International Journal of Research in Dermatology
Gala MYN et al. Int J Res Dermatol. 2023 Nov;9(6):347-352
http://www.ijord.com

DOI: https://dx.doi.org/10.18203/issn.2455-4529.IntJResDermatol20233178

Original Research Article

Evaluation of sensory parameters and tensile strength on damaged hair after ten washes with Mintop shampoo: *in vitro* study

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Received: 13 June 2023
Revised: 17 July 2023
Accepted: 01 August 2023

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ABSTRACT

Background: Hair damage is a widespread problem that affects people of all ages, genders, and hair types. It can be caused by a variety of factors, such as heat styling, chemical treatments, environmental factors, and genetics. The effects of hair damage can range from minor split ends and frizz to severe breakage, thinning, and hair loss. Hair damage can also affect the texture and appearance of the hair, causing it to become dull, dry, and difficult to manage.
Methods: In the present study 6 natural black hair tresses were selected to evaluate the sensorial parameters such as detangling, combability, static, shine, softness, smoothness, and bounce at baseline and post 10 wash cycles with Mintop Shampoo (fortified with Procapil 1% and Redensyl 1%).
Results: After 10 wash cycles with Mintop Shampoo, the mean score for detangling 3.33 (0.516), combability 4.00 (0.516), Static (Frizz) 3.67 (0.516), Shine 3.00 (0.000), Softness 3.00 (0.632), Smoothness 3.33 (0.516), Bounce 3.33 (0.516), maximum GF 99.17 (0.516) and Strain 44.24 (5.235).
Conclusions: The study findings demonstrated that a significant improvement was observed in sensorial parameters such as detangling, combability, static (reduction), shine, softness, smoothness, bounce, tensile strength, and percentage elongation when compared to baseline or initial damaged state.

Keywords: Combability, Damaged hair, Detangling, Shampoo, Static, Tensile strength

INTRODUCTION

Hair is a unique biocomposite.[1] Healthy hair looks clean, soft to feel, shiny, untangled, has no frizz, and is bouncy.[2] At the molecular level, hair damage generally indicates the destruction of keratin.[3] Hair damage occurs as a result of various external factors, primarily due to the impact of the environment and cosmetic treatments. These factors typically affect the tips of growing hair fibers, resulting in "wear and tear." Damage can be caused by friction resulting from brushing and combing, as well as excessive heat from tools such as hair dryers and curling irons. Additionally, chemical treatments, including bleaching, coloring, perming, and straightening, can cause structural and chemical damage to hair. Finally, exposure to ultraviolet radiation and photoaging can also have adverse effects on hair health.[4] Dull, frizzy, dry hair with split ends is a sign of ill and damaged hair. These characteristics are due to changes in the physical, and mechanical characteristics of the fiber.[5]

Hair damage can affect the sensory parameters of hair, such as its texture, feel, and appearance. It also impacts the tensile strength of hair, which refers to its ability to resist stretching and breaking. Damaged hair can be weaker and more prone to breakage, especially when exposed to stressors like brushing or heat styling. This can lead to hair loss and thinning over time.[1] Hair products that improve the structural integrity of hair fibers and increase tensile strength are available, as are products that increase hair volume, reduce frizz, improve hair manageability, and stimulate new hair growth.[6]

The dermatologist plays a critical role in identifying and addressing the factors that impact scalp and hair health throughout a patient's lifetime. This involves developing personalized treatment plans that take into account the multifaceted nature of the condition, including educating patients on appropriate hair care practices such as using suitable shampoo and conditioner. Dermatologists must suggest shampoos that minimize the risk of frizz and interfiber friction augmentation.[7] Shampoo is the most prevalent form of hair cleanser.[8] Shampoos are not only scalp cleaners but also act on the hair shaft.**Error! Bookmark not defined.** An ideal shampoo must improve both physical and mechanical properties of hair like elasticity, smoothness, volume, shine, and softness. To improve the sensorial attributes (detangling, Combability, static, shine, softness, smoothness, bounce) and tensile strength of damaged hair, it is important to take steps to repair and protect the hair. This can include using hair care products like shampoos specifically designed for damaged hair, avoiding excessive heat styling and chemical treatments, and eating a healthy diet that supports hair growth and strength.

Objectives

The objective of this study was to evaluate *in vitro* hair sensory attributes and tensile strength on damaged hair tresses after 10 washes with Mintop shampoo.

METHODS

In the present study, Six natural black virgin Indian hair tresses were selected for pre-treatment weighed approximately 15-20 gms each and 8-10 inches in length. Initially, knots were combed and removed. Further hair tresses were washed with 20% SLES (Sodium Lauryl Ether Sulfate) Solution (approximately 1 ml for 1 tress) to remove the sebum and debris. After washing tresses were dried overnight at room temperature. Damaging solution (pH 10.5) was prepared by adding 9% H_2O_2 & 20% Ammonia. Hair tresses were dipped in this damaging solution for 1 hour, then removed, rinsed thoroughly, and dried. Baseline evaluations were carried out for all the groups by keeping hair tresses at 30°C/65% RH for approximately 18 hours to condition them. Sensory Attribute Evaluations were carried out by 6 Medical Experts at Baseline and after 10 washes. Hair tresses were treated with 1 ml of Mintop shampoo (fortified with Procapil 1% and Redensyl 1%) and massaged for 1 minute on both sides. Tresses were rinsed till they were free from surfactant. Excess water was squeezed from the tresses and dried. This completed one wash cycle. Steps were repeated for 10 wash cycles. Tresses were maintained in controlled humidity and temperature (30°C/65% RH) before evaluations. Statistical analysis was done by using the statistical software SPSS 10.0. All p values were reported based on a two-sided significance test and all the statistical tests were interpreted at a 5% level of significance.

RESULTS

The study methodology includes pre-treatment of Hair tresses, damaging of hair tresses, Baseline Evaluations before treatment for all the groups followed by Hair Tress Treatment with Mintop Shampoo. All the sensory parameters were analyzed at baseline and after 10 wash cycles. The study results are depicted as follows:

Sensory analysis of hair parameters

Detangling: Post 10 wash cycles, the Mean (SD) Score of Detangling is 3.33 (0.516). A notable mean difference (p=0.023) was observed in detangling between baseline and post-treatment with Mintop shampoo (Table 1). From (Figure 1), a significant improvement in the mean score for detangling was observed after 10 wash cycles with Mintop Shampoo (Figure 1).

Table 1: sensory analysis of detangling.

Time points	Mean score of detangling (Mean±SD)
Baseline	0.67±0.516
Post 10 wash cycles	3.33±0.516
Mean difference-Post 10 wash cycles-Baseline, (p value)	*2.66±0.00, (0.023)

By Wilcoxon Sign Rank Test, *Significant

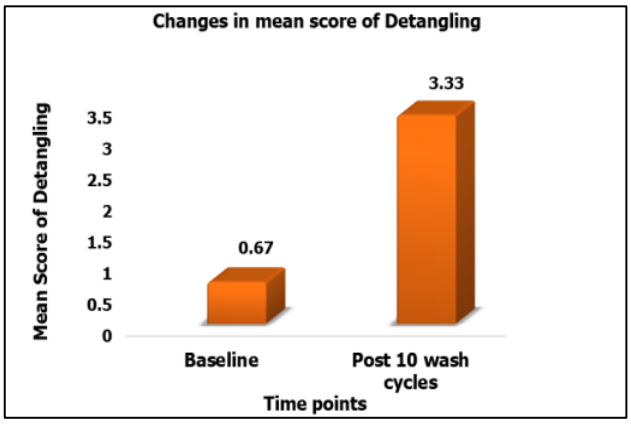

Figure 1: Changes in mean score of detangling with Mintop shampoo.

Combability: Post 10 wash cycles, the Mean (SD) Score of Combability is 4.00 (0.516). A marked mean difference

(p=0.023) was seen in combability between baseline and post-treatment with Mintop shampoo (Table 2). A significant improvement in the mean score for combability was observed after 10 wash cycles with Mintop Shampoo compared to the baseline (Figure 2).

Table 2: Sensory analysis of combability.

Time points	Mean score of compatibility (Mean±SD)
Baseline	0.67±0.516
Post 10 wash cycles	4.00±0.516
Mean difference-Post 10 wash cycles-Baseline, (p value)	*2.66±0.00, (0.023)

By Wilcoxon Sign Rank Test, *Significant

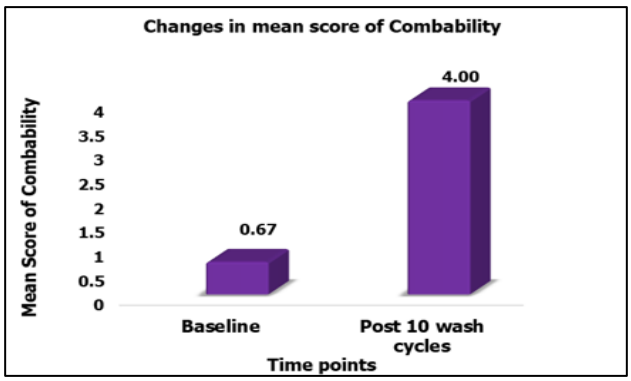

Figure 2: Changes in mean score of combability with Mintop shampoo.

Static (Frizz): Post 10 wash cycles, the Mean (SD) Score of Static (Frizz) is 3.67 (0.516). A notable mean difference (p=0.026) was observed in Static (Frizz) between baseline and post-treatment with Mintop shampoo (Table 3). From (Figure 3), a significant improvement in the mean score for Static (Frizz) was observed after 10 wash cycles with Mintop Shampoo (Figure 3).

Table 3: Sensory analysis of static (frizz).

Time points	Mean score of static (Frizz) (Mean±SD)
Baseline	1.50±0.548
Post 10 wash cycles	3.67±0.516
Mean difference-Post 10 wash cycles-Baseline, (p value)	*2.17±0.32, (0.026)

By Wilcoxon Sign Rank Test, *Significant

Shine: Post 10 wash cycles, the Mean (SD) Score of Shine is 3.00 (0.000). A marked mean difference (p=0.023) was seen in shine between baseline and post-treatment with Mintop shampoo (Table 4). A significant improvement in the mean score for Shine was observed after 10 wash cycles with Mintop Shampoo compared to the baseline (Figure 4).

Table 4: Sensory analysis of shine.

Time points	Mean score of shine (Mean±SD)
Baseline	1.33±0.516
Post 10 wash cycles	3.00±0.000
Mean difference-Post 10 wash cycles-Baseline, (p value)	*1.67±0.516, (0.023)

By Wilcoxon Sign Rank Test, *Significant

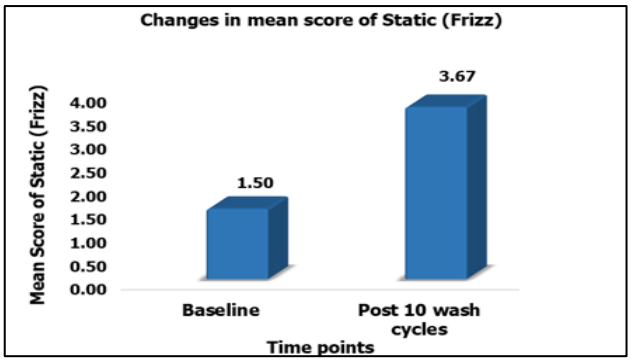

Figure 3: Changes in mean score of Static (Frizz) with Mintop shampoo.

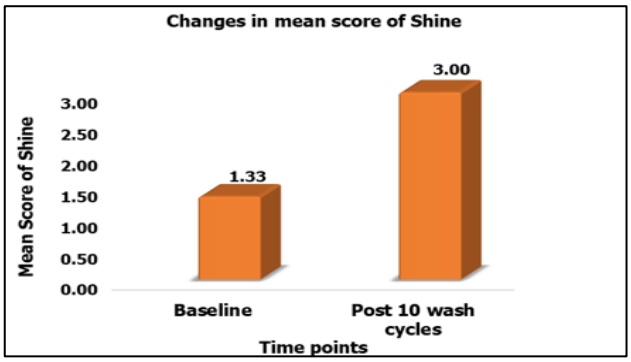

Figure 4: Changes in mean score of Shine with Mintop shampoo.

Softness: Post 10 wash cycles, the Mean (SD) Score of Softness is 3.00 (0.632). A notable mean difference (p=0.023) was observed in Softness between baseline and post-treatment with Mintop shampoo (Table 5). From (Figure 5), a significant improvement in the mean score for Softness was observed after 10 wash cycles with Mintop Shampoo (Figure 5).

Table 5: Sensory analysis of softness.

Time points	Mean score of softness (Mean±SD)
Baseline	1.33±0.516
Post 10 wash cycles	3.00±0.632
Mean difference-Post 10 wash cycles-Baseline, (p value)	*1.67±0.116, (0.023)

By Wilcoxon Sign Rank Test, *Significant

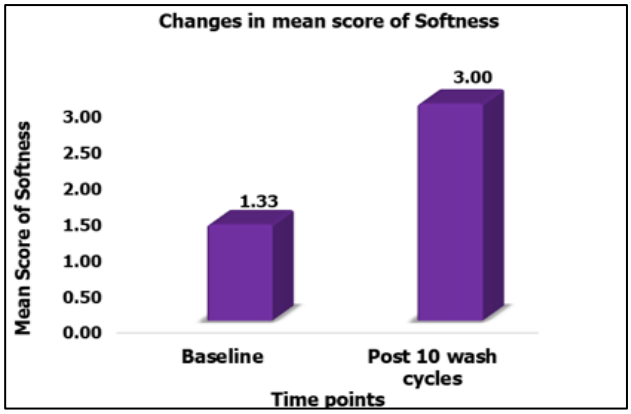

Figure 5: Changes in mean score of Softness with Mintop shampoo.

Smoothness: Post 10 wash cycles, the Mean (SD) Score of Smoothness is 3.33 (0.516). A marked mean difference (p=0.020) was seen in Smoothness between baseline and post-treatment with Mintop shampoo (Table 6). A significant improvement in the mean score for Smoothness was observed after 10 wash cycles with Mintop Shampoo compared to the baseline (Figure 6).

Table 6: Sensory analysis of smoothness.

Time points	Mean score of smoothness (Mean±SD)
Baseline	1.50±0.548
Post 10 wash cycles	3.33±0.516
Mean difference-Post 10 wash cycles-Baseline, (p value)	*1.67±0.032, (0.020)

By Wilcoxon Sign Rank Test, *Significant

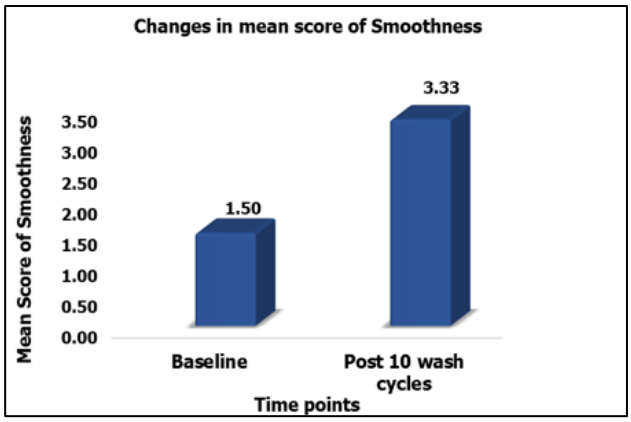

Figure 6: Changes in mean score of smoothness with Mintop shampoo.

Bounce: Post 10 wash cycles, the Mean (SD) Score of Bounce is 3.33 (0.516). A notable mean difference (p=0.023) was observed in Smoothness between baseline post-treatment meant with Mintop shampoo (Table 7). From (Figure 7), a significant improvement in the mean score for Bounce was observed after 10 wash cycles with Mintop Shampoo (Figure 7).

Table 7: Sensory analysis of bounce.

Time points	Mean score of bounce (Mean±SD)
Baseline	1.67±0.516
Post 10 wash cycles	3.33±0.516
Mean difference-Post 10 wash cycles-Baseline, (p value)	*1.66±0.000, (0.023)

By Wilcoxon Sign Rank Test, *Significant

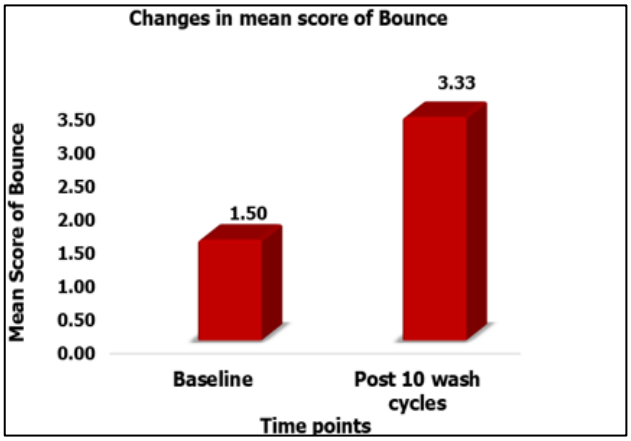

Figure 7: Changes in mean score of Bounce with Mintop shampoo.

Tensile strength: After the treatment with Mintop shampoo, the Mean (SD) Score of Tensile Strength is 99.17 (0.516). A marked mean difference (p=0.000) was seen in Tensile Strength between baseline and post-treatment with Mintop shampoo (Table 8). A significant improvement in the mean score for Tensile Strength was observed after 10 wash cycles with Mintop Shampoo compared to the baseline (Figure 8).

Table 8: Changes in maximum GF after treatment.

Time points	Mean score maximum GF (Mean±SD)
Baseline	70.32±21.077
Post 10 wash cycles	99.17±0.516
Mean difference-Post 10 wash cycles-Baseline, (p value)	*1.66±0.000, (0.000)

By Wilcoxon Sign Rank Test, *Significant

Strain: After the treatment with Mintop shampoo, the Mean (SD) Score of Strain is 44.24 (5.235). A notable mean difference (p=0.001) was observed in Strain between baseline and post-treatment with Mintop shampoo (Table 9). A significant improvement in the mean score for Strain was observed after 10 wash cycles with Mintop Shampoo compared to the baseline (Figure 9).

Table 9: Changes in strain at max% after treatment.

Time points	Mean score maximum GF (Mean±SD)
Baseline	40.31±3.800
Post 10 wash cycles	44.24±5.235
Mean difference-Post 10 wash cycles-Baseline, (p value)	*3.93±1.435, (0.001)

By Wilcoxon Sign Rank Test, *Significant

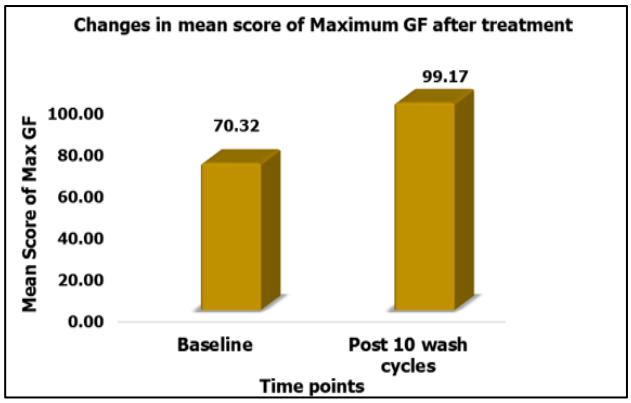

Figure 8: Changes in mean score of maximum GF after treatment with Mintop shampoo.

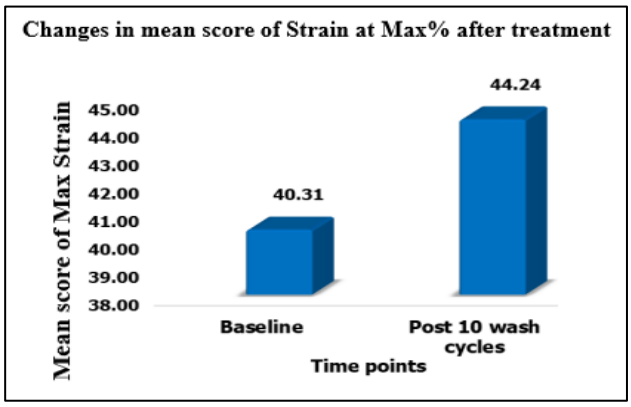

Figure 9: Changes in mean score of Strain at Max% after treatment with Mintop shampoo.

DISCUSSION

Shampoos form an inevitable part of everyone's hair care routine.[10] Although historically, cleansing the hair was their only function, today additional benefits are expected like easy combability, shine, softness, smoothness, and bounce.[11]

Camargo et al stated that there is currently a great interest not only in developing products for the protection and recovery of damaged hair but also to investigate the safety and efficacy of hair care products.[12] Similarly, the results of the present study showed that the Mintop Shampoo helped repair damaged hair. Trueb et al indicated that shampoo treatments are the most commonly used means of managing hair. Modern shampoos are expected to be much more than mere cleansing agents. They are expected to not dry out the hair and simultaneously should enhance smoothness, shine, and bounce.[12] The findings of the present study revealed that there was a significant increase in hair sensorial attributes such as shine, softness, smoothness, and bounce. Qu et al stated that chemical treatments, including permanent dyeing, greatly disrupt the structural and mechanical properties of hair fibers and cause mechanical damage. As a result, the fibers become weak and are more susceptible to breakage with time. Therefore, the demand for products that improve the fiber qualities of hair is increasing rapidly. One of the simplest ways to assess the integrity and quality of the hair fiber is by measuring its mechanical properties.[3] The present study results reported that there was a significant improvement in Tensile Strength was seen after 10 wash cycles with Mintop Shampoo. Mintop Shampoo is fortified with ingredients like Procapil and Redensyl that help with nourishing as well as strengthening the hair and aid in restoring the shine. Sulfate and paraben-free formula make Mintop Shampoo suitable for sensitive scalp skin types.

CONCLUSION

Mintop Shampoo significantly improves sensorial parameters of detangling, combability, static reduction, shine, softness, smoothness, and bounce after 10 hair wash cycles when compared to the baseline or initial damaged state. It also significantly improves the tensile strength and percentage elongation of the hair follicle.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Gala MYN, Muchhala S, Paspulate A, Rathod R, Veligandla K, Aich B, et al. Evaluation of sensory parameters and tensile strength on damaged hair after ten washes with Mintop shampoo: *in vitro* study. Int J Res Dermatol 2023;9:347-52.