3,4-trihydroxybenzaldehyde, 2,4,6-trihydroxybenzaldehyde, 3,4,5-trihydroxybenzaldehyde, 2,4,5-trihydroxybenzaldehyde, 2-(3,4-dihydroxyphenyl)ethanol, 2,4,6-trihydroxy-1,3-dimethylbenzene, 2,6-dihydroxy-4-methylbenzyl alcohol, 2-fluoro-3,4-dihydroxybenzaldehyde, 3,4-dihydroxy-6-fluorobenzaldehyde, 2-methoxychloroglucoinol, 3,5-dihydroxyanisole hydrate, 4-aminoresorcinol hydrochloride, 2-aminoresorcinol hydrochloride, 5-aminoanisole-1,3-diol hydrochloride, phloroglucinol dihydrate, 3',4'-dihydroxypropionophenone, 3,4-dihydroxyphenylacetone, (2,3-dihydroxyphenyl)acetone, 2',4'-dihydroxypropionophenone, 2',4'-dihydroxy-3'-methylacetophenone, (2,4-dihydroxyphenyl)acetone, (3,5-dihydroxyphenyl)acetone, 2,6-dihydroxy-4'-methylacetophenone, 4-tert-butylcatechol, 4-N-butylresorcinol, 2,4-diethyl-1,3-benzenediol, 3,4-dihydroxyphenylacetamide, 3-hydroxyacetaminophen, 2',3',4'-trihydroxyacetophenone, 3,4-dihydroxyphenylacetetic acid, 2,3-dihydroxy-4-methoxybenzaldehyde, 3,4-dihydroxy-5-methoxybenzaldehyde, 2',3',4'-trihydroxyacetophenone,