



CREATINE MONOHYDRATE AS A CONDITIONING AGENT FOR HAIR

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ABSTRACT

Creatine Monohydrate a synthesized nitrogenous organic acid from L-arginine, L-glycine and L-methionine is used as a food supplement by athletes and in skin care cosmetics for its moisturizing and collagen producing property. Its moisturizing property was used and a hair conditioner was formulated with varying concentration (0.5 % to 3%) of Creatine monohydrate. Photomicrographs (SEM) of treated and untreated hair showed that Creatine monohydrate conditioned the abraded protein layer of hair. Electrostatic property of hair was significantly reduced after application of hair conditioner having 2% active. Subjective analysis further proved that the formulated product improved combability, decreased friction and detangling of hair.

Keywords: Creatine Monohydrate, Electrostatic properties, Photomicrograph, Conditioner, Moisturizer

1. Introduction:

Damage to the hair structure and reduction in the strength of the hair fibre are caused by daily stress such as exposure to sunlight, daily grooming like shampooing, combing, brushing, blow drying and chemical treatments like colouring and relaxing. These factors cause chemical degradation of lipid and protein as well as abrasion of protein layer of hair. Hair conditioners are common hair care product formulated to improve hair appearance, combability and manageability. (Jachowicz, 2017) The ideal conditioner is capable of restoring hydrophobicity of the fibre and neutralizing static electricity. Conditioner molecules contain cationic surfactants which give a positive electrical charge to the conditioner. The negative charge of the hair is attracted to the positively charged conditioner

molecule, which results in conditioner deposition on hair. Damaged hair fibres are negatively charged. The attraction of the conditioner to hair results in reduction of static electricity on the fibre surface reducing the flyaway behaviour. The conditioner layer also flattens the cuticle scales against each other which improves shine and colour. It gives easier combing and detangling in wet and dry condition. (Bhushan, 2010).

The active ingredients in most conditioners include mainly cationic surfactants. Polymers like mono and polypeptide like hydrolyzed proteins (amino acids), polypeptides derived from collagen are also used. Emollients composed of natural and synthetic oils, esters, waxes and silicones are most frequently used. (Arora & Piraccini, 2016). The hair cosmetic industry has undergone a revolutionary change over the last two decades from merely cleansing and conditioning to repair and stimulating growth. (Madhani & Khan, 2013). Recent market trends have increased the need for hair protection. The use of keratin collagen ingredients including peptides and other derivatives are used for moisture retention and hair softness. (Roddick, 2018). Creatine is a naturally occurring nitrogenous organic acid containing L-glycine, L-arginine, L-methionine. Creatine monohydrate is the most commonly used salt form of creatine. It supplies energy to the muscles and is most commonly used as a food supplement by athletes as it delays fatigue during intensive exercise. It enhances athlete performance (Racette, 2003). Creatine is found naturally in skin. Creatine acts as an energy reservoir and important for energy supply and functioning of cells. It repairs skin cell and stimulates collagen production. Multifunctional creatine monohydrate has many uses in skin care for its moisturizing and collagen producing property (EP2160186A2). Relates the use of creatine monohydrate, creatine pyruvate and creatine

ascorbate for treatment of skin. It claims for treating uneven pigmentation in skin, 5mg/ml inhibits tyrosinase by 25%. (Nivaggioli, Zu & Paredes, 2008). A group of scientists from Beiersdorf Research and Development state that the nitrogenous organic acid creatine represents a beneficial active ingredient for topical use in the prevention and treatment of human skin ageing by stimulating dermal collagen. In-vivo application of a creatine containing formulation for six weeks significantly reduced sagging (Mc Dougall, 2011). Creatine monohydrate has three amino acids and thus it can give an excellent conditioning property which has been employed in this paper. An attempt was made to formulate a hair conditioner with creatine monohydrate and evaluate its conditioning effect on hair.

2. Experimental

2.1 Active (Creatine Monohydrate)

Creatine monohydrate was procured from Himedia Laboratories. Creatine is a synthesized nitrogenous organic acid from L-arginine, L-glycine and L-methionine and three enzymes. N-(aminoiminomethyl)-N-methylglycine monohydrate. (USITC No. 3177, 1999).

After procurement of active, it was evaluated and tested as per the specification provided by the company. It was qualitatively analyzed for Ninhydrine, Xanthoprotic, Sakaguchi, Hopkin's cole and Folin's Mc Carthy Sullivan's test. (Jain, 2003).

2.2 Formulation of Conditioner

The base of the hair conditioner was formulated as shown in Table 1 (Willkinson & Moore, 1982).

Table 1 - Formulation and Development of Base of Hair Conditioner

Sr.n	Ingredients	Quantity for 100%
1.	Glyceryl monosterate	2
2.	Span 60	1
3.	Mineral Oil	3
4.	Cetyl alcohol	1.5
5.	Stearic acid	2
6.	Lanolin	1
7.	Propyl paraben	0.1
8.	Tween 20	3
9.	Propylene Glycol	5
10.	Methyl paraben	0.2
11.	Water	Upto 100ml

To the selected base the active Creatine monohydrate was added at the concentration of 0.5%, 1%, 1.5%, 2% and 3% in formula F₁, F₂, F₃, F₄, F₅ respectively.

2.3 Electrostatic Properties of Hair

The hair tresses were cut to a length of 10 cm, weight of each tresses was 1.0±1 g. The tresses were cleaned with a solution of sodium lauryl sulphate, then rinsed thoroughly. The hair tresses under experimentation were treated with formulated hair conditioners F₁, F₂, F₃, F₄ and F₅, containing 0.5%, 1.0%, 1.5%, 2.0% and 3.0% respectively and plain water. The tresses were then washed thoroughly and dried with a towel. They were combed bottom up with a fine plastic comb. Combing was repeated 14 times. The electrostatic property of hair was conducted on the basis of hair volume measurement (Olszanska et al., 2011). Width of the shadow cast by the hair piece was plotted on the graph paper sheet. The diameter of the shadow was measured in cm. The read out was carried out at 6cm from the top of the hair piece and the shadow width was measured. The width of the shadow was consequently read out for all the 5 formulations.

2.4 Instrumental Method

Scanning electron Microscope (SEM): Scanning electron microscope facilitates the detailed examination of hair fiber surface at much larger magnification. Cuticle appearance, surface debris and thick surface deposits are readily observed (Ali et al., 2015).

To get a very clear view of conditioning effect SEM analysis was carried out. Hair from a single subject was selected for study. The formulated hair conditioner was applied on a washed and dried hair strand before SEM examination. Hair fibres (treated and untreated) 10 mm in length were fixed on a metal stub. The metal stub of each sample were subjected to gold coating for 300 seconds, after which they were kept in a vacuum chambered microscope and observed under different magnification. The photographs were viewed on the screen (David et al., 2015).

2.5 Subjective Analysis

50 female subjects (18 to 40 years) were selected to use the hair conditioner for a period of one month. They were asked to use the hair conditioner after every wash on a daily basis. A sensory questionnaire was provided to the subjects, to indicate daily on a scale from 1-10 for softness, manageability, combability, detangling flyaway and shine.

2.6 Accelerated Stability Studies

To check the stability of the product various physical parameters like change in pH, color, odor were checked for one month as per BIS of shampoo IS 7679:1978 (BIS)

3. Result and Discussion

3.1 Evaluation of Creatine Monohydrate

Experimental analysis of Creatine monohydrate

complied with the specifications given by Hi-Media Laboratories. Creatine monohydrate was confirmed qualitatively for the presence of amino acids. The tests showed positive results for Ninydrin, Xanthoprotic, Sakaguchi, Folins McCarthy Sullivan's and Hopkin's Cole tests.

3.2 Evaluation of Electrostatic Property

Evaluation of electrostatic property from the Table 2 showed that the hair tresses washed with plane water showed a large shadow of 14.3 cm.

Table 2- Evaluation of Electrostatic Property

% of creatine monohydrate in hair conditioner	Hairpiece shadow width (cm)
Water	14.3
0.5% creatine monohydrate(F ₁)	11
1% creatine monohydrate (F ₂)	10.3
1.5% creatine monohydrate (F ₃)	10.0
2% creatine monohydrate (F ₄)	9.3
3% creatine monohydrate(F ₅)	9.6

The shadow width decreased with increase in concentration of Creatine monohydrate showing that the electrostatic property of hair was significantly reduced. For concentration 2% and 3% the shadow width was 9.6 cm as both the concentrations gave a constant hair volume measurement the formulation of hair conditioner having 2% creatine monohydrate (F₄) was selected for further studies as this concentration had significant antistatic effect on hair tresses.

3.3 Scanning Electron Microscopy (SEM)

From photomicrographs of treated hair fibre with F₄ formulation having 2% creatine monohydrate and untreated hair fibre (Fig. 1a&b) it was concluded that the hair conditioner deposited and coated peeled off cuticle evenly and uniformly and closed the spacing of cuticle scale.

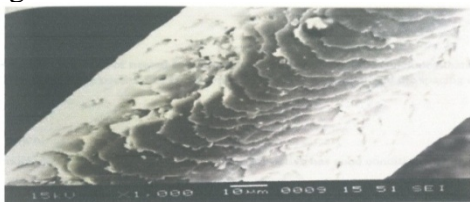


Fig. 1a: Untreated hair fibre

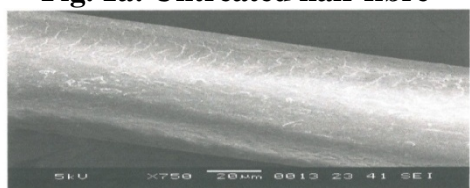


Fig. 1b-Treated Hair Fibre with Hair Conditioner F₄ (2% creatine monohydrate)

3.4 Subjective Analysis

Subjective analysis enabled a deeper understanding whether creatine monohydrate imparts a wide range of attributes. F₄ formulation (2% Creatine monohydrate) was given to 50 female subjects where they rated the product on a scale of 1-10. Detangling, flyaway and manageability were the three parameters which were rated 9 out of 10 by 50 female subjects.

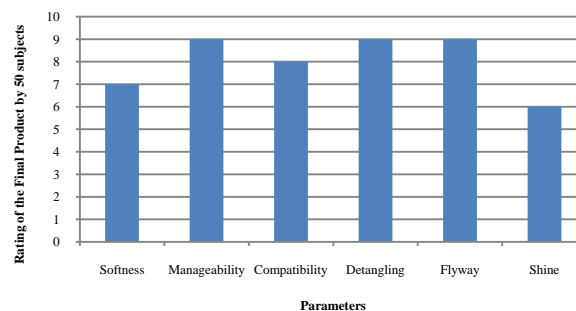


Fig. 2. Subjective Analysis of the Finished Product

3.5 Qualitative Analysis

The accelerated stability studies of the finished product F₄ was carried out daily for a period of one month. Various physical parameters like change in colour, odour, pH were checked at oven temperature 45⁰ C, room temperature and refrigeration temperature 4⁰ C and it was found that there was no significant change in colour, odour and pH and the product was found to be stable.

Thermal stability studies of the formulation showed that the product was stable at 4⁰ C and 45⁰ C.

4. Conclusion

In the present study the formulated hair conditioner with 2% Creatine monohydrate exhibited good antistatic property as well as excellent conditioning effect on hair as revealed by SEM studies.

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