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A review on marketed hair products

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Abstract

Hair is an important part of the body appeal and its look is a health indicator. Hair can be strategically divided into two distinct parts: the hair follicle, deeply buried in the skin, and the visible hair fiber. Accordingly, recent advances in hair science and hair care technologies have been reported in literature claiming innovations and strategies for hair treatments and cosmetic products. This paper reviews the key topics in hair follicle biology and hair fiber focus on dramatically veered from merely cleaning to repair, increasing the tensile strength, reducing oxidative damage, and stimulating growth. The treatment of hair and scalp, primarily, involved the use of shampoo for an effective, but gentle cleansing; however, for years, the shampoo is considered not only as a cosmetic product having the purifying purpose, but it is also responsible for maintaining the health and the beauty of hair, imparting gloss and improving manageability and also useful products are Hair conditioner, Hair Gels, Hair Spray, Hair waxes, Hair dyes, Hair mousses, Pomades and brilliantine, Hair colors, Hair bleaching, Hair highlighting can alter the 'lift' of the hair-shaft. When hair is often exposed to some particularly aggressive cosmetic treatments, hair fibers become damaged. The future of hair cosmetics, which are continuously evolving based on ongoing research, will be the development of more efficient and safer procedures according to consumers' needs and concerns.

Keywords: review, hair products, hair follicle biology

Introduction

As far back as ancient time, people use natural extracts and resources for health care and cosmetic purposes. Accordingly, nowadays, consumers' demand for natural ingredients and additives, especially in cosmetic products, as a replacement of synthetic compounds, having possible negative effects on health and the environment, is tremendously increased. Therefore, with the aim to satisfy these requirements, together with the impelling need for reducing the microplastic use, marketing trends are developing towards a cosmetic based on natural ingredients, generally associated with a healthy lifestyle, both in food and cosmetic fields (i.e., hair care) ^[1, 2]. A 'healthy' head of hair is described as hair that has luster, is smooth, long and silky, bouncy, with good volume, and with no evidence of balding ^[3].

To achieve this, the hair-care industry has provided us with a plethora of products to beautify, enhance, strengthen, and 'nourish' our tresses. Most of the products work at the cuticle level of the exposed hair shaft. A few can enter the cortex. Some hair procedures like coloring, perming, straightening, and the like, result in structural damage. Specialized products then have to be used to repair and restore (if possible) the natural hair integrity. Hair dressing has evolved from just cutting, to altering the color, texture, and 'health' of the hair. Frizzy hair can be straightened and straight hair can be curled. Understanding the structural components is essential to understanding 'hair care'. Hair cosmetics act on the part of the hair shaft that projects beyond the scalp surface. The hair consists of a cortex surrounded by a multilayered complex cuticle with/without a central medulla. The cuticle has a very important role to play in regulating the entry and exit of chemicals/water to and from the cortex. It provides protection from external environmental factors, and when intact, keeps the hair surface smooth and glossy. The cuticle is six to eight layers thick and closely adherent to the inner cortical layer of the hair shaft. It is damaged in procedures that require disruption of the cortex, such as, bleaching, coloring, and perming. The individual cuticular cells are made up of proteins, lipids, and polysaccharides. The cells are colorless and arranged in an overlapping, roof tile-like pattern, providing for an impenetrable barrier to external

environmental damage. The open ends of the overlapping tiles are directed away from the scalp, toward the growing tip. The adjacent hair grows and moves outward in relation to each other. This arrangement facilitates the lifting up of dirt and scales, helping for easy removal^[4].

Moreover, nonetheless, the difficulties due to technologies related to allowed ingredients and their legislative range of concentrations, the cosmetic expertise is focused on the research of raw materials, innovative strategies and techniques for the formulation of novel products, characterized also by a good texture and skin feel^[5]. Interestingly, besides the development of products mainly devoted to skin care, several cosmetic industries are focusing on hair care, with the production of safety products and eco-friendly packaging, paying attention to their action. Indeed, for example, Shampoo, Hair conditioner, Hair Gels, Hair Spray, Hair waxes, Hair dyes, Hair mousses, Pomades and brilliantine, Hair colors, Hair bleaching, Hair highlighting these marketed products are used in control the hair follicle or damaged hair an also important key factor to take into account in the clinical observation, management, and treatment of skin and hair disorders^[6,7].

Hair Anatomy

Hair, Structure protective appendages on the body and structures of integument with sebaceous glands, sweat glands and nails are considered an important part of the body, derived from the skin ectoderm. They are also known as epidermal derivatives, since they originate from the epidermis during embryological development^[2]. As described by Naizet^[8], the hair is mainly constituted by three parts: the bulb, the root and the stem, and it is implanted in the pilosebaceous follicle in the dermis. The bulb is the deepest end of the hair and is also the portion that makes it grow. It is connected to the richly innervated and vascularized dermal papillae, which allow the contribution of nutrients necessary for hair growth. The root is firmly fixed in the hair follicle, the part of the hair located between the bulb and the surface of the epidermis where hair takes the form of the stem. The root and stem are made of the same three concentric layers: the medulla, the cortex and the cuticle on the outside. The medulla is the central core. The next stratum, the cortex, represents the largest and thickest part of the hair determining many of their mechanical properties^[8]. The cortex is made of packed spindle-shaped cortical cells, filled with keratin filaments parallelly oriented to the longitudinal axis of the hair shaft, and of an amorphous matrix of high sulfur proteins. In particular, cysteine residues in adjacent keratin filaments tend to form covalent disulfide bonds with a strong crosslink between adjacent keratin chains^[9]; thus, it contributes to providing the shape, the stability, and the texture of the hair. The cuticle is a very resistant layer of overlapping dead cells that form a protective barrier against the outside environment and external aggressions. It consists of endocuticle and exocuticle. Keratin is the main component of the hair. It is a fibrous and resistant protein, whose amino acidic chains are organized in an α helix and contains mainly tyrosine, glycine and cysteine. It is usually present as acidic, neutral and basic keratin^[9,10].

Hair Fiber Structure

The hair fiber, about 50–100 μm in diameter, has both protective and cosmetic functions. Hair protects the scalp

from sunburn and mechanical abrasion, provides thermoregulation and social communication. The human hair scalp, eyebrows, and lashes are long, thick and pigmented terminal hair fibers. However, the body is covered with hairs of 2–4 cm in length, under 40 μm in diameter, and often unpigmented, named vellus hairs. Human hair fibers are divided into three main morphological constituents, also components of the hair follicle: cuticle, cortex and, in some cases, medulla^[11-13].

Cuticle

The hair fiber is enclosed in the cuticle, a barrier protecting the underlying cortex from external environmental damage. It contains 6–10 layers of overlapping scales, in a way that only approximately one-sixth of each surface is exposed. The cuticle's proximal end is firmly attached to the cortex and the distal open end of the overlapping tiles points towards the tip of the fiber. Adjacent hairs grow and move outwards in relation to each other, facilitating the elevation of dirt and scales and assisting easy removal^[14]. The shape and orientation of the cuticle cells are responsible for limiting friction between hair fibers. The outermost layer of cuticle cells is the epicuticle, a lipid layer that includes 18-methyl eicosanoic acid (18-MEA) and free lipids, providing lubricity to the hair and consequently constituting the first line of defense against environmental assaults. Immediately below is the A layer, with approximately 30% cystine content, highly cross-linked, which confers structural strength and rigidity to the cuticle. The following layers gradually have less cystine content and consequently less rigidity. The B-layer, or the exocuticle, is immediately below with approximately 15% cysteine content. The last layer corresponds to the endocuticle, which is mainly composed by remaining cell organelles, and consists of proteins with low cystine content (3% cysteine content)^[15,16].

Cortex

The cuticle encircles the cortex, the major part of the hair mass. The cortex is composed of cortical cells and the CMC. The elongated cortical cells enclose melanosomes containing eumelanin (brown/black pigment) and/or pheomelanin (red pigment), responsible for the hair color. These cells are tightly packed and contain macrofibrils which are parallel and longitudinal oriented to the hair fiber axis. Each macrofibril is arranged in a spiral formation and comprises intermediate filaments proteins (IFPs), also called microfibrils, and keratin associated proteins (KAPs), also known as matrix proteins. The matrix is formed by crystalline proteins of high cystine content (approximately 21%). The intermediate filaments, low in cysteine (~6%), contain subfilamentous units, protofilaments, incorporating short sections of α -helical polypeptide chains in coiled coil formation. The cortex is responsible for the great hair tensile strength. Three types of cortical cells have been observed in the hair fiber with different ratio of intermediate filaments and matrix arrangements: orthocortical, paracortical and mesocortical cells. Orthocortical cells contain less matrix among the intermediate filaments composed of keratin and a low cystine content (~3%); paracortical cells have higher matrix content and more regular intermediate filaments, have smooth and rounded edges, are smaller in diameter and have a higher cystine content high (~5%); and mesocortical cells contain an intermediate level of cysteine^[17,18].

Medulla

Fine hair fibers are composed only by cuticle and cortex. With an increase in the hair fiber diameter, a third region, the medulla, may be found in the core of the hair fiber. Cells from medulla are spherical hollow vacuoles, which are loosely packed along the fiber, being bound together by a CMC-type framework. These cells only constitute a small percentage of the mass of keratin fibers. Medulla may be continuous, discontinuous or even entirely absent in the hair fiber [19]. Medulla is believed to contribute negligibly to the mechanical properties of hair fibers [16].

Weathering Of Hair

The hair surface in untreated hair has a pH of 4.5 to 5.5. This acidic pH helps to keep the cuticular cells closely opposed to the cortex. Damage to the cuticle results in structural changes to the hair shaft over a period of time and constitutes hair weathering. As the scalp hair of women grows over long anagen periods, the hair is exposed to several years of cumulative damage from external factors. The contributing factors include chronic ultraviolet exposure, excessive wetting, repeated harsh chemical procedures, hot combs, blow-drying, and even simple, but repeated activities, such as rough combing and brushing. [20, 21] Loss of cuticle or lifting-up of the cuticular plates exposes the cortex that is then readily susceptible to damage resulting in split ends (trichoptilosis) and frayed tips. Weathered hair loses moisture more rapidly than normal hair, and hence, looks dull and dry [22]. Weathering is not a common occurrence in men (except those with long hair styles) as their hair are constantly cut, which helps the damage (if any) to be trimmed off. HofbauerTsambaos, Spycher, and Trueb have reported that the excessive weathering seen in areas of androgenetic alopecia is due to a low threshold to damage caused by changes of acquired piliannulati. Environmental dust, dirt, sebum accumulation, and hair products build up on the hair making it sticky, dull, and often unmanageable. This is termed as a 'bad hair day'. Copper from tap water in copper water pipes gets deposited on the hair during washing. Being a catalyst, it liberates free radicals and causes the hair to become dull and damaged. Fortunately, in India, we do not have copper water pipes. Water from wells also has a very high mineral content, which can get deposited on the hair shaft. Hair washed with such water can also damage the hair [23].

Hair Care

If, on one hand, hair texture and shine are usually related to hair surface properties, on the other hand, the integrity of hair is due to the hair cortex. For this purpose, hair products that improve the structural integrity of hair fibers and increase tensile strength are available, along with products

that increase hair volume, reduce frizz, improve hair manageability, and stimulate new hair growth. Interestingly, modern cosmetic products are formulated to clean hair from detritus, and to restore and improve hair physiology. For example, intensive conditioning agents can temporarily "replace" the f-layer, improving the moisture retention in the cortex and rebuilding some of the reduced physical properties of hair. Therefore, the boost in hair shine is a key benefit of modern products are hair healthy in available on marketed products are Shampoo, Conditioner, Oils, Gels, Spray and Wax etc [24].

1. Shampoos

The arrangement of the hair cuticles allows self-cleaning properties of the hair fibers, repelling by itself some dirt and greasy residues. However, with time accumulation of grease and dirt occurs and the hair needs to be cleaned. Shampoos' primary goal is to clean the hair and scalp of these residues. Nowadays, it is expected that shampoos have secondary benefits such as to prevent hair fiber damage, keep the hair aesthetically presentable, preserve its softness, combability and shine. These secondary functions are usually the reason to purchase a particular shampoo. Therefore, the most significant interactions for shampoos are the ones happening near the fiber surface and first few cuticle layers. Nonetheless, if the hair surface is damaged and the cortex exposed, shampoos interact also with the exposed cortex [11]. A shampoo usually has an average of 80% water content and pH from 5 to 7. They are typically composed of 10 to 30 ingredients; that can be grouped into cleansing agents, conditioning agents, special care ingredients, additives, preservatives and aesthetic agents (Table 1) [16, 25-27]. Surfactants, as cleaning agents, are among the most important ingredients on shampoos, providing foaming and detergent properties. Typically, dirt is excess of sebum, produced by scalp and dirt adsorbed to this sebum. Surfactants weaken the physicochemical adhesive force that binds lipid residues to the hair, transfer it into the aqueous rinse, and disperse them, avoiding redeposition on the hair fiber. Surfactants have, generally, a tail of fatty hydrocarbons and a polar head. In contact with water, they attain the structure formation of a micelle, with hydrophilic exterior and hydrophobic interior, where the residues are trapped and kept in a dispersed form within the aqueous rinse [11, 19, 26]. The surfactants can be classified into four groups according to the electric charge of the polar extremity: anionic, cationic, amphoteric and nonionic. Modern shampoos contain a mixture of surfactants to provide different cleaning levels according to hair type [25]. Usually, a primary surfactant for cleaning and foaming and a secondary surfactant for foam and/or viscosity enhancement [11].



Fig 1: Marketed Hair Shampoo

2. Conditioners

Conditioners fulfill the need for hair shaft protection and are agents either incorporated into shampoos or used after cleansing, on slightly damp hair. After a shampoo wash, the cuticles get slightly lifted, and the hair develops a negative charge causing the hair to repel each other and appear rough and uncombed. Conditioners flatten the cuticles and seal the gaps that could expose the important cortex to environmental damage. Conditioning agents incorporated into shampoos (labeled as conditioning shampoos/ dry hair shampoos/hair fall shampoos) include mineral oils, vegetable oils, fatty alcohols/esters, humectants, hydrolyzed animal proteins, glycerin, stearylalkonium chloride, propylene glycol, silicones (dimethicone, simethicone), and natural products like bees' honey (an emulsion of proteins sugars and lipids), vinegar, wheat germ oil, panthenol, collagen, and placenta. Silicones have become very popular as they provide good 'slip' and luster, and retain moisture in the

hair, but silicone oil is hydrophobic and it does not get absorbed onto the hair very easily. Sebum is a natural conditioner for the hair. By capillary action, the excreted sebum, coats only the proximal 1.5 inch of the hair shaft. It is the process of combing that helps to distribute the sebum distally and coat the hair evenly. An ideal conditioner, if it did exist, would need to match the components and natural properties of sebum. Hence, they would need to have a combination of free saturated/unsaturated fatty acids, squalene, cholesterol, and triglycerides. The practice of using hair oil in India since ancient times is akin to using conditioners today. Coconut oil, but not sunflower or mineral oil, can penetrate the hair shaft and reduce protein loss [28]. Commercially, conditioners are available as rinses, instant, leave-on, serums, and professional conditioners. Rinses or instant conditioners are applied to washed and towel-dried hair, left on for two to five minutes, and rinsed off. They serve only to improve the combability of the hair.



Fig 2: Marketed Hair Conditioners

3. Hair sprays/fixatives

These are products in aerosol form, which when sprayed, create stiffness and 'hold' between hair. They are employed after styling the hair to 'hold' the style for an extended period. The main constituent is polyvinylpyrrolidone, which

is water washable. An addition of vinyl acetate makes the sprays longer lasting (high-hold), but difficult to shampoo off. Newer softer hair sprays contain methacrylate copolymers.



Fig 3: Marketed Hair sprays/fixatives

4. Hair gels

These are useful products for individuals with diffuse hair thinning, as when applied to the damp hair, can be styled to give a lift from the scalp, giving a semblance of volume.

They also give a gloss to the hair. The constituents are similar to hair sprays and can be used for 'styling' or 'sculpting' the hair.



Fig 4: Marketed Hair Gels

5. Hair waxes

These are available as a wax containing copolymers, which

are softer and can be evenly spread over dry hair for styling and can give an 'oily' look.



Men's Beauty Tips



Fig 5: Marketed Hair Waxes

6. Hair mousses: These are very popular because of their ease of use. Available as a foam in aerosolized cans, they

contain a soft copolymer that gives a more natural look, with less 'hold'.



Best Mousse for Curly Hair



Fig 6: Marketed Hair Mousses

7. Pomades and brilliantine

Very popular with African-American people as a styling aid. These are products that contain vegetable/mineral oils, petrolatum, lanolin and waxes, and help in styling,

moisturizing and conditioning the hair. They are comedogenic. Brilliantines are liquid pomades and newer formulations have better slip, as they contain silicones.



Fig 7: Marketed Hair Pomades and brilliantine

8. Shine' sprays

These contain silicones, hydrolyzed animal proteins, and cationic amino acid derivatives, and leave a shine when

sprayed on damaged hair. These are very useful for hair that has become dry and lusterless.



Fig 8: Marketed Hair Shine' sprays

9. Hair colors

Youth is represented by absence of gray hair. Graying becomes obvious when at least 20% of hair loses pigment. In the quest for looking young, research has focused on providing us with several options for covering gray hair/changing hair color temporarily or permanently. Hair

coloring molecules are of different sizes, with the larger molecules mainly getting deposited on the hair shaft as a temporary or semi-permanent color. In order for a hair dye to be termed 'permanent' the molecules should be capable of penetrating into the cortex and remaining there.

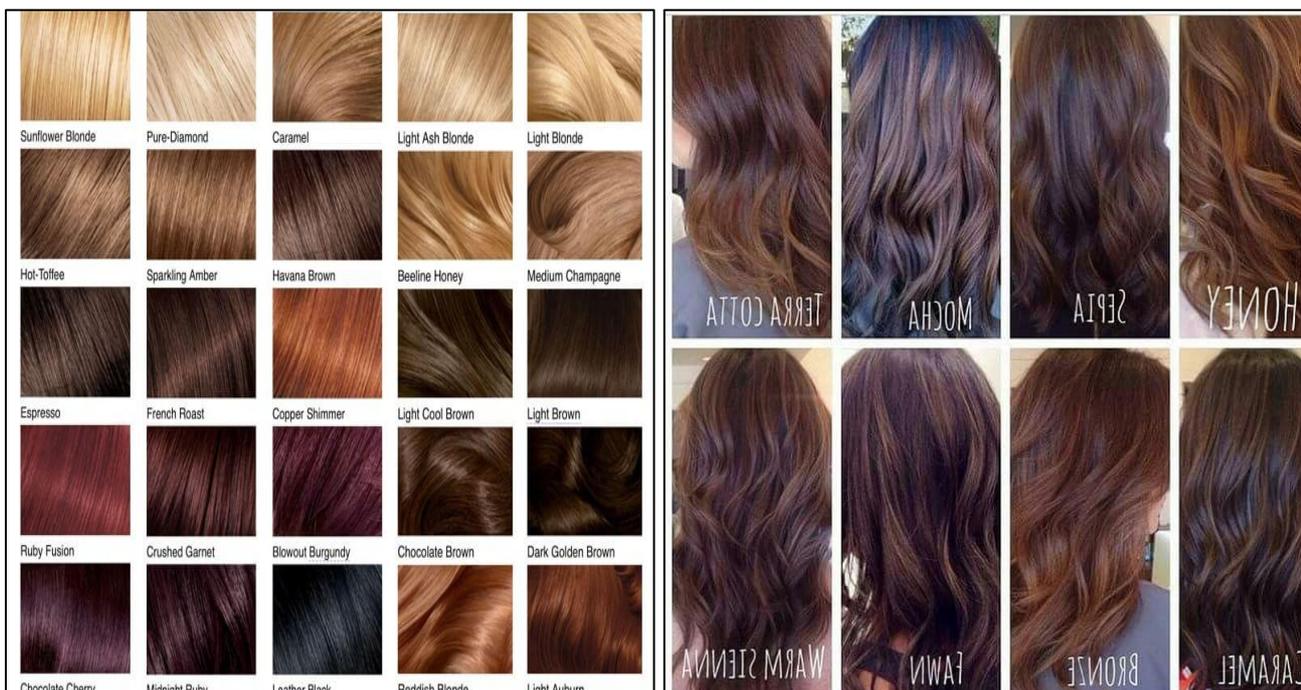


Fig 9: Marketed Hair Colors

10. Gradual hair dyes

These are home-use products, which give the desired color after several days of use. The product has to be applied daily on the hair till the desired shade is reached. The patient then stops the applications, but would need to restart once the shade starts fading off. The gradual hair colors contain salts of metals (lead, silver or bismuth) in a liquid form, which when applied to the hair, leave behind the metallic salts as sulfides, oxides, and suboxides. Compliance is not very good because of the messiness of application, but these are useful for individuals who are allergic to para-phenylenediamine (PPD). The end result is dull hair with a 'not-perfect' shade of color, which fades off faster and requires constant reapplication. In addition, hair that has been colored with these gradual dyes cannot be subjected to chemical perming or straightening procedures. Some examples of gradual hair dyes available in the Indian market are 'Vegetal' (non-PPD) and 'Godrej Kesh Kala' (PPD-containing) [29, 30].

11. Hair bleaching

This is a process used when the individual is unhappy with the existing hair color, and wants to go lighter (all scalp hair), or wants to get hair highlighted in streaks (small sections of hair). It involves two steps, namely, stripping hair of all eumelanin, and then using a toner to get the required shade. This process is capable of only bleaching eumelanin and not pheomelanin. A mix of hydrogen peroxide and ammonia (with/ without ammonium/potassium persulfate as a booster) is used for opening up the cuticle and stripping the eumelanin from the cortex. When extreme color change is done, that is, from black or dark brown to blonde, the process requires boosters that can result in severe damage to the hair shaft. Hair bleaching is a time-bound process where the hairdresser checks the color of the hair every 10 to 15 minutes. The total duration depends on the final color required. The hair is then washed with a specialized shampoo. The next step is the application of the hair color that may be a semi-permanent or a permanent dye. This is left on for half an hour and the hair is rinsed with water to remove all color. Conditioning is necessary as the hair structure is now damaged and brittle. This process is called 'toning' [31].

12. Hair highlighting

Highlighting is a process by which isolated sections of hair are either lightened or darkened. This is done by the 'foil method,' where strands of hair are separated by a comb and laid over an aluminum foil sheet, and then painted with a mixture of hydrogen peroxide and pigment. The foil is then folded, and the contact time depends upon the shade required. Every 10 to 15 minutes, the foil is unfolded to check the degree of lightening. The remaining steps are as mentioned earlier. The result is an enhanced esthetic appearance. Peters reported a burn following hair highlighting using foil [32]. Often darker hair has to be bleached first and then colored. This highlighting can also be done with a brush or spray, which contains semi-permanent or permanent color. Various coloring styles are used to enhance the overall aesthetic appeal. Dip dyeing is a process where only the hair ends are colored with a dye different from the base hair color. Ombré (French: Shaded) is a new trend where hair is dyed to give a shaded color. Chan and Maibach reviewed reports of eight cases with

adverse reactions (chemical burns) caused by hair highlighting. The event was due to caustic chemical, thermal burn, or toxic reaction to the dye [33].

13. Hair straightening/perming

Hair perming and straightening are procedures that change the physical appearance of hair. By breaking down the disulfide bonds between the keratin filaments, both these processes alter the structural integrity and affect the cystine content of the hair. The bonds are then rearranged and reformed to give the desired shape of the hair. The process has to be repeated after three to four months. The important hydrophobic layer 18-MEA is permanently lost and is irreplaceable. Such hair becomes porous to water, swells easily, and loses its tensile strength. Straightening (lanthionization) is a chemical process popular in people with frizzy or unmanageable hair, which results in at least 35% of the cysteine bonds changing to lanthionine. There is swelling of the shaft with lifting of the cuticles as the first step of the procedure. This is achieved with the use of strongly alkaline agents like 1.5 to 3.5% sodium/potassium hydroxide (lye-based), or guanidine/lithium hydroxide, (no-lye). As the lye-based straighteners cause great irritation, petrolatum needs to be applied to the scalp and hairline as protection, prior to the procedure. This is not required (except to the hairline) in non-lye-based procedures. The pH of these straighteners varies between 12.5 and 14. This strong alkaline pH is caustic to the skin, scalp, and eyes [34] and hence, should be handled only by professionals in a salon. Thioglycolic acid salts are increasingly being used as an alternative to ammonia, as reducing agents. They have a pH of 9-9.5 and are less caustic and provide good curling/straightening results. Home-use straightening products contain ammonium bisulfite + sulfite, have less alkaline pH (less than 9), and are safe to use, but their hair straightening ability is mild and the results are short-lived. [34].

Conclusion

Hair is a very distinctive personal feature playing a major role in self-perception. It is one of the physical features that can be easily changed in terms of length, color or shape. However, common chemical styling processes are also known to induce changes in hair cuticle and cortex, damaging the fiber and in some cases the health of the person or the hair care professional. Shiny hair having a smooth texture and clean-cut ends is generally perceived to be healthy. In recent years, the consumers' demand of product for hair care is increased, especially in the field of natural products. Thus, this review focuses on hair care and technologies known in the cosmetics, highlighting the importance of shampoo in different form and formulations. Information about traditional shampoo, herbal shampoo and solid shampoo are reported. Since there is also focusing on the Hair products for marketed formulation are used in more people for damaged or hair follicle condition so, this hair products useful are, Hair conditioner, Hair Gels, Hair Spray, Hair waxes, Hair dyes, Hair mousses, Pomades and brilliantine, Hair colors, Hair bleaching and Hair highlighting etc.

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