CONTRACT RESEARCH SERVICES REPORT

To

Monat Global

Doral, FL

On

Hair Damage Testing

Contributing Scientist(s)
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Inspiring, Educating, and Connecting Through Science

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Objective

Use industry-accepted technical evaluation procedures to investigate any compromising of hair structure as a result of repeated treatment with the client's products.

Background

The structure of hair is under continuous bombardment from a variety of daily habits and practices. It is often convenient to categorize these insults based on the portion of the hair structure which is affected most[1,2,3]. For example, chemical treatments (e.g. permanent color, bleaches, perms, relaxers, etc.) can compromise hair's internal structure (the cortex) leaving it weaker and more prone to breakage. Conversely, mechanical manipulation (e.g. grooming, back-combing, etc.) can damage the surface structure (the cuticle) leading to compromising of sensorial and manageability factors.

Our industry has a variety of assessment approaches which are widely-used for investigating the nature and severity of such insults. Surface damage is often visualized by high magnification Scanning Electron Microscopy (SEM), while instrumental combing experiments[4] provide a measure of hindered grooming ease. Meanwhile, single fiber tensile experiments assess any effect on hair's underlying tensile properties[5].

This report documents use of these techniques in probing any negative effects on hair that might result from repeated treatment with the clients' shampoo and conditioner products.

Products

The following products were provided by the sponsor for use in this study.

Monat Intense Repair Shampoo

Monat Intense Repair Treatment Conditioner

Test Plan

Package instructions on the shampoo product states "massage a generous amount on wet hair". The client has concerns that shampoo "overuse" could be behind complaints about hair damage.

For this reason, two different shampoo dosages were used in all experiments. Our traditional shampoo dosage is 10 v/w (i.e. 0.3 mL per 3 gram hair tress). Therefore, for a "generous amount" (as per product directions) we doubled this dosage (i.e. 0.6 mL per 3 gram hair tress). A comparable set of experiments was similarly performed using our normal dosage (i.e. modified product directions).

These two dosages were utilized in experiments involving shampoo only, shampoo and conditioner, and shampoo, conditioner and heat straightening. Therefore, the experimental design is shown below.

1) Shampoo alone (as per product directions)
2) Shampoo alone (modified product directions)
3) Shampoo and Conditioner (as per product directions)
4) Shampoo and Conditioner (modified product directions)
5) Shampoo, Conditioner + heat straightening (as per product directions)
6) Shampoo, Conditioner + heat straightening (modified product directions)

A further untreated control cell is also necessary to act as a baseline for any changes.

7) Untreated Control

Hair and Treatments

Testing was performed on both virgin and bleached/dyed hair. Virgin medium brown European hair tresses were procured from International Hair Importers (Glendale, NY). Tresses consisted of 3 grams of hair and measured 1 inch in width by 8 inches long.

Bleached/dyed tresses were obtained by first bleaching hair with our standard bleaching procedure – followed by dying with L'Oreal Preference Natural Blonde. These procedures are described in the Appendix at the end of this report.

Product treatment involved first wetting hair tresses under flowing water for 30 seconds. The hair was squeegeed to remove excess water - and shampoo (see above for discussion on dosage) was applied via a syringe. The product was massaged through the hair and allowed to sit for 2 minutes. The shampoo was then removed by rinsing for 30 seconds. All rinsing was performed using 38°C water at a flow rate of 1 gallon/minute.

Conditioner application occurred in a similar manner – except a 15% dosage ratio (i.e. 0.45mL per 3 gram tress was employed).

Heat straightening was performed using a commercially-available Remington device at its highest temperature setting (230°C, 450°F). Ten passes were performed once the hair attained a dry state.

Hair tresses were run through 12 such treatment cycles – in a belief this simulates around 1 month of product usage (i.e. assuming washing every 2-3 days). Tresses were blow dried on a low setting between treatment cycles.

Full Experimental design

To summarize, the full experimental design is shown below.

Virgin Hair
1) Untreated (control)
2) Shampoo alone (as per product directions) - 12x treatment cycles
3) Shampoo alone (modified product directions) - 12x treatment cycles
4) Shampoo and Conditioner (as per product directions) - 12x treatment cycles
5) Shampoo and Conditioner (modified product directions) - 12x treatment cycles
6) Shampoo, Conditioner + heat straightening (as per product directions) - 12x treatment cycles
7) Shampoo, Conditioner + heat straightening (modified product directions) - 12x treatment cycles

Bleach/Colored Hair
8) Untreated (control)
9) Shampoo alone (as per product directions) - 12x treatment cycles
10) Shampoo alone (modified product directions) - 12x treatment cycles
11) Shampoo and Conditioner (as per product directions) - 12x treatment cycles
12) Shampoo and Conditioner (modified product directions) - 12x treatment cycles
13) Shampoo, Conditioner + heat straightening (as per product directions) - 12x treatment cycles
14) Shampoo, Conditioner + heat straightening (modified product directions) - 12x treatment cycles

Tensile Testing

Methodology

Assessing the tensile properties of hair arguably represents the most fundamental test that is performed in our industry. The mechanical properties of hair are a direct reflection of the internal structure, and therefore such measurements represent a probe into this inner sanctum. Most often, these experiments are used as a probe for “damage” – where a variety of external insults can compromise the inner structure (e.g. chemical treatments, UV exposure, etc.). The industry standard for performing such testing involves the generation of stress-strain curves using constant rate extension experiments[5]. This approach involves stretching individual fiber to their break point in a controlled manner – while measuring the internal forces that arise. There is great variability in the properties of single hair fibers, and so a relatively high number of replicate fibers must be tested in each experiment. This has led to development of a commercial automated single fiber tester (Diastron, UK) which is widely used throughout our industry. A picture of this equipment is given in Figure 1, while Figure 2 shows a typical stress-strain curve.

A variety of tensile parameters can be extracted from such curves to provide structural information.

Figure 1

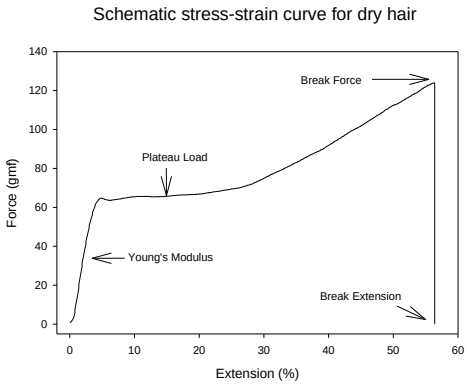


Figure 2

Results

Virgin hair

Figure 3 shows wet state break stress results for the various treatments on virgin hair. The data is depicted using Box & Whisker plots that were generated using Statistica® while statistical analysis was performed using JMP software at a 95% confidence level.

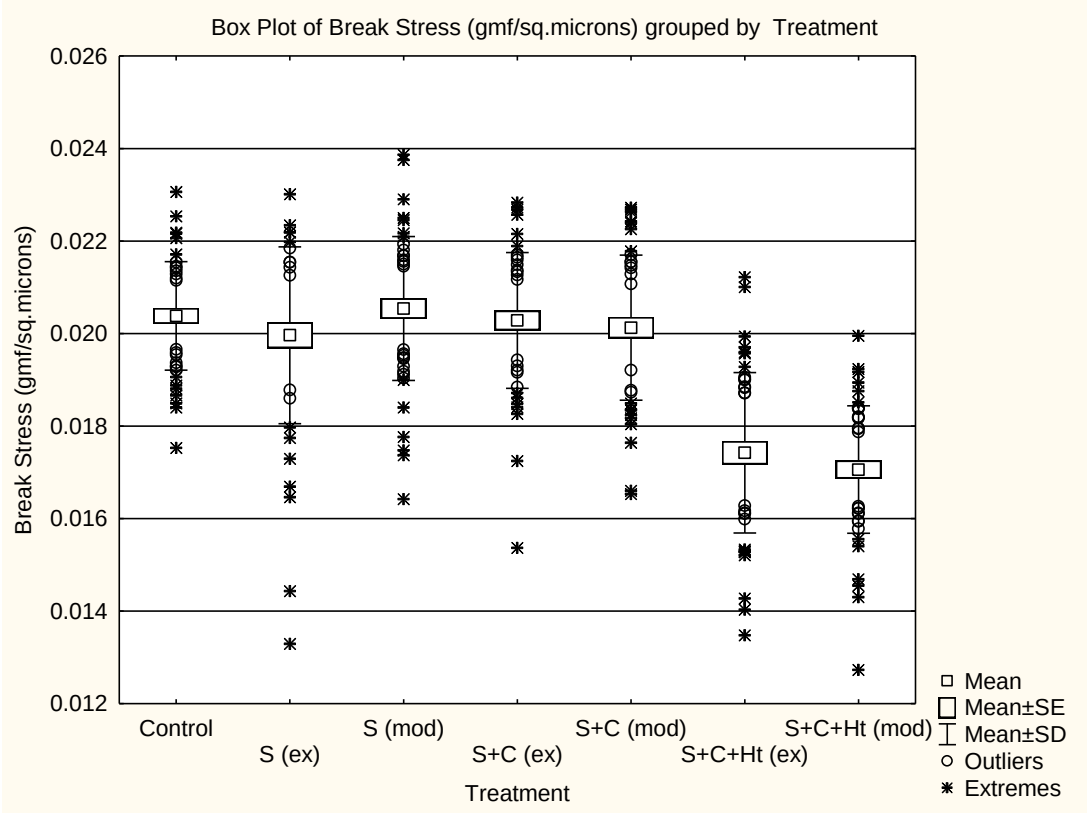


Figure 3. Wet state break stress for virgin hair as fn of treatment

Break Stress (gmf/sq.microns)						
Treatment	Number	Mean	Std Dev	Std Err Mean	Level	
S (mod)	50	2.05E-02	1.56E-03	2.20E-04	A	
Control	48	2.04E-02	1.17E-03	1.70E-04	A	
S+C (ex)	48	2.03E-02	1.47E-03	2.10E-04	A	
S+C (mod)	49	2.00E-02	2.43E-03	3.50E-04	A	
S (ex)	47	2.00E-02	1.91E-03	2.80E-04	A	
S+C+Ht (ex)	49	1.73E-02	1.95E-03	2.80E-04		B
S+C+Ht (mod)	50	1.71E-02	1.38E-03	1.90E-04		B

All samples that did not involve heat treatment gave rise to comparable break stress results. That is, repeated washing with the shampoo, either using the existing "generous" product direction (S_{ex}), or the modified lower dosage (S_{mod}) resulted in no diminishment of this property. Similarly, repeated washing and conditioning under either dosage condition did not effect this property.

Multiple washing and conditioning cycles in combination with heat straightening resulted in a break stress for hair that was 15% lower than the untreated control. This result is in accordance with the well-known damaging effect of these high heat treatments[6] and should not be attributed to any product effects. There is no

statistically significant difference in the magnitude of this “heat treated” break stress value as a function of shampoo dosage.

Similarly Figure 4 shows comparable findings when assessing the Young’s modulus (extensional stiffness) of virgin hair as a function of product treatment.

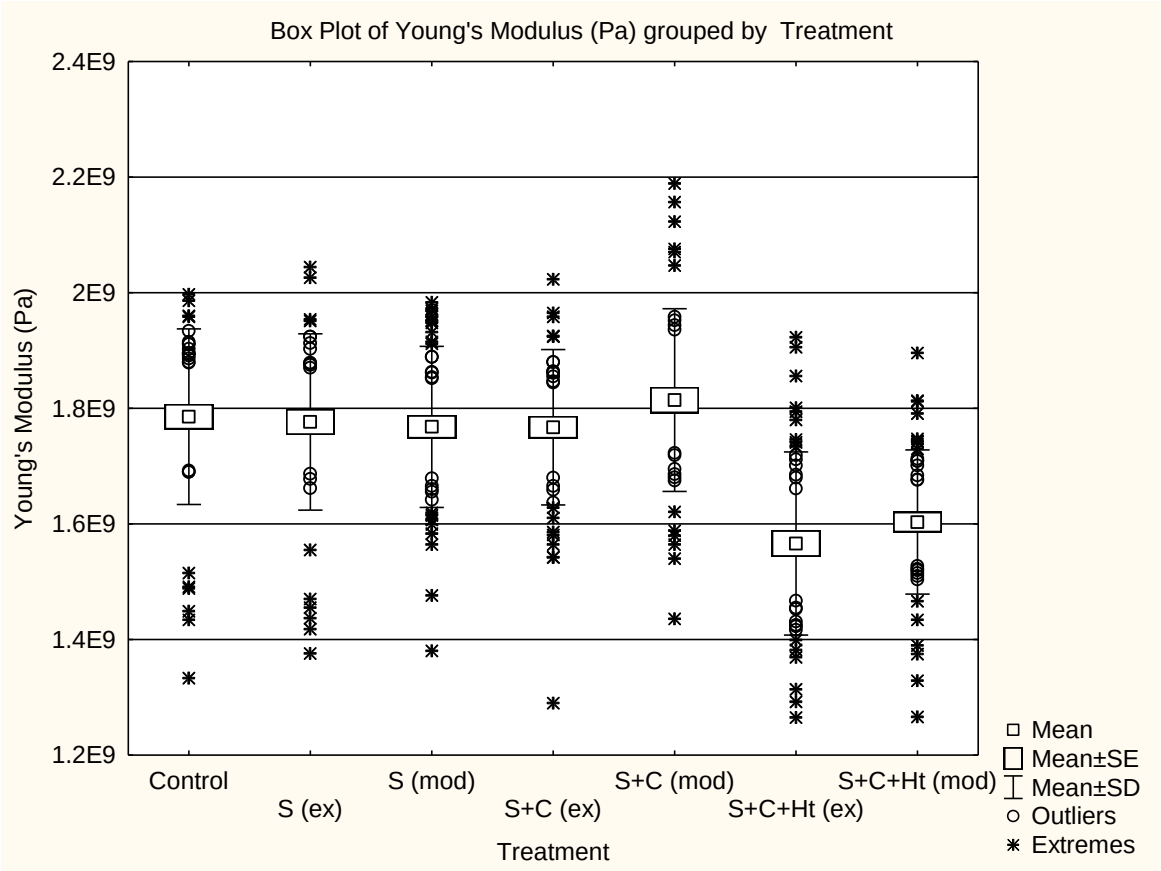


Figure 4. Wet state Young’s modulus for virgin hair as fn of treatment

Young's Modulus (Pa)						
Treatment	Number	Mean	Std Dev	Std Err Mean	Level	
S+C (mod)	49	1.81E+09	1.58E+08	2.26E+07	A	
S (mod)	50	1.80E+09	2.16E+08	3.05E+07	A	
Control	48	1.79E+09	1.52E+08	2.19E+07	A	
S (ex)	47	1.78E+09	1.53E+08	2.22E+07	A	
S+C (ex)	48	1.77E+09	1.34E+08	1.94E+07	A	
S+C+Ht (mod)	50	1.60E+09	1.25E+08	1.76E+07		B
S+C+Ht (ex)	49	1.56E+09	1.70E+08	2.43E+07		B

Again, all samples that did not involve heat treatment gave rise to statistically equivalent results. That is, neither repeated washing with shampoo nor shampooing and conditioning (at either dosage) resulted in any diminishment of this important tensile parameter.

As before, multiple washing and conditioning cycles in combination with heat straightening did lead to a reduction in this property; but again this is attributed to the well-known damaging effect of high heat treatments.

Bleached/dyed hair

Figure 5 shows wet state break stress data for the bleached/dyed hair as a function of treatment.

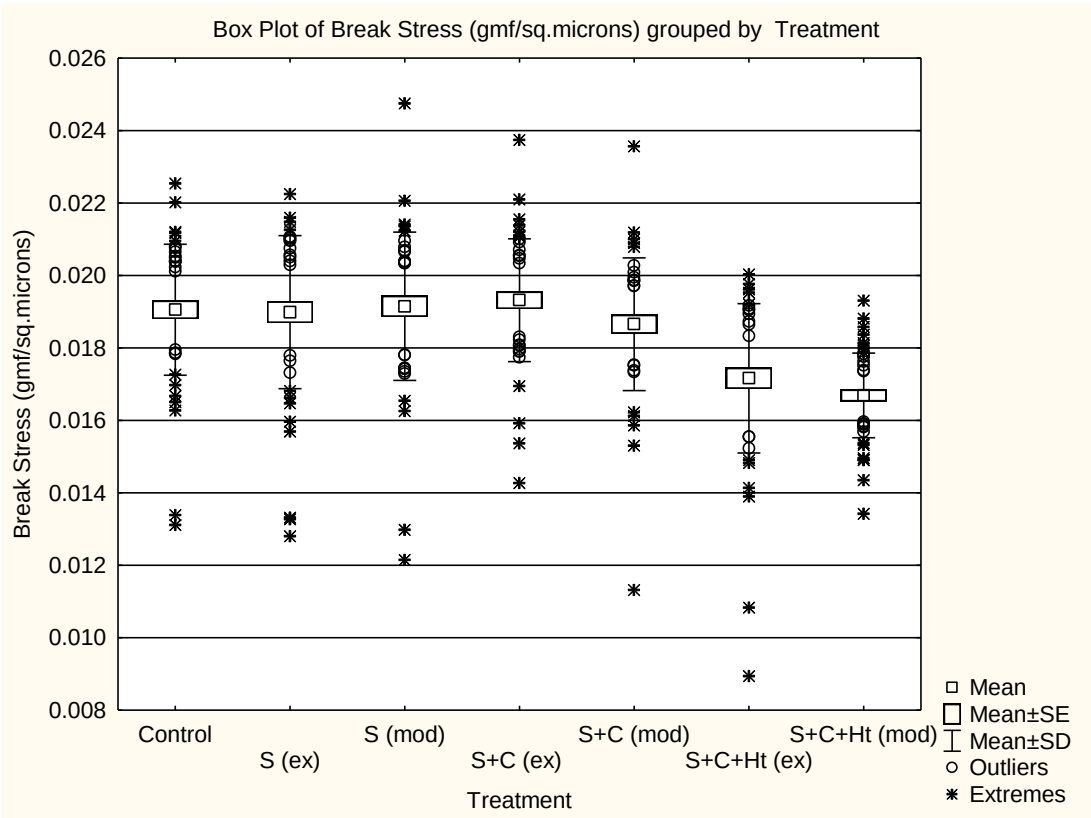


Figure 5. Wet state break stress for bleached/dyed hair as fn of treatment

Break Stress (gmf/sq.microns)						
Treatment	Number	Mean	Std Dev	Std Err Mean	Level	
S (mod)	50	1.92E-02	2.05E-03	2.90E-04	A	
S+C (ex)	50	1.91E-02	2.21E-03	3.10E-04	A	
Control	50	1.91E-02	1.81E-03	2.60E-04	A	
S (ex)	50	1.90E-02	2.11E-03	3.00E-04	A	
S+C (mod)	49	1.87E-02	1.83E-03	2.60E-04	A	
S+C+Ht (ex)	50	1.72E-02	2.06E-03	2.90E-04		B
S+C+Ht (mod)	50	1.67E-02	1.17E-03	1.70E-04		B

Wet state break stress results for the bleached/dyed control hair are approximately 6% less than the virgin control and illustrate the known damaging effect of these chemical treatments on the hair structure.

<u>As seen with the virgin hair, all samples that did not involve heat treatment again gave rise to statistically equivalent results</u>.

Likewise, samples that included flat iron treatment gave rise to somewhat lower values – but, as before, this effect is associated with high heat and not the products.

Figure 6 shows wet state Young's modulus data for the bleached/dyed hair as a function of treatment.

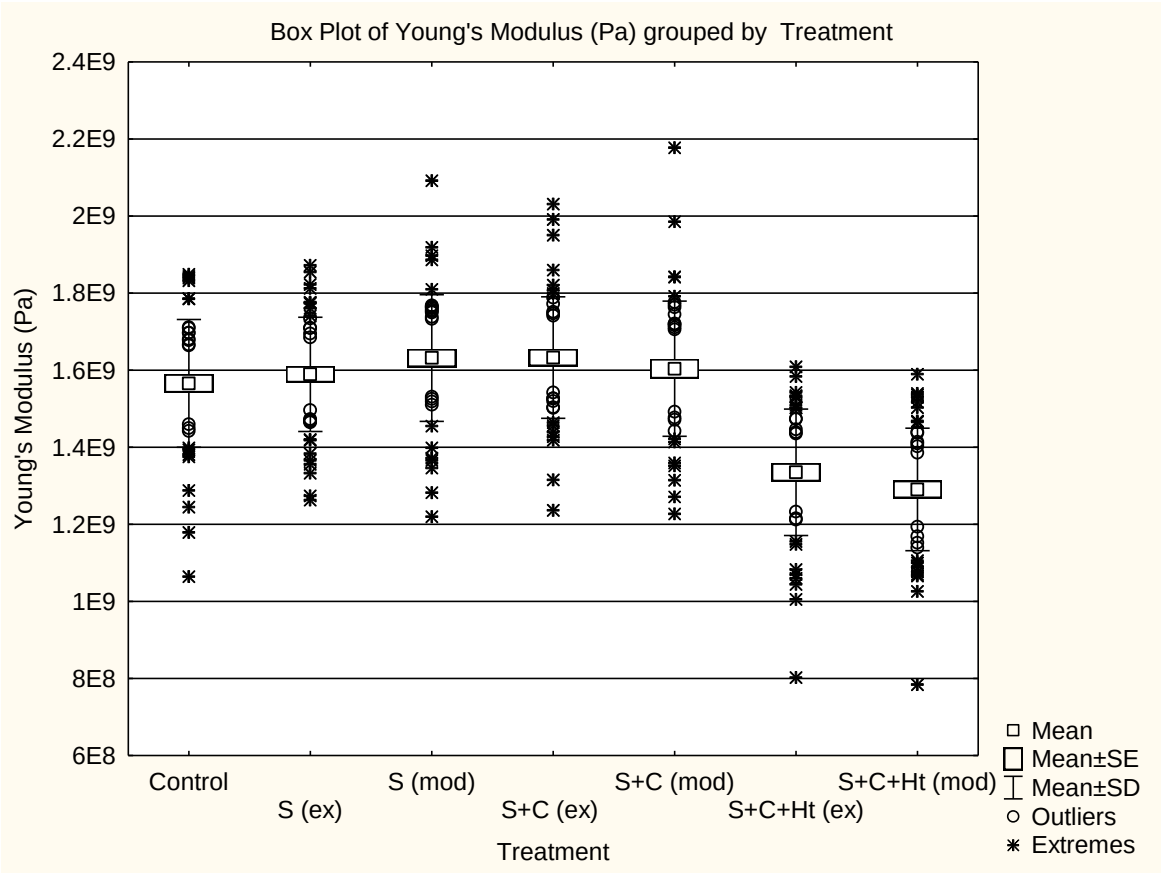


Figure 6. Wet state Young's modulus for bleached/dyed hair as fn of treatment

Young's Modulus (Pa)							
Treatment	Number	Mean	Std Dev	Std Err Mean	Level		
S+C (ex)	50	1.63E+09	1.58E+08	2.23E+07	A		
S (mod)	49	1.63E+09	1.64E+08	2.35E+07	A		
S+C (mod)	49	1.60E+09	1.76E+08	2.51E+07	A	B	
S (ex)	50	1.59E+09	1.48E+08	2.10E+07	A	B	
Control	49	1.57E+09	1.66E+08	2.37E+07		B	
S+C+Ht (ex)	50	1.34E+09	1.64E+08	2.32E+07			C
S+C+Ht (mod)	50	1.29E+09	1.59E+08	2.25E+07			C

Wet state Young's modulus results for the bleached/dyed control hair are approximately 12% less than the virgin control and again illustrate the damaging effect of these chemical treatments.

As seen throughout, results for all the non-heat treated samples are very similar – while the damaging effect of heat is again evident.

Summary of Tensile Work

The above results show consistent findings in which chemical treatments (bleaching and dying) and the high heat associated with heat straightening are observed to compromise the tensile strength of hair. Moreover, these findings are in-line with expectations based on the well-known deleterious nature of these treatments[1,2,3].

In no instance is there any indication of a decrease in tensile properties as a result of repeated shampooing or conditioning. Similarly, there are no indications of any changes associated with shampoo dosages. These conclusions are true for both tensile parameters shown here and consistent across experiments performed on both virgin and bleached/dyed hair.

Wet Combing

Methodology

A decrease in hair manageability is one symptom of hair damage. A degrading cuticle structure, in combination with an increased propensity for swelling can significantly hinder the ability to run a brush or comb through hair. With this said, the most-fundamental technical function provided by hair conditioning products is surface lubrication. This benefit, when provided in an aesthetically-pleasing manner, will greatly improve manageability while also mediating negative feel properties. Clearly, "lubrication" is not a consumer word; but resulting benefits are commonly described by the end-user in terms of "softness", "smoothness",

"moisturization" and many others. The classical means of evaluating ease-of-combing involves so-called instrumental combing experiments[4,7] where a mechanical testing device is used to assess frictional forces while hair is pulled through a comb or brush.

The seminal paper on instrumental combing of hair was published by Garcia & Diaz[7] in 1976; a more-recent treatise on the approach was given by Evans[4] in 2011. Our methodology involves use of an Instron Model 5500 tensile tester to pull a hair tress through a comb while a load cell measures resulting frictional forces. Figure 7 shows this experimental set-up.

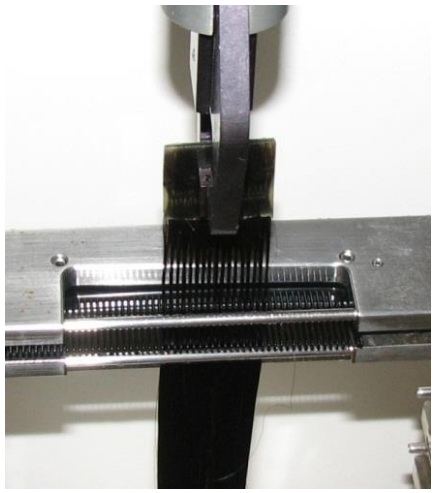


Figure 7: Instrumental combing set up

All testing was performed in the wet state. Individual hair tresses were combed a suitable number of times to yield a consistent average value. For example, Figure 8 shows typical results from a wet combing experiment and illustrates how combing forces usually converge to a consistent value after 1-2 initial detangling strokes. Eight replicate hair tresses were used per treatment to ensure statistical relevance.

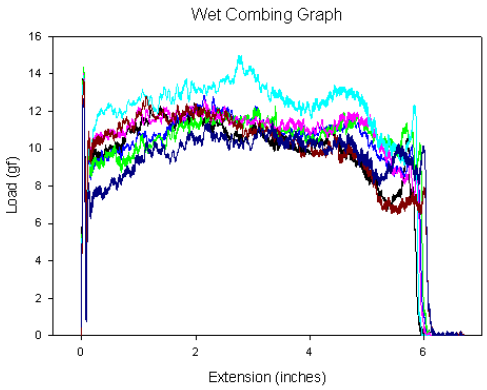


Figure 8: Typical wet combing curves

Note: These experiments were only performed on treatment regimens that contained the conditioner product (i.e. no effects would be expected for shampoo alone).

Results

Virgin hair

Figure 9 shows wet state combing forces for the various treatments on virgin hair. The graph demonstrates how combing forces are considerably facilitated by the lubrication provided by the conditioner product. Combing forces for the treated hair are about half that of the untreated control.

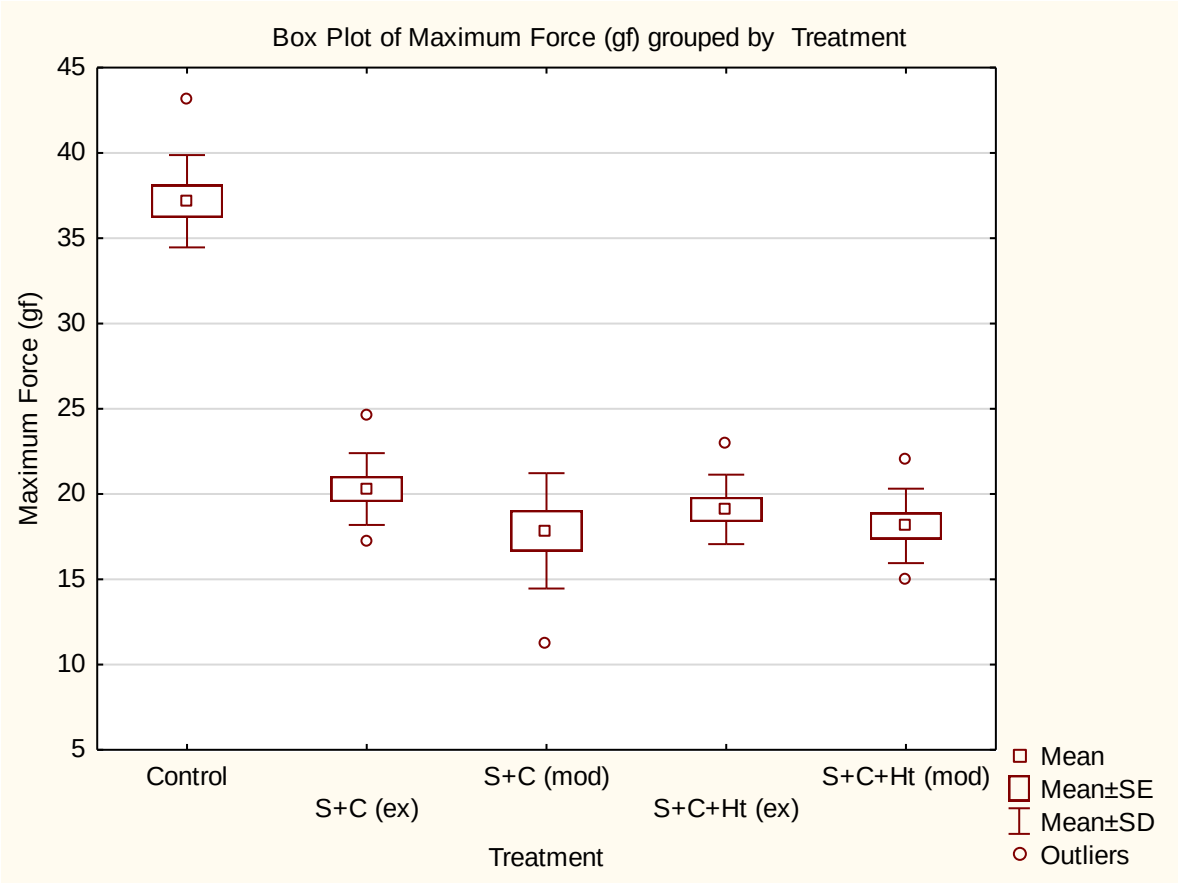


Figure 9. Wet state results on virgin hair

Maximum Force (gf)						
Treatment	Number	Mean	Std Dev	Std Err Mean	Level	
Control	8	37.17	2.70	0.96	A	
S+C (ex)	8	20.29	2.10	0.74		B
S+C+Ht (ex)	8	19.10	2.04	0.72		B
S+C+Ht (mod)	8	18.13	2.18	0.77		B
S+C (mod)	8	17.84	3.38	1.20		B

Bleach/dyed hair

Figure 10 now shows wet state combing forces for the various treatments on bleach/dyed hair.

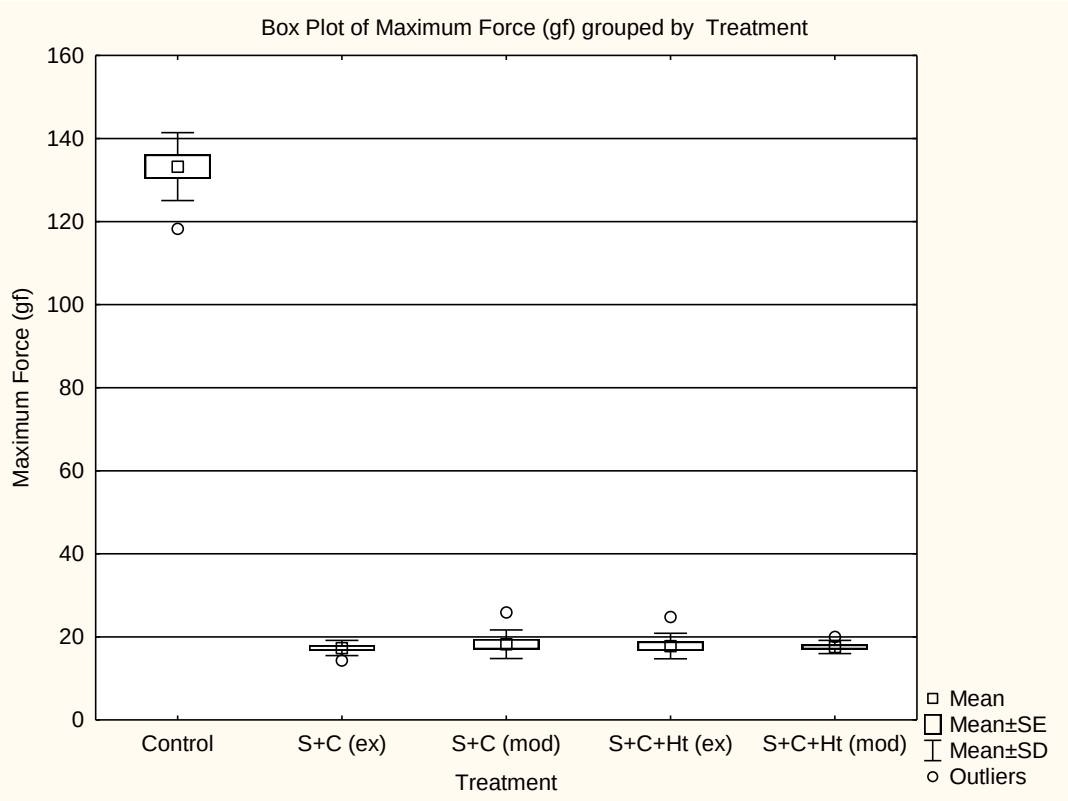


Figure 10. Wet state results on bleach/waved hair

Maximum Force (gf)						
Treatment	Number	Mean	Std Dev	Std Err Mean	Level	
Control	8	133.25	8.18	2.89	A	
S+C (mod)	8	18.22	3.45	1.22		B
S+C+Ht (ex)	8	17.79	3.08	1.09		B
S+C+Ht (mod)	8	17.56	1.60	0.57		B
S+C (ex)	8	17.33	1.83	0.65		B

Combing forces for the bleach/dyed control tresses are approximately 3.5x higher than the comparable virgin hair control tresses. This dramatically demonstrates how manageability suffers as hair becomes damaged.

Nonetheless, despite much higher combing forces for the unconditioned bleach/dyed hair, use of the Monat shampoo and conditioner regimen lowers these values to a point comparable to that seen for virgin hair after the same

treatments. In short, these treatments mask the considerable effect of the chemical treatments such that the consumer doesn't experience this effect.

Summary of Wet Combing Work

Figures 9 and 10 illustrate the ability for the Monat shampoo and conditioner regimen to considerably lower combing forces and facilitate the grooming process. These products produce an approximate 50% reduction in combing forces when using virgin hair and around an 85% reduction on bleach/dyed hair.

Moreover, results show how these products completely mitigate the sizable negative effect of bleaching and dying treatments such that these negative do not become apparent to the consumer.

Similarly, Figures 9 and 10 show no increase in combing forces for the treatment regimens that included flat ironing. As seen previously, the high heat associated with flat ironing is known to be highly damaging to hair – to the end that increased combing forces would again be anticipated. However, this end point is not seen in either Figure 9 or 10 – which again is taken as a representation of the shampoo and conditioner treatments masking and alleviating this occurrence.

Scanning Electron Microscopy

Methodology

Scanning electron microscopy (SEM) allows for very high magnification imagery of the hair surface and is most commonly used to visualize the state/health of the cuticle structure. This tile-like structure is progressively eroded, degraded and generally "beaten-up" by the rigors associated with everyday hair care habits and practices. Accordingly, this approach is popular screen of hair surface damage.

The extremely high magnification leads to some issues in ensuring that any collected images are representative of the general state of the hair. That is, healthy-looking patches may be found on even the most highly damaged hair; and vice versa. Therefore, each set of treated fibers was first examined via a quick screening approach to ascertain an overall picture of surface health. A number of representative images (10-12) were then collected as indications of these states.

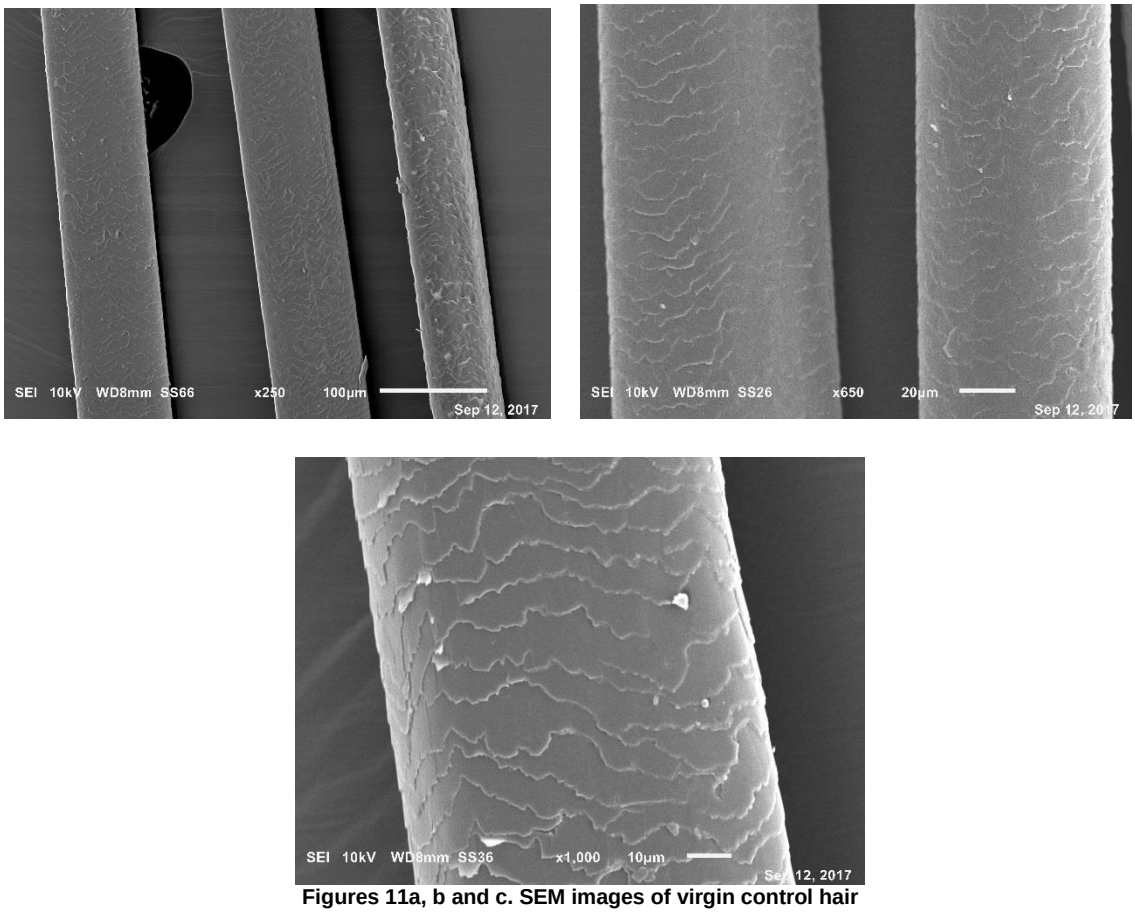
In an attempt to control the length of this report, 2-3 representative images will be shown for each test cell. All images will be supplied separately on a memory stick drive.

Imaging was performed on a FEI XL30 FEG-SEM. Samples were made conductive by depositing a thin layer of platinum using a VCR group incorporated IBS/TM200S ion beam sputterer. Photomicrographs were obtained at 10kV using Scandium software.

Results

Virgin Control

Figures 11a, b and c show surface images that are considered representative of the virgin control hair. The first image illustrates the earlier point about single fiber variability – in that it shows 2 relatively healthy-looking fibers and one that appears considerably more damaged.

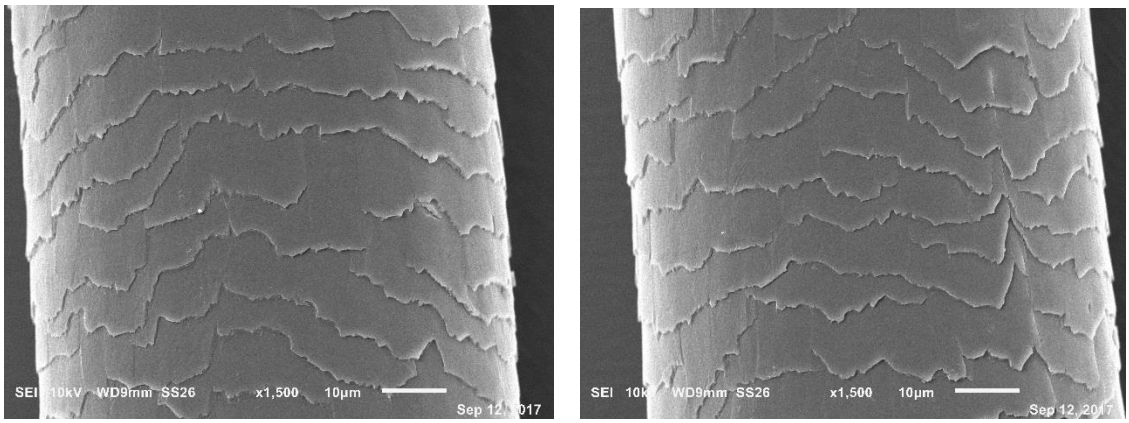


Figures 11a, b and c. SEM images of virgin control hair

With this said, in general the virgin control appeared in reasonably good shape. That is, we observe mainly minor chipping of the cuticle edges, slight cuticle uplift in isolated areas and the odd surface crack.

Virgin hair – shampoo alone as per direction (i.e. generous dosage)

Figures 12a and b show surface images that are considered representative of virgin hair repeatedly washed with the “generous” dosage of Monat Intense Repair Shampoo.

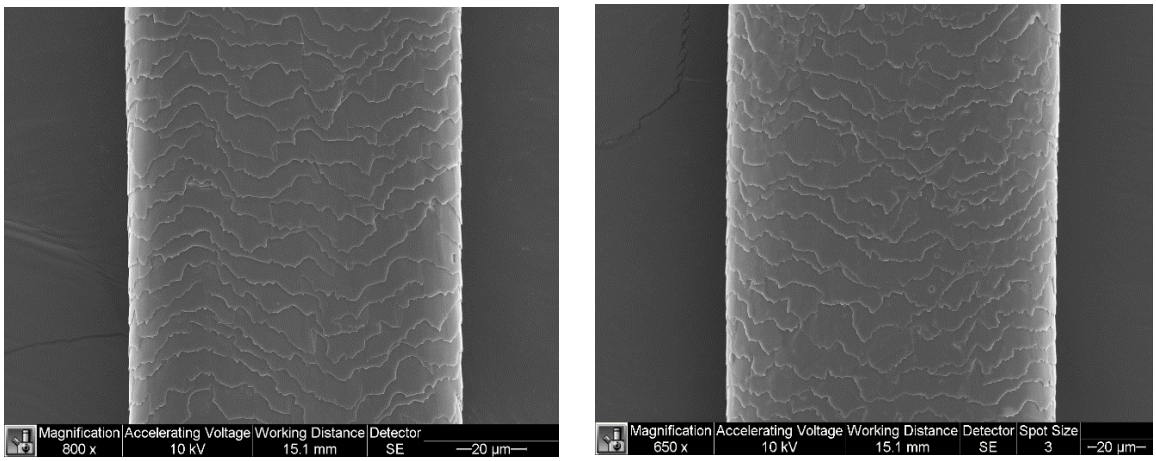


Figures 12 a and b. Representative SEM images for virgin hair repeatedly washed with shampoo (as per directions)

There are no indications of the hair surface being further compromised by repeated washing with “generous” dosages of Monat Intense Repair Shampoo. Again, the surface appeared in reasonable shape with only minor chipping of the cuticle edges, slight cuticle uplift in isolated areas and the odd surface crack.

Virgin hair – shampoo alone with modified (lower) dosage

Figures 13a and b show surface images that are considered representative of virgin hair repeatedly washed with the lesser dosage of Monat Intense Repair Shampoo.

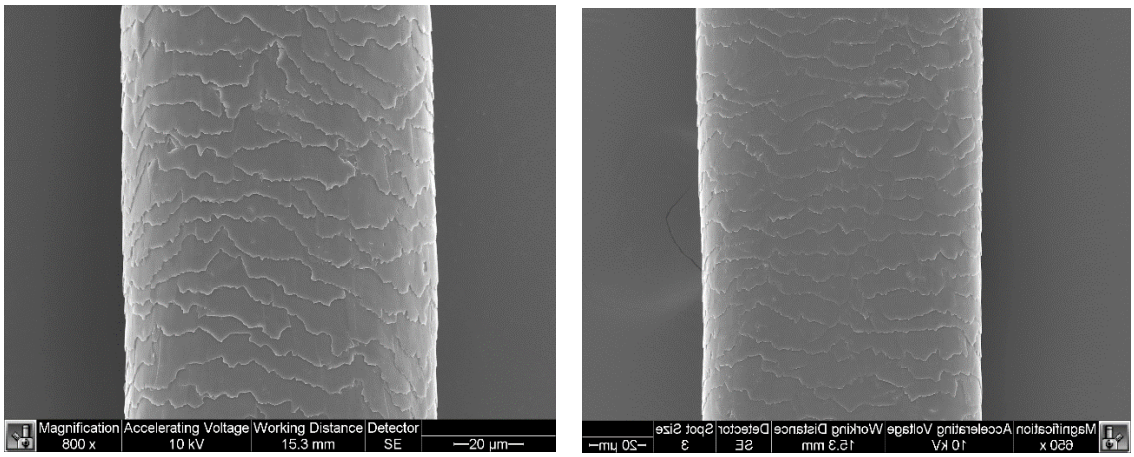


Figures 13 a and b. Representative SEM images for virgin hair repeatedly washed with shampoo (modified directions)

Again the state of the cuticle surface is comparable to that of the control virgin hair.

Virgin hair – shampoo and conditioner as per direction (i.e. generous dosage)

Figures 14a and b show surface images that are considered representative of virgin hair repeatedly washed with the “generous” dosage of Monat Intense Repair Shampoo followed by Monat Intense Repair Conditioner.



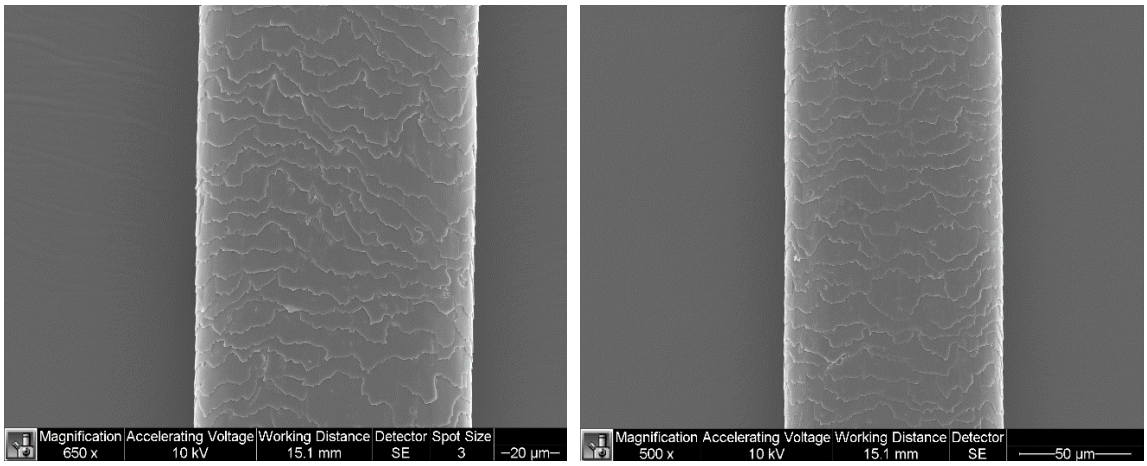
Figures 14 a and b. Representative SEM images for virgin hair repeatedly washed with shampoo and conditioner (existing directions)

Conditioners leave behind surface deposits that facilitate manageability while mediating negative feel properties. However, these deposits exist in very thin layers and are not easy to visualize – even with the extremely high magnification of an SEM. These deposits also minimize frictional forces between adjacent fibers during grooming and other forms of manipulation which help limit surface wear and wear. Again, the hair surface shows only mild indications of surface damage.

Virgin hair – shampoo and conditioner with modified directions (i.e. lesser dosage)

Figures 15a and b show surface images that are considered representative of virgin hair repeatedly washed with the lesser dosage of Monat Intense Repair Shampoo followed by Monat Intense Repair Conditioner.

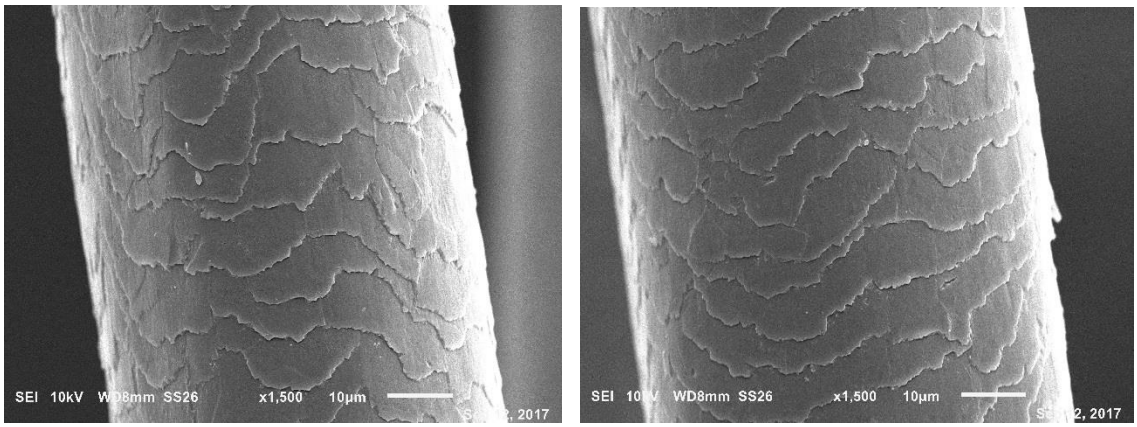
Again the hair surface is in relatively good shape and is not notably different from the untreated control.



Figures 15 a and b. Representative SEM images for virgin hair repeatedly washed with shampoo and conditioner (modified directions)

<u>Virgin hair – shampoo, conditioner and heat straightening as per direction (i.e. generous dosage)</u>

Figures 16a and b show surface images that are considered representative of virgin hair repeatedly washed with the “generous” dosage of Monat Intense Repair Shampoo followed by Monat Intense Repair Conditioner and a heat straightening step.

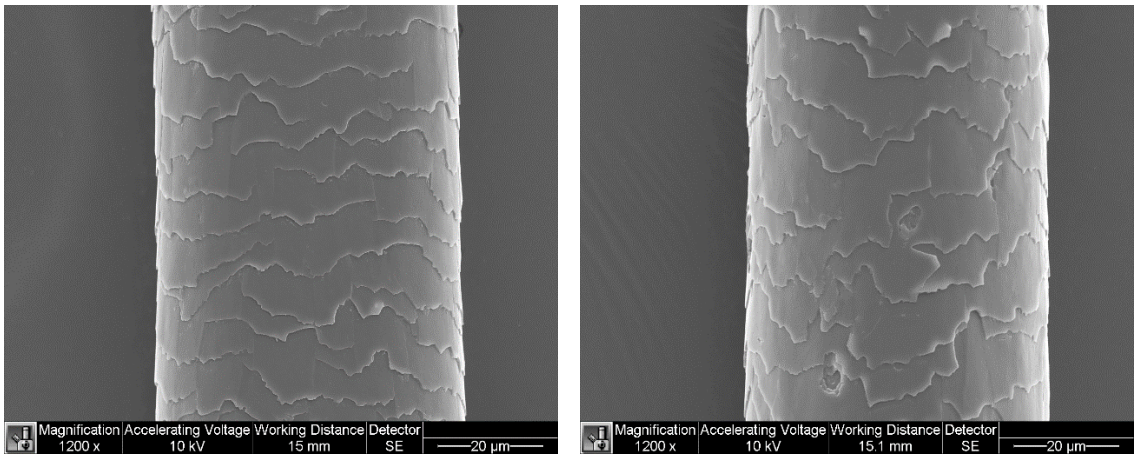


Figures 16 a and b. Representative SEM images for virgin hair repeatedly washed with shampoo and conditioner and then heat styled (existing directions)

The considerable damaging potential of the flat ironing process has already been highlighted – so an increased level of surface damage might be anticipated. However, any effect is mild at best. As described above, it seems likely that conditioning lowers frictional wear and tear to help mediate this otherwise damaging condition.

Virgin hair – shampoo, conditioner and heat straightening modified direction (i.e. lesser dosage)

Figures 17a and b show surface images that are considered representative of virgin hair repeatedly washed hair repeatedly washed with the lesser dosage of Monat Intense Repair Shampoo followed by Monat Intense Repair Conditioner and a heat straightening step.



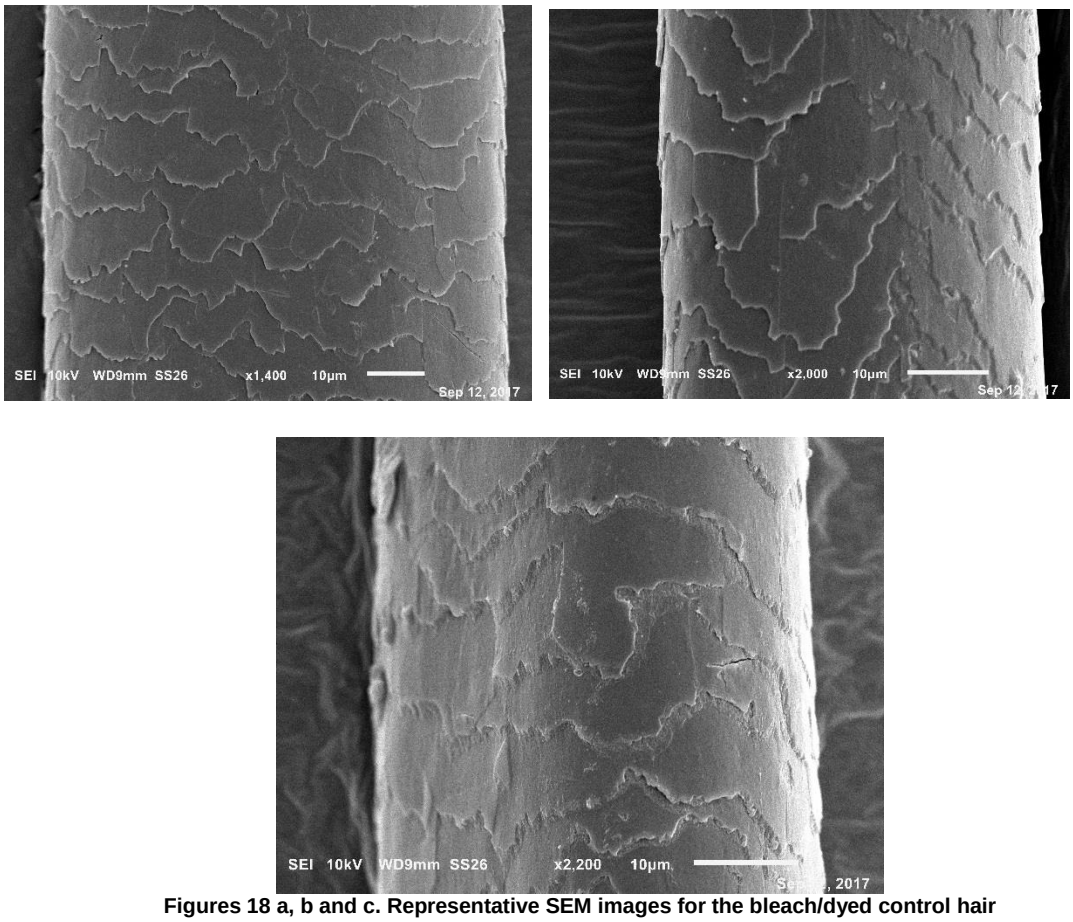
Figures 17 a and b. Representative SEM images for virgin hair repeatedly washed with shampoo and conditioner and then heat styled (modified directions)

Mild signs of surface heat damage are encountered such as small longitudinal cracks and slightly increased cuticle uplift. In addition, Figure 17b appears to show the remnants of a surface blister that would be indicative of “bubble hair”. This is a commonly seen occurrence in heat-treated hair whereby water is superheated and bursts through the cuticle – like a “hair volcano”. These phenomena were expected based on the heat stimulus and are still relatively minor in occurrence.

Bleach/Dyed Control

Figures 18a, b and c show surface images that are considered representative of the bleach/dyed control hair. Chemical treatments are well-recognized to be “damaging” to hair – but effects are often not immediately seen after treatment. Instead such treatments appear to weaken the cuticle such that exacerbated wear and tear subsequently occurs. Therefore, despite two chemical treatments, the bleach/dyed hair surface doesn’t look too bad.

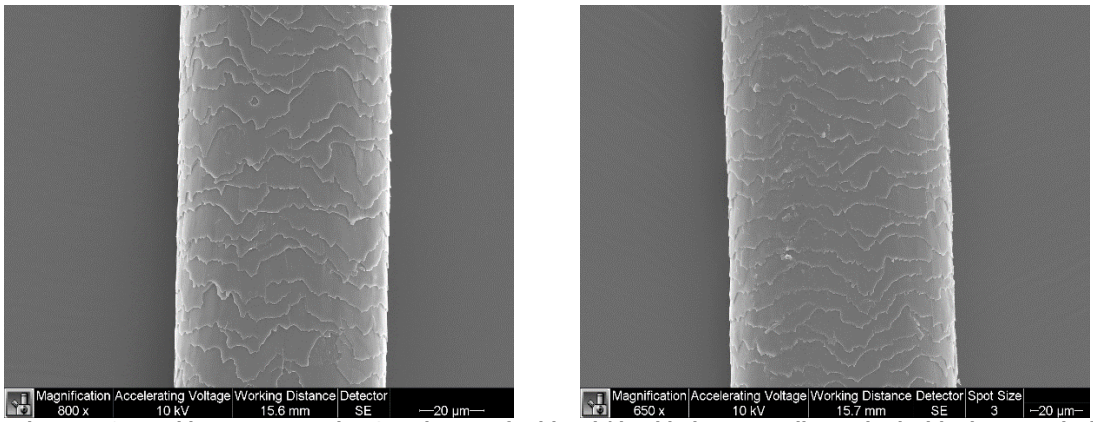
There is a somewhat elevated irregularity to the individual cuticle scales and seemingly some eroded cuticle debris. Figure 18 c appears to show some product deposits that presumably were left over from the dye product.



Figures 18 a, b and c. Representative SEM images for the bleach/dyed control hair

<u>Bleach/dyed hair – shampoo alone as per direction (i.e. generous dosage)</u>

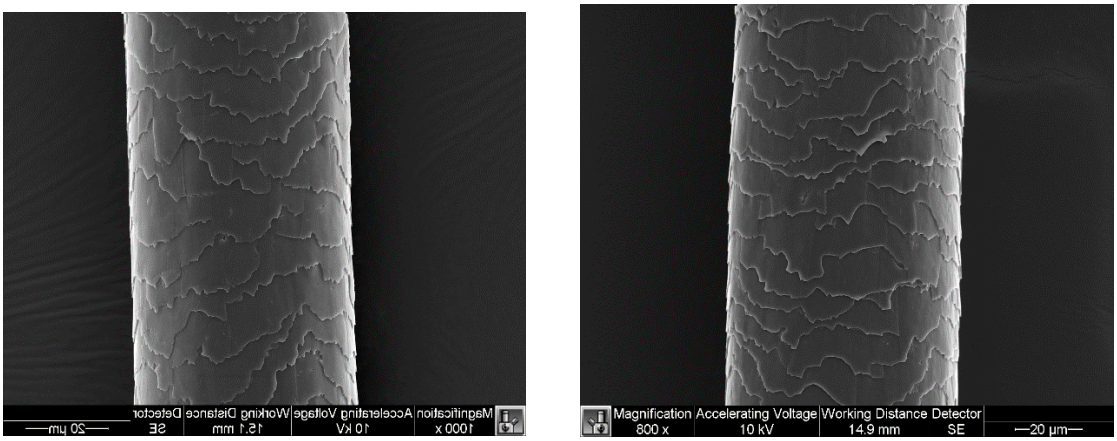
Figures 19a and b show surface images that are considered representative of bleach/dyed hair repeatedly washed with the “generous” dosage of Monat Intense Repair Shampoo. As described above, the hair surface still looks in relatively good shape – with seemingly only a slight increase in surface irregularity due to the chemical treatments.



Figures 19 a and b. Representative SEM images for bleach/dyed hair repeatedly washed with shampoo (existing directions)

Bleach/dyed hair – shampoo alone per modified direction (i.e. lesser dosage)

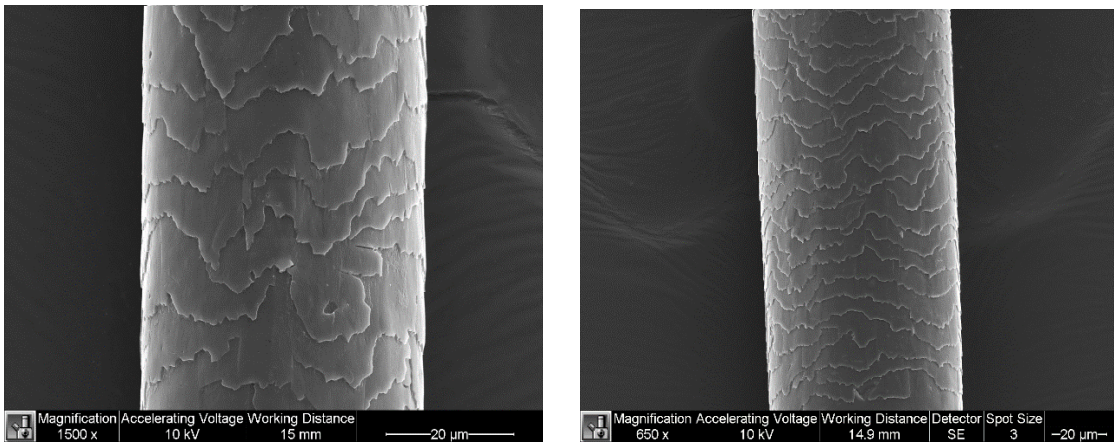
Figures 20a and b show surface images that are considered representative of bleach/dyed hair repeatedly washed with the lesser dosage of Monat Intense Repair Shampoo. In agreement with above comments, certain fibers possess slightly increased surface damage – but effects are still relatively mild.



Figures 20 a and b. Representative SEM images for bleach/dyed hair repeatedly washed with shampoo (modified directions)

Bleach/dyed hair – shampoo and conditioner as per direction (i.e. generous dosage)

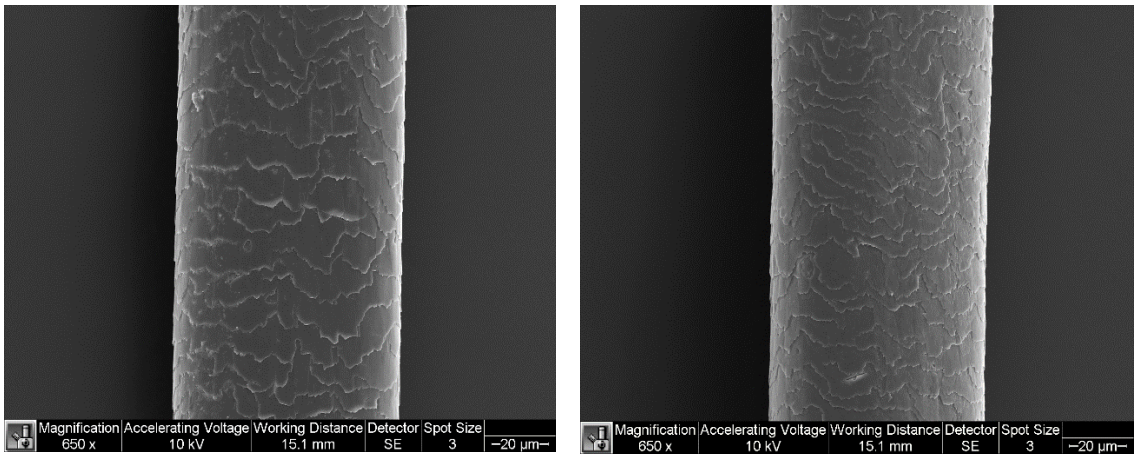
Figures 21a and b show surface images that are considered representative of bleach/dyed hair repeatedly washed with the “generous” dosage of Monat Intense Repair Shampoo followed by Monat Intense Repair Conditioner. As described above, certain fibers show mildly more-irregular cuticle structure; while others still look mostly in-tact.



Figures 21 a and b. Representative SEM images for bleach/dyed hair repeatedly washed with shampoo and conditioner (existing directions)

Bleach/dyed hair – shampoo and conditioner modified direction (i.e. lesser dosage)

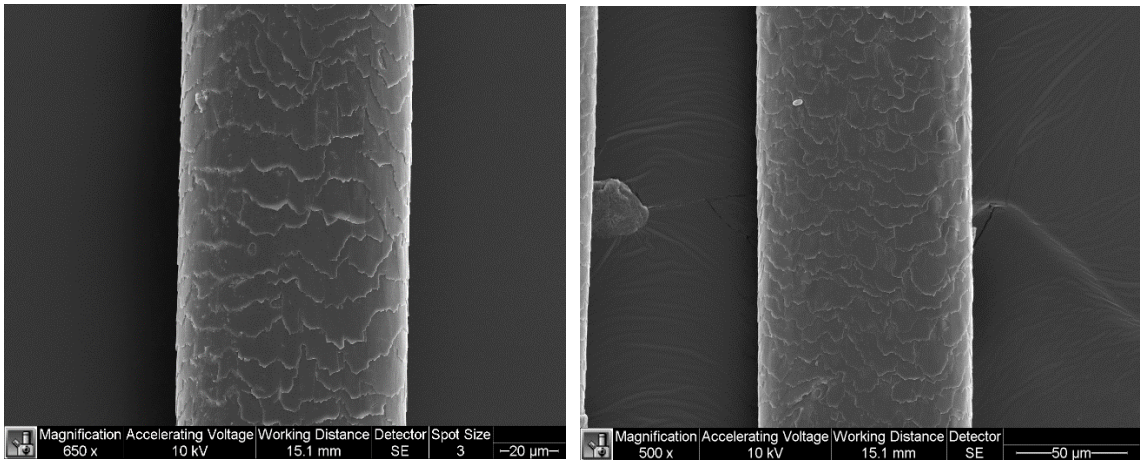
Figures 22a and b show surface images that are considered representative of bleach/dyed hair repeatedly washed with the lesser dosage of Monat Intense Repair Shampoo followed by Monat Intense Repair Conditioner. A similar hair surface state is observed.

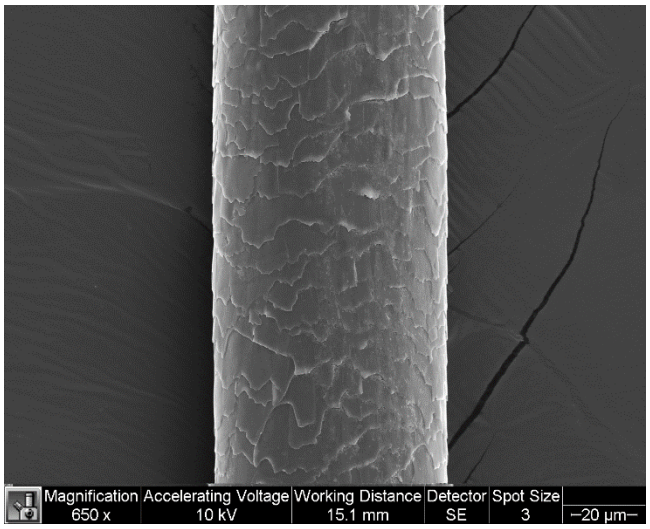


Figures 22 a and b. Representative SEM images for bleach/dyed hair repeatedly washed with shampoo and conditioner (modified directions)

Bleach/dyed hair – shampoo, conditioner and heat straightening as per direction (i.e. generous dosage)

Figures 23a, b and c show surface images that are considered representative of bleach/dyed hair repeatedly washed with the “generous” dosage of Monat Intense Repair Shampoo followed by Monat Intense Repair Conditioner and heat straightening.



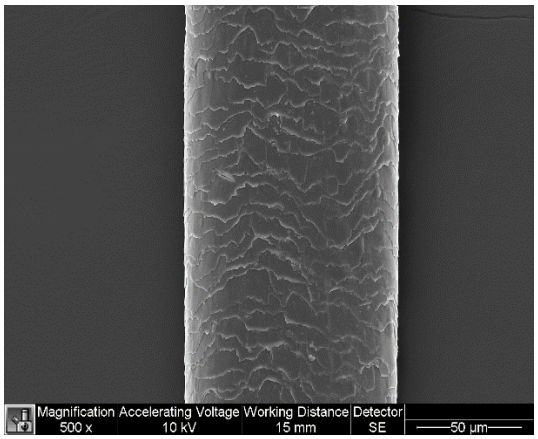


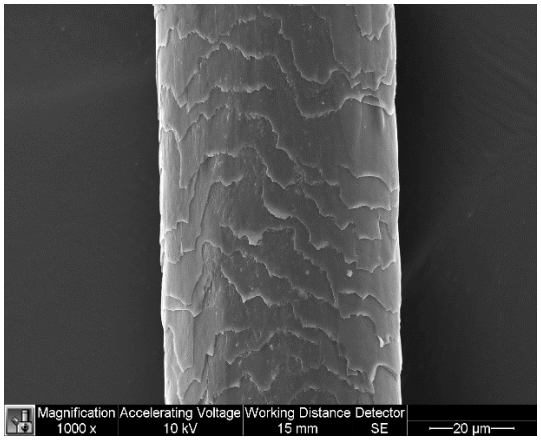
Figures 23 a, b and c. Representative SEM images for bleach/dyed hair repeatedly treated with shampoo, conditioner and heat straightening (existing directions)

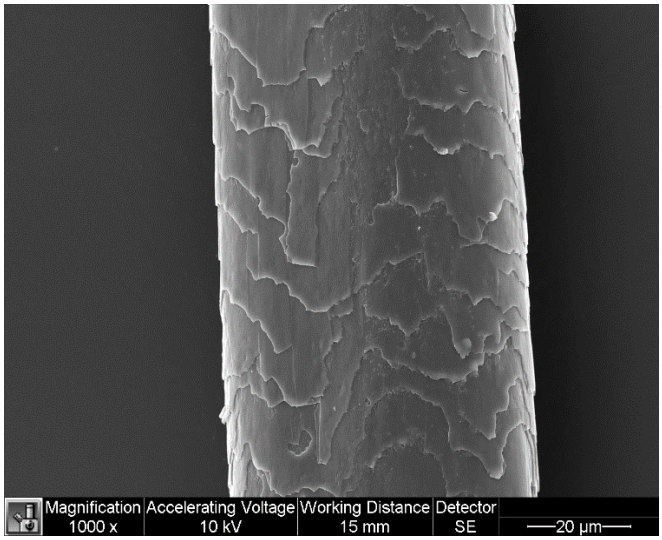
The combined effects of two chemical treatments and high heat results in further stimuli for wear at the surface. The cuticle structure appears more irregular and worn. Again signs of bubble hair are apparent.

<u>Bleach/dyed hair – shampoo, conditioner and heat straightening modified direction (i.e. lesser dosage)</u>

Figures 24a, b and c show surface images that are considered representative of bleach/dyed hair repeatedly washed with the lesser dosage of Monat Intense Repair Shampoo followed by Monat Intense Repair Conditioner and heat straightening.







Figures 24 a, b and c. Representative SEM images for bleach/dyed hair repeatedly treated with shampoo, conditioner and heat straightening (modified directions)

Again, the combined effects of the chemical and heat treatments lead to higher levels of surface damage. Increasing incidence of cuticle uplift and irregularity are observed. Figure 24c appears to show a portion of the surface where the cuticle has been completely worn away.

Summary of SEM Work

The images shown herein demonstrate how the outer cuticle structure of hair can become compromised by known damaging treatments and procedures (i.e. chemical treatments and heat styling).

Yet, at the same time, there are no signs of any surface damage effects resulting from repeated shampooing or conditioning. In fact, it is suggested that conditioning helps retard surface damage by reducing abrasion-related wear and tear. There are also no indications of any changes associated with shampoo dosages.

Overall Summary

Shampoos and conditioners have been around in their current forms for many decades. While formulas may change slightly, they are all essentially based on the same groups of ingredients that have been heavily utilized and tested throughout the years with no adverse effects on hair. Shampoos are formulated to yield a functionality that cleans oils and dirt and other soils from the hair surface. Similarly, conditioners deposit aesthetically-pleasing lubricious materials onto the same surface to improve manageability and tactile properties. The size

of the active molecules in these products makes it difficult to conceive of penetration into the inner portions of the hair shaft which support the tensile properties (strength). Conversely, the active molecules in chemical treatments (perms, bleaches, relaxers, permanent color, etc.) are small enough to penetrate and react with the hair protein to compromise this structure. This occurrence is well-recognized and well-studied in the hair field – yet the vast scientific literature in this area shows no such evidence for any adverse effects from traditional rinse-off products (shampoos, conditioners).

The results shown herein are in line with these viewpoints. Results show how tensile properties, manageability and cuticle integrity are all negatively impacted by bleaching and dying. The high heat and friction/abrasion associated with heat styling has similar effects. But no such effects are obtained after repeated washing with Monet Intense Repair Shampoo and Conditioner. There are no indications of reduced tensile strength, manageability issues or compromised surface (cuticle) structure. Instead, Monat Repair Treatment Conditioner is seen to hugely facilitate manageability, mask chemical and heat related negatives and help protect against frictional/abrasional wear and tear.

APPENDIX

Standard Bleaching Protocol

Hair tresses were bleached using a 9% hydrogen peroxide solution at pH of 10.2. The tresses were left in contact with the bleach solution for 20 minutes under controlled temperature conditions (40°C). At the end of this process, tresses were thoroughly rinsed under an intelli-faucet set at 40°C with a controlled flow rate of 1.0 GPM.

Dying Procedure:

Bleached hair tresses were subsequently dyed using L'Oréal Preference Natural Blonde permanent hair dye (shade 9N). The color (dye) and developer packages were mixed until uniform. 10 grams of this mix were applied to each tress (5g on each side) and manipulated thoroughly through the tress using a stylist brush. Tresses were placed on large hot plate maintained at 27°C. The hair was processed for 25 minutes before thoroughly rinsing the dye from the hair (again using intelli-faucet set at 40ºC and 1.0 gpm). Tresses were left to air dry overnight prior to further treatment with the supplied products.

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