

Strengthening the Cortex of Chemically Damaged Hair from Within



Introduction

Advancements in hair reactive chemistry has enabled consumers to easily change their hair color and geometry. This, in addition to grooming, styling and weathering, results in many different types of damaging effects within the hair structure. This damage becomes visible on the surface of hair with loss of shine and the manifestation of split ends along with the tactile properties with loss of smoothness and entanglement. Additionally, modifications in hair behavior become apparent such as hair alignment, combing stress, hair breakage and hair color retention reflecting both protein structure changes and surface damage. Therefore, a comprehensive approach to addressing damaged hair is to strengthen the hair fiber and modify the surface properties of hair.

FiberHance™ bm solution (hydroxypropylgluconamide (and) hydroxypropylammonium gluconate is a new patented chemistry to be included in the arsenal of ingredients for hair strengthening, evolving from glucose based chemistry and has a unique multifaceted mode of action which penetrates deep into the cortex to create new hydrogen and ionic bonds which support the damaged internal keratin structure and strengthen and provide manageability back to the hair

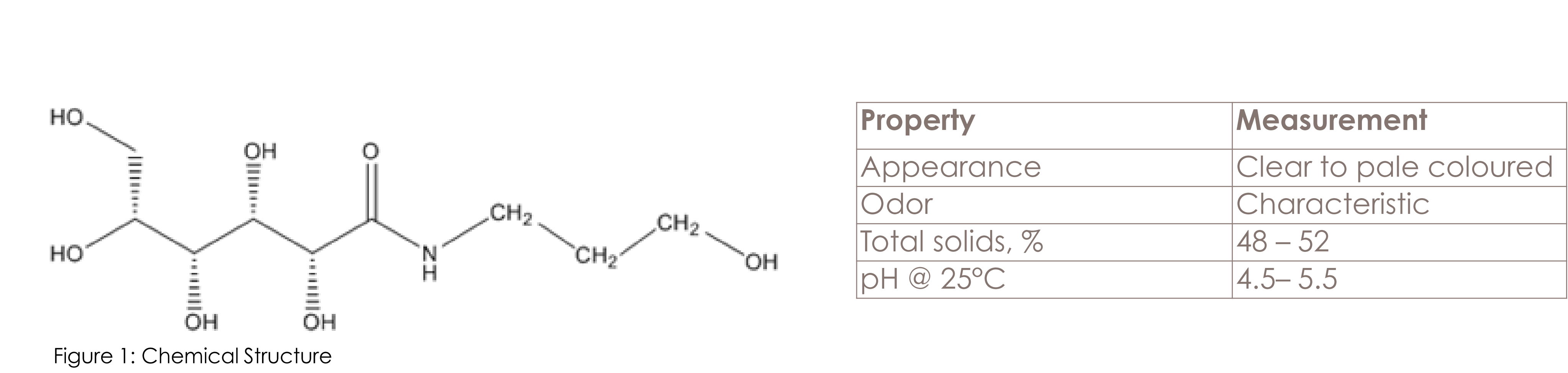


Figure 1: Chemical Structure

INCI: Hydroxypropylgluconamide and Hydroxypropylammonium Gluconate
Trade name: FiberHance™ bm solution

Key Features and Benefits

Features	Benefits
New to the world, patented sugar-based ingredient designed to strengthen the internal hair structure.	Strengthens internal hair structure up to 3X that of untreated hair.
Works by creating additional hydrogen and ionic bonds within the hair keratin structure.	New multifunctional mechanism of action, optimized to interact at the molecular level.
Penetrates deep into the hair fiber to the cortex and restores hair fiber strength back to levels of virgin hair.	Very few technologies can claim inner strengthening functionality.
Cost effective.	Replaces higher cost alternatives.
Supplied as 50% aqueous solution.	Enables easy manufacturing
Good sustainability footprint.	Glucose origin
Works in hair color process systems.	Enters fast growing bond multiplier/builder segment in hair care.

Mode of Action

The α -helix protein structure in the hair fiber provides the strength to the hair. In weak hair the bonds are broken and missing. FiberHance™ BM solution is a small molecule in which the chemical structure and dimensions have been specifically designed to optimize multi-bond interactions within the hair keratin cortex and as such builds new bonds within and across the structure (dual mechanisms).

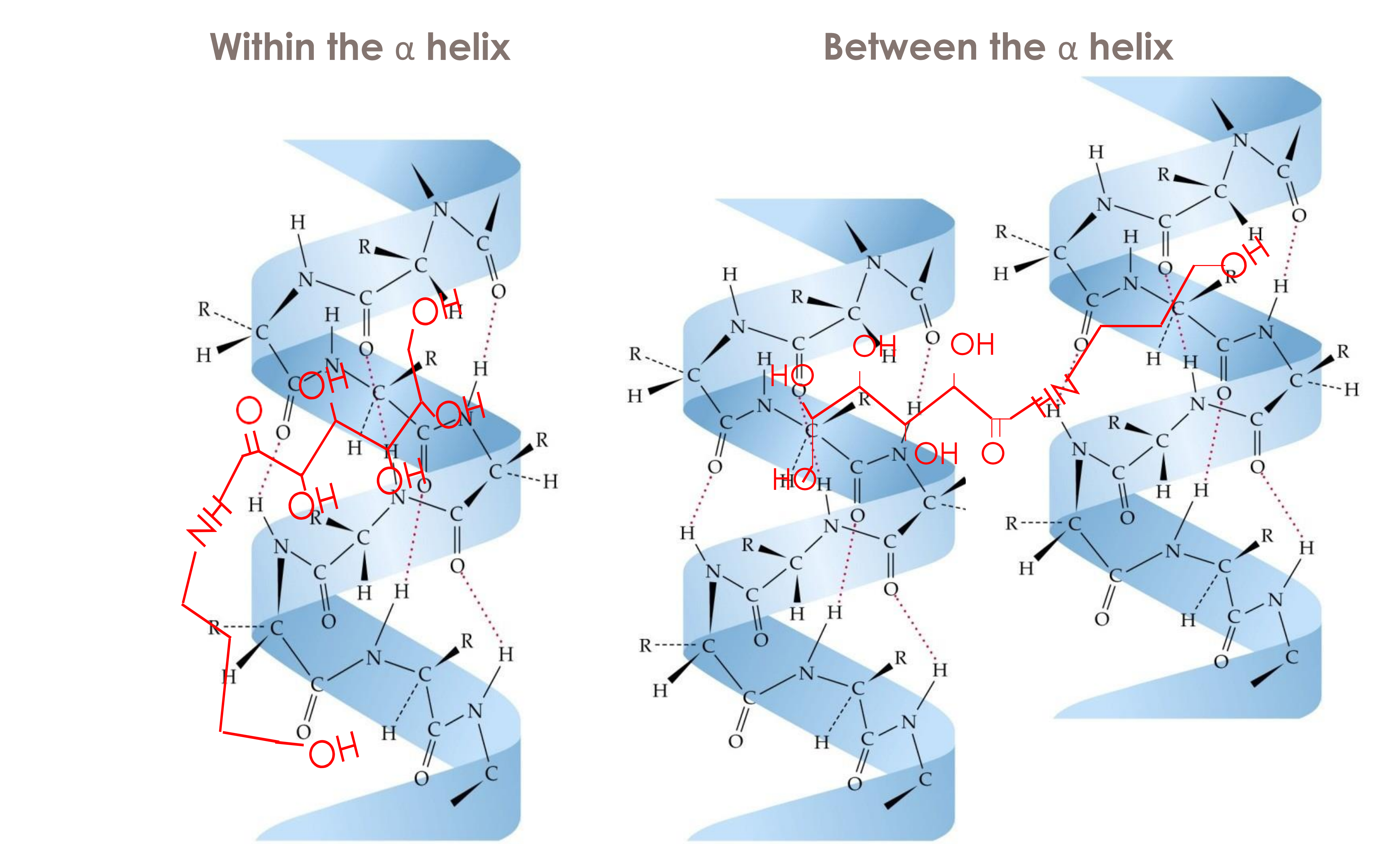


Figure 2: Proposed mechanism

FiberHance™ bm for measurable inner strengthening of hair in shampoos

Provides up to 3X strengthening of untreated hair across various degrees of damage and hair types

Changes in hair mechanical performance upon treatment were investigated by cyclic tensile fatigue measurements using a Cyclic CYC801 instrument purchased from Dia-stron Limited (Andover, UK). It had an automated hair loading sample (n=50) and also was fitted with a Fiber Dimensional Analysis System (FDAS 765model) that incorporates the Mitutoyo laser micrometer (LSM-500) to measure the hair diameter of each fiber. In figure 3, cyclic tensile fatigue results for hair with different damage levels (2x 1 hr. bleach and 3x 1hr bleach) with and without FiberHance™ application are summarized. In comparison to these samples, virgin untreated hair also was measured. For the FiberHance™ treated hair a significant increase of cycles to break - up to three times higher - was observed, as compared to the non FiberHance™ treated hair. Figure 4 shows the effect of FiberHance™ for hair of different ethnic groups – Afro, Caucasian and Chinese. For all three types of virgin hair ethnicities treated with FiberHance™ showed an increase in mechanical resistance of the hair.

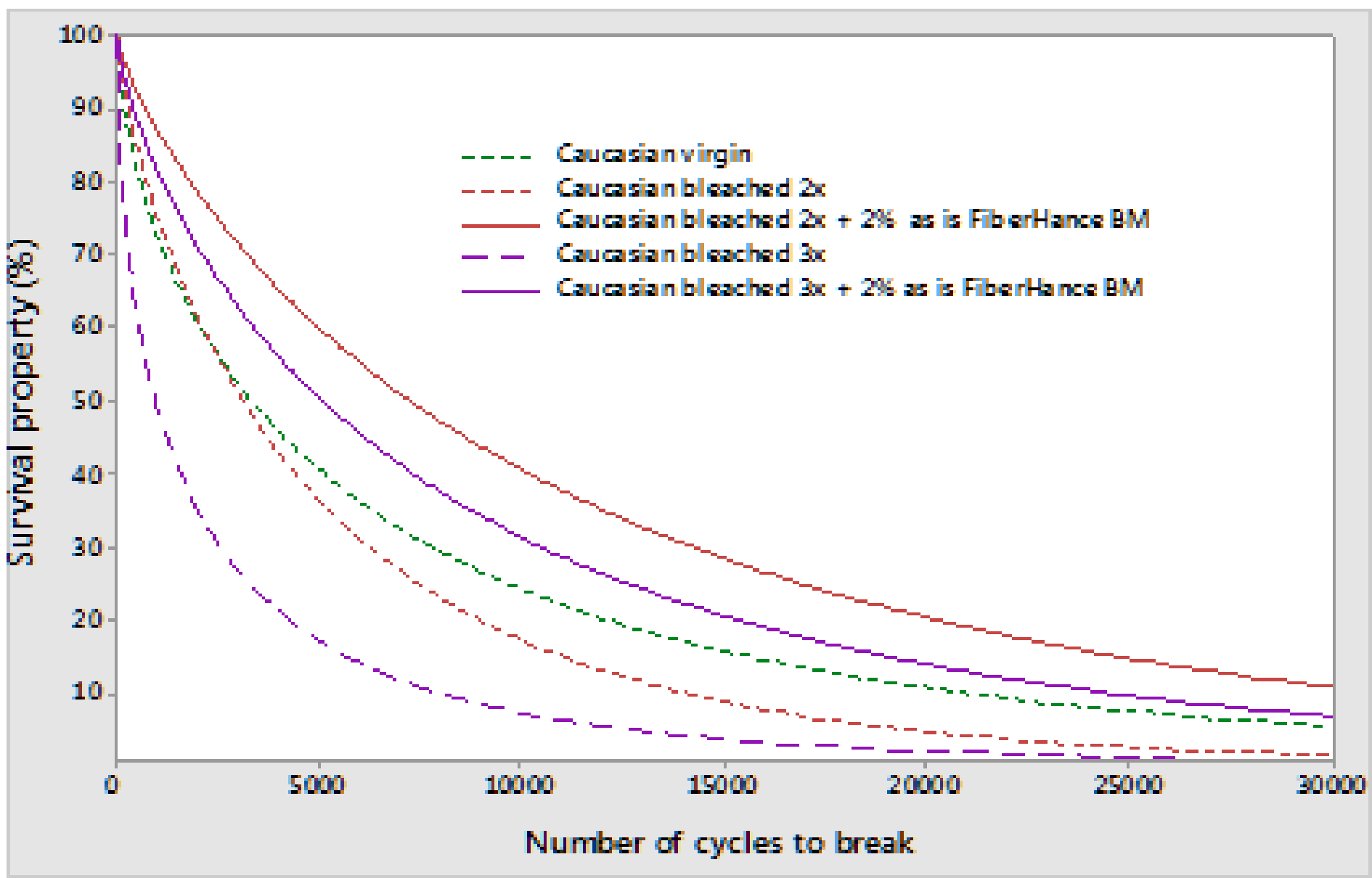


Figure 3: FiberHance™ provides up to 3x strengthening across various degrees of damaged hair

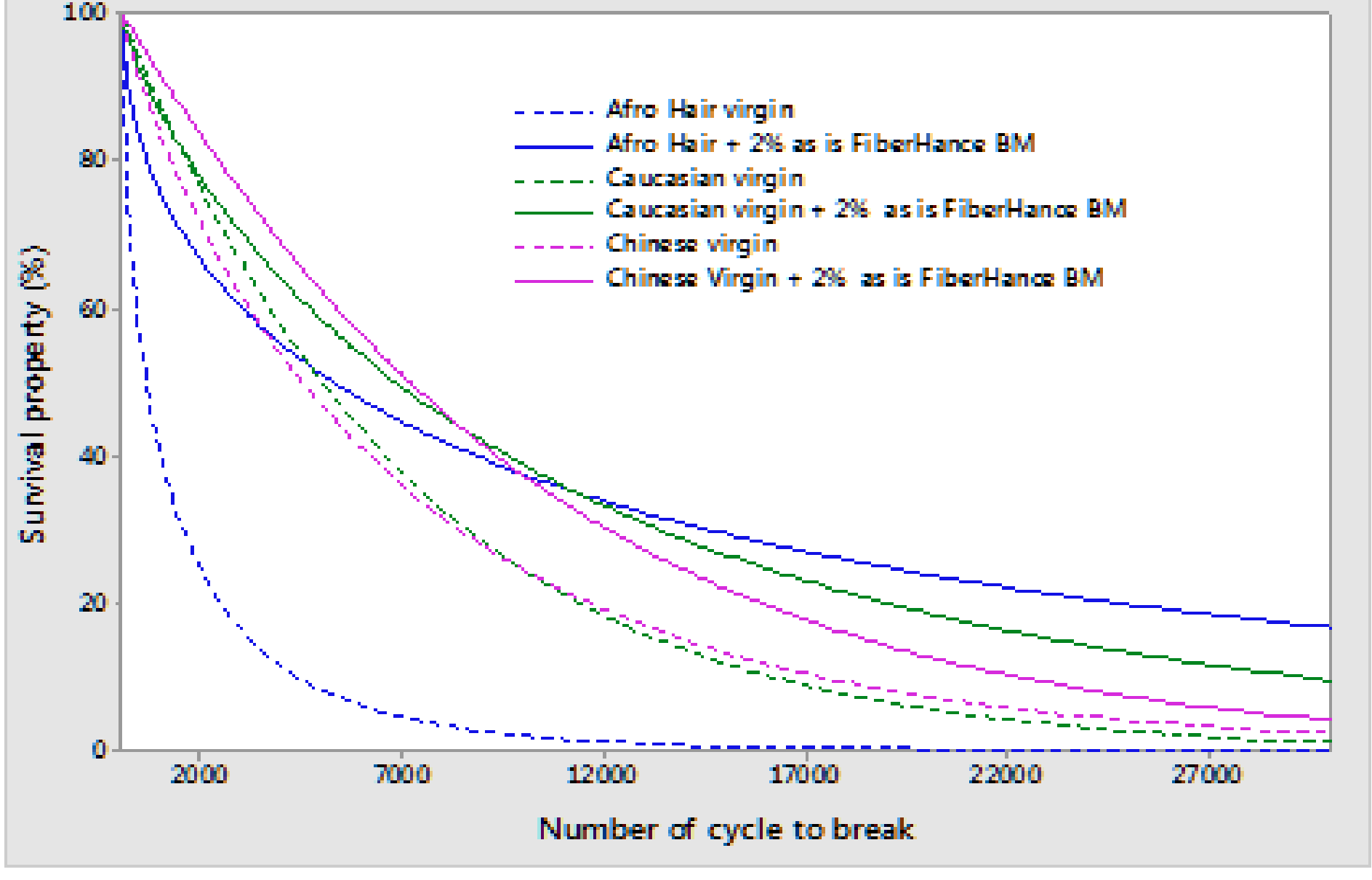
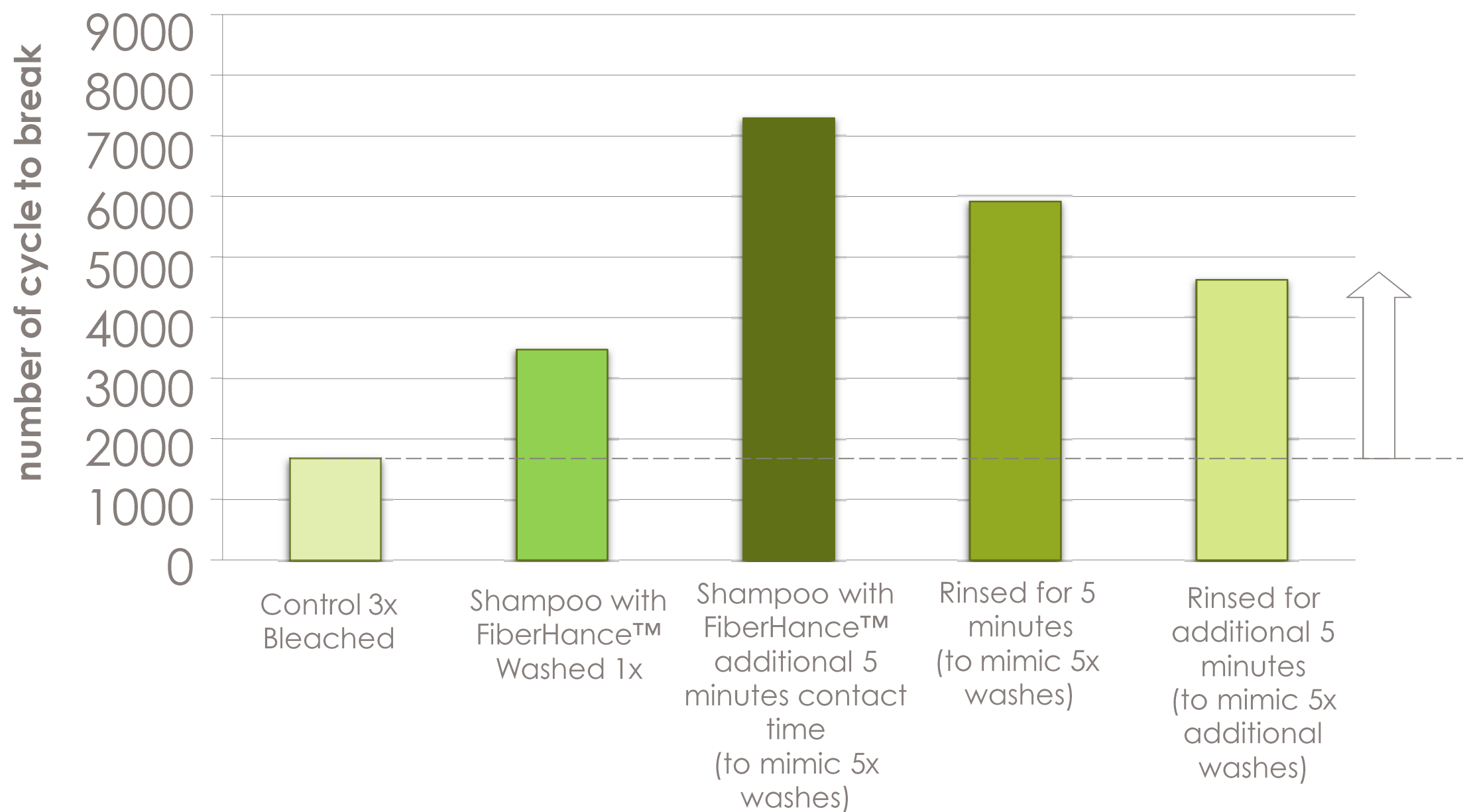


Figure 4: FiberHance™ solution provides >3X strengthening of untreated hair across different types of hair ethnicities

Figure 5: FiberHance™ shampoo formulations really work!
(When tested with a fully formulated shampoo ref Z351-18A)
Performance is maintained even after ceasing use



Confocal Raman (CR) Spectroscopic Imaging was carried out with a CR Microscope & Workstation from Kaiser Optical Systems, Inc. Figure 6 shows the loss of alpha-helix peak (1652 cm⁻¹) after 20 % and 40 % strain of virgin white hair, bleached white hair and bleached white hair treated with FiberHance™ at 1 % active in water for 30 minutes duration at pH 4 followed by rinsing. For the bleached white hair treated with FiberHance there was less of a loss of alpha-helix peak (1652 cm⁻¹) than untreated indicating that the treatment preserves the alpha-helix keratin structure.

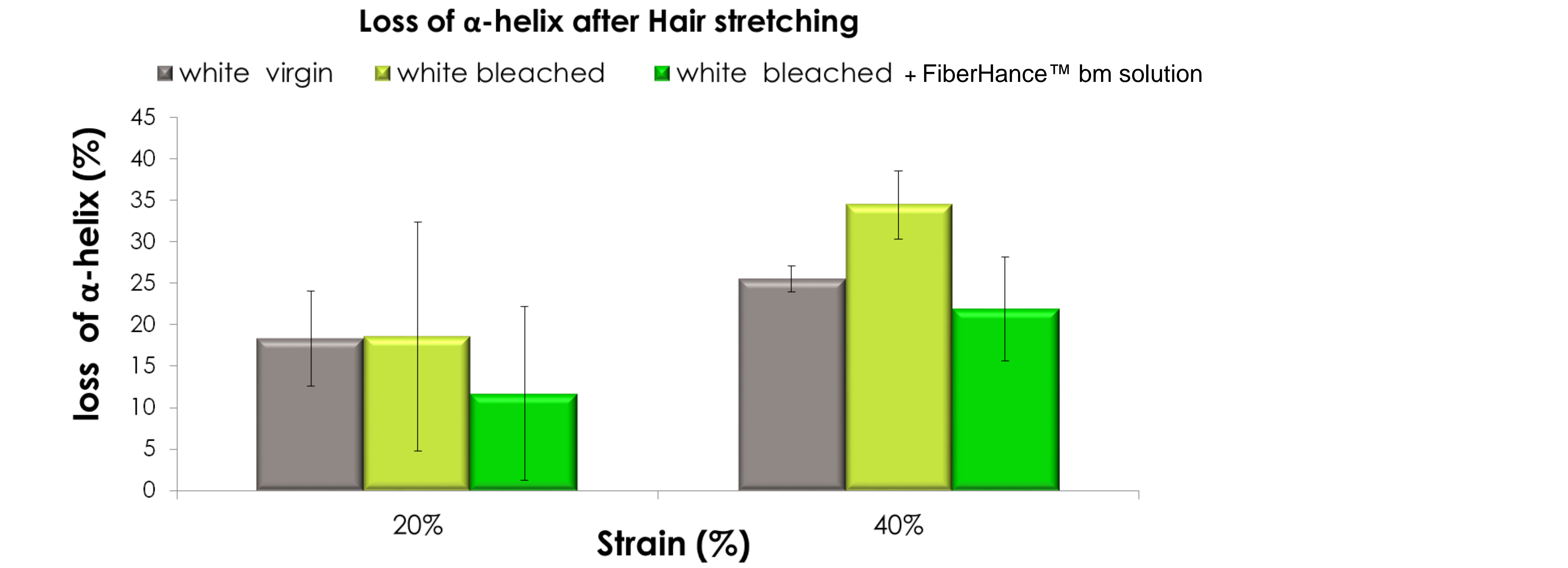


Figure 6: FiberHance™ bm treated bleached hair –preserves more α -Helix Keratin structure

Conclusion

Evaluation of FiberHance™ bm solution in treated hair versus untreated, via single fiber cyclic tensile fatigue testing, differential scanning calorimetry, FTIR spectroscopic imaging, and confocal raman imaging, demonstrated hair mechanical strengthening, increased Td and more alpha-helix structure permanently retained as a result of the treatment with FiberHance™ bm solution. FiberHance™ bm solution strengthens the internal hair fiber structure up to 3x that of untreated hair. It has demonstrated performance in shampoos and hair dye formulations.