TRI Princeton
RESEARCH EDUCATION SERVICE

# 3rd Multi-Ethnic
## Hair & Scalp Care Symposium
# 2023

## New Jersey, US

### 6th & 7th June 2023

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Increased market interest in textured (very curly) hair is creating a surge in new developments and product launches in the black hair care category. The 3rd Multi-Ethnic Hair and Scalp Care Symposium 2023 will focus on the hair and scalp care needs of consumers with different hair types and from different parts of the world, with a particular emphasis on textured hair.

This 3rd symposium, following the 1st and 2nd in 2019 and 2020, will update attendees with the latest findings from leading, international research groups and companies. Keynote presentations from experts at TRI, will also share, for the first time, the results of the extensive Textured Hair Consortium Project, completed in 2021.

# Textured Hair Consortium Project 2019-2021: A Big Thank-You to Our Sponsors!

**The Textured Hair Consortium provided a deeper scientific understanding of key problems associated with curly hair textures and new technical routes to address unmet consumer needs.**

## All the Outputs From the Project

**REPORT 1** Effects Of Curl Type On Breakage Properties Of Non-chemically Treated Hair: Fatigue Studies

**REPORT 2** Effects Of Curl Type On Hair Fracture Patterns In Non-chemically Treated Hair

**REPORT 3** Effects Of Hair Curl Type On The Habits And Concerns Of Consumers With Non-chemically Treated Hair In The United States And South Africa

**REPORT 4** A Comparison Of Walker And L'Oréal Curl Typing Methods

**REPORT 5** Effects Hair Curl Type, Consumer Habits And Age On Scalp Lipids; Spectroscopy Studies

**REPORT 6** Effects Hair Curl Type And Consumer Habits On Scalp Condition

**REPORT 7** Textured Hair Friction Method Development For Claims Substantiation

**REPORT 8** Textured Hair Breakage Method Development For Claims Substantiation

**REPORT 9** A New Shine Method For Textured Hair

**REPORT 10** Textured Hair Curl Elongation Test Method Development For Claims Substantiation

**REPORT 11** Effects Of Hair Curl Type And Consumer Habits On Scalp Condition - Determination Of Inflammatory Markers, IL-1α And IL-1RA

**REPORT 12** Effects Of Hair Curl Type And Consumer Habits On Scalp Condition - Scalp Visualization And Analysis

**TRI Princeton is Very Grateful to the Industrial Sponsors for This Project Who Provided the Encouragement & Crucial Funding for This Work**

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# SYMPOSIUM

## Conference Agenda

All Times Eastern Standard Time

# INDEX

Tuesday, June 6th

# Session 1

## Scalp Health & Scalp Microbiome

# Tuesday, June 6th

## Session 1 - Scalp Health and Scalp Microbiome

**8:30a - 8:45a** Welcome & Introductory Remarks

8:45a - 9:30a

KEYNOTE **Changes In Scalp Condition with Curl Type & Wash Frequency**

Paul Cornwell, TRI Princeton New Jersey, USA

9:30a - 10:00a

**Most Common Hair & Scalp Disorders in Black Patients: Clinical, Trichoscopic & Treatment Studies**

Amy McMicheal, Wake Forest School of Medicine, NC

10:00a - 10:30a

**Scalp Microbiota Analysis to Elaborate a Solution to Treat Oily Scalp**

Sabrina Leoty-Okombi, BASF, Lyon, France

**30-Minute Break**

11:00a - 11:30a

KEYNOTE **Effects of Curl Type On Scalp Lipids & Proteins, FTIR Studies**

Samuel Gourion-Arsiquaud, TRI Princeton New Jersey, USA

11:30a - 12:00p

**The Role of the Microbiome in Scalp Health, Hair Follicle Biology, & Disease**

Kimberley Capone, NY

12:00p - 12:30p

**Introduction of Posters by Poster Presenters**

Tuesday, June 6th

# POSTERS

## Part 1

POSTER #1

## Human Hair Profile by Mass Spectroscopy: A Preliminary Study About Curvature & Age

Carla Scanavez 1, Daniela Zimbardi, Marcel Pratavieira, Mario Sergio Palma
1 - Natura Cosméticos S/A, Brazil

POSTER #2

## Evaluating the Efficacy of 3-Point Bending Test on Multi-Ethnic Hair Types

Xuzi Kang,
TRI Princeton, USA

POSTER #3

## Extraction & Analysis of Curly Fibre Image Features: A Proof-of-Concept Study

Gabriela Daniels1, Affan Hameed1, Danka Tamburic1, Sergio Benini2, Mattia Sarvardi2
1 - London School of Fashion, UK, 2 - University of Brescia, Italy

POSTER #4

## A Comparison of Walker & L'Oréal Curl Typing Methods

Paul Cornwell, Jennifer Van Wyk, Katerin Mateo
TRI Princeton, USA

POSTER #5

## Characterizing Hair Damage & Prevention Using IR Spectroscopy & Validating the Findings Via DSC

Anwar Zahar
Aveda, USA

POSTER #6

## Effects of Treatments on Textured Hair Porosity

Ayinoluwa Abegunde, Marquita Braxton, Leila Sorrells, Ernesta Malinauskyte
TRI Princeton, USA

Tuesday, June 6th

# Session 2

## Hair Types & Properties

## Session 2 - Hair Types & Properties

1:30p - 2:15p

KEYNOTE **Why Is Textured Hair So Fragile?**

Trefor Evans, TRI Princeton, USA

2:15p - 2:45p

**The Effect of Fibre Twist On the Fatigue Behaviour of High Curl Type Hair**

Rebecca Lunn, Dia-Stron Ltd, UK

2:45p - 3:15p

**Ethnic Hair & Scalp - A Comparative Study**

Ali & Maliha Syed, Avlon Industries

**30-Minute Break**

3:45p - 4:15p

**The Role of Matrix/Intermediate Filament Interactions on the Shape & Cosmetic Properties of Curly Hair**

Manuel Gamez-Garcia, USA

4:15p - 5:00p

**Introduction of Posters by Poster Presenters**

Part 2

5:00p - 7:00p

**Poster & Networking Session + Cocktail Reception**

Tuesday, June 6th

# POSTERS

## Part 2

POSTER #7

## Quantifying High Curl Hair via 360° Video Analysis

Nina Ninua, Mehdi Doumi,
L'Oréal, USA

POSTER #8

## The Koyld Hair Guide: A Joy Filled Guide to Fulfilling Your Koily Hair Dreams

Ayinoluwa Abegunde
TRI Princeton, USA

POSTER #9

## Textured Hair Engine – How Brands Can Use Customer Intelligence to Drive Innovation

Winifred Awa, Soraya Hausl
Carra Labs, UK

POSTER #10

## Textured Hair Engine – How Brands Can Use Customer Intelligence to Drive Innovation

Winifred Awa, Soraya Hausl Carra Labs, UK
Aveda, USA

POSTER #11

## Spring Into Action: A Vibrant Journey into the Bounce of Coiled Hair

Xuzi Kang,
TRI Princeton, USA

POSTER #12

## Hair Ageing & Subjective Wellbeing in Black Women (Age>59) with High Curl Type & Living In the UK

Gabriella Daniels, Young-Jin Hur, Ameerah Khadaroo,
Caroline Searing, Dion Terrelonge, Hannah Zeilig
London School of Fashion, UK

POSTER #13

## On the Map - Skin Actives for Scalp Care

Margaret Dwyer1, Emmanuel Martin1, Remo Campiche1, Samuel Gourion-Arsiquaud2, Matthieu Jomier3, Mélanie Waeckel1, Fabrice Guillemard1
1 - DSM Personal Care, 2- TRI Princeton, 3- Newtone Technologies

POSTER #14

## A New Tool to Human Hair In Vivo Damage Diagnosis & Product Recommendation

Carla Scanavez 1, Paula Oliveira 1, Gustavo Gomes 1, Lucas Prado 1, Vitor Paciello, Ana Carolina, Gustavo Cheles 2, Conrado Vitor 3 (Live)
1 - Natura Cosméticos S/A, Cajamar, São Paulo, Brazil
2 - Chelles & Hayashi Design, São Paulo, Brazil
3 - Pullup Soluções em Sistemas Eletrônicos, São Paulo, Brasil

POSTER #15

## Time to Get Vibrational Spectroscopy Out of the Laboratory & Start Using This Technique for Clinical Studies

Jessica Turner, Samuel Gourion-Arsiquaud
TRI Princeton, USA

Wednesday, June 7th

# Session 3

## Hair & Scalp Care Treatments

# Wednesday, June 7th

## Session 3 - Hair & Scalp Care Treatments

8:30a - 9:15a

KEYNOTE **Why Is Textured Hair So Fragile? (Part II)**

Trefor Evans, TRI Princeton, USA

9:15a - 9:45a

**Indian Hair Oil Market: Consumer Habits & Oil Benefits**

Pankuri Chandani, Dabur, India

9:45a - 10:15a

**Novel No-Lye Relaxer Formulation for Textured Hair Management**

Tosin Dania, BASF

**30-Minute Break**

10:45a - 11:15a

**Preliminary Investigation Into the Impact of Bleach On Curl Shape & Integrity**

Ronak Rughani, L'Oreal, USA

11:15a - 11:45a

**Clinical Evaluation of a Scalp Treatment Intended for Dry Scalp**

Zoe D Draelos, Dermatology Consulting Services PLLC, NC

**Lunch**

Wednesday, June 7th

# Session 4

## New Methods

## Session 4 - New Methods

1:15p - 2:00p

KEYNOTE **Methods for Substantiating Claims for Textured Hair Care Products**

Ernesta Malinauskyte and Leila Sorrells, TRI Princeton, USA

2:00p - 2:30p

**Overcoming the Challenges of Measuring the Attributes of Textured Hair**

Roger McMullen, Ashland, NJ

2:30p - 3:00p

**Understanding Scalp Skin With & Without Dandruff: An In-Vivo Raman Study**

Paul Pudney, Unilever, UK

3:00p - 3:30p

**Are Fatigue & Failure of Hair Influenced by Ethnicity? First Lessons From the Weibull Parameters**

Leila Berriche, Henkel, Germany

3:30p - 4:00p

**Developing New Quantitative Geometrical & Structural Mechanical Parameters to Better Classify Straight, Wavey, Curly, and Kinky Hair Phenotypes**

Michelle Gaines, Spelman College, USA

**End of Symposium Remarks**

# PRESENTER ABSTRACTS

## Podium Presentations

KEYNOTE

# Changes In Scalp Condition With Curl Type & Wash Frequency

**Samuel Gourion-Arsiquaud 1, Rezma Shrestha 1, Matthieu Jomier 2, Paul A. Cornwell 1**

1 - TRI Princeton, 601 Prospect Avenue, Princeton, NJ, 08540, USA
2 - Newtone Inc., 252 Nassau Street, Princeton, NJ 08542, USA

## ABSTRACT

Very curly, textured hair is often associated with scalp conditions, such as traction alopecia and seborrheic dermatitis. However, to date, no detailed healthy human volunteer studies have been performed that related scalp condition to curl type and hair habits. In this presentation new data from a large, two-country clinical study will be presented that shows that styling practices in Walker Type 4 hair are linked to higher levels of traction alopecia. Moreover, evidence will show that lower wash frequencies in Type 4 hair result in a higher degree of scalp irritation and scaling, and conversely, washing hair more frequently has the potential to improve scalp health.

Scalp images combined with advanced image analysis (AI) tools allows scalp scaling and scalp skin colour to be measured instrumentally. AI data will be shared that show that scalp scaling is elevated in panellists with Walker Type 4 hair. Furthermore, that scaling is associated with a darkening of the surrounding skin. Interestingly, AI data were more consistent than dermatologist assessments.

ELISA assays can be used to measure the levels of inflammatory cytokine in scalp sebum samples. Data will be shared to show that levels of IL-1a and IL-1RA correlated with changes in sebum levels, and with scalp inflammation.
Together, these data provide the first clear, broad picture of the effect of hair curl type and wash frequency on scalp condition in healthy volunteers. Scalp imaging, and assays of inflammatory markers present in scalp sebum, also show great promise in measuring changes in scalp health.

## Dr Paul Cornwell

**TRI PRINCETON, NEW JERSEY USA**

Paul is based in the UK. Paul's technical expertise is focussed on product evaluation, instrumental measurement techniques and on formulation design, particularly in cosmetic skin and hair care products. He has industrial experience in claim support testing, innovation and product development at Unilever and PZ Cussons.

Paul qualified as a pharmacist in 1989 and gained a PhD in Pharmaceutical Technology in 1993. For his PhD Paul worked with Professor Brian Barry at Bradford University on topical drug delivery and skin penetration enhancers. For his postdoctoral research he continued to work in skin delivery with Dr Joke Bouwstra and Dr Harry Bodde at Leiden University. Since then Paul has enjoyed a career in R&D in the cosmetics industry working at Unilever and PZ Cussons.

Over his career Paul has published many journal articles and presented at many scientific conferences. His publications have been cited in many academic papers. In industry, Paul has been involved in many successful product launches for major, international cosmetic brands such as Organics, Dove, Lux, Sunsilk, Carex, Original Source, Charles Worthington and Imperial Leather. He has contributed to several patent applications, at least four of which have gone to the full 'grant' stage.

# Most Common Hair & Scalp Disorders in Black Patients: Clinical, Trichoscopic & Treatment Studies

**Amy McMicheal, Wake Forest School of Medicine, NC**

## ABSTRACT

With recent breakthroughs in the science of hair loss, many new treatments are being tried for various forms of hair loss. In this lecture, the updates epidemiology of scalp and hair loss conditions affecting people of color (POC). Common disorders affecting POC include: seborrheic dermatitis, alopecia areata, traction alopecia, central centrifugal alopecia, and hair breakage. The appropriate clinical evaluation of alopecia patients, the appropriate complementary studies, as well as the updates on diagnostic techniques for the most common scarring and non-scarring forms of hair loss will be reviewed.

## Amy McMicheal, MD, FAAD

**WAKE FOREST SCHOOL OF MEDICINE, NC**

Dr. Amy McMichael is a Philadelphia native who received her medical degree from the University of Pennsylvania School of Medicine. She completed Internship at Thomas Jefferson University Hospital in Philadelphia and her Dermatology residency training at the University of Michigan School of Medicine.

Dr. McMichael is a Professor in the Department of Dermatology at Wake Forest School of Medicine in Winston-Salem, NC. She has held leadership positions in the Department for over 20 years first as Residency Program Director for 12 years and Chair of the Department for 11 years. She stepped down from the Chair position September 2022 in order to pursue her other interests including clinical medicine, research, and mentorship. She has been a leader in her field, including her roles as past President of Skin of Color Society as well as past President of the National Medical Association Dermatology Section. She has also served as Vice President of the Womens Dermatologic Society and Secretary/Treasurer of the North American Alopecia Research Society. She currently serves as a Board member of the American Academy of Dermatology. She has mentored countless students, residents, and junior faculty over the years.

Dr. McMichael's clinical and research interests include: hair and scalp disorders, psoriasis, and skin of color. She is co-editor of several texts including Hair Diseases: Medical, Surgical, and Cosmetic Treatments and Fitzpatrick's Dermatology 9th edition. She serves on the editorial boards of JAMA Derm, Cosmetic Dermatology, Skin Appendages, and The Dermatologist, and is the author of numerous journal articles and chapters.

# Scalp Microbiota Analysis to Elaborate a Solution to Treat Oily Scalp

**Sabrina Leoty-Okombi 1; Allison Guinta 2; Nicolas Stefano Del Bene 2; George Kritikos 3; Valérie Andre-Frei 1**

1- BASF Beauty Care Solutions France, 32 rue Saint Jean de Dieu, 69366 Lyon, France
2- BASF Corporation 540 White Plains Road, 10591-9005 Tarrytown, United States
3- BASF SE, 67056 Ludwigshafen, Germ

## ABSTRACT

A comprehensive study-based DNA sequencing analysis was conducted to observe the composition of the microbiota in normal (non-oily) and oily scalp as well as the differences which can exist.

In both groups, we observed common scalp microorganism like Cutibacterium acnes, Staphylococcus epidermidis, Malassezia restricta and globosa.

In normal scalp, we observed a higher diversity in some aerobic commensal bacteria producing antimicrobial peptides. Some gram+ facultative anaerobe known to produce antioxidant enzyme were also observed. These bacteria seem to be less lipophilic, likely due to the lower sebum levels on normal scalp. Volunteers with oily scalp had a high abundance of lipophilic and anaerobic bacteria, which are hypothesized to be thriving off the sebum rich scalp.

This study helped us to develop a global solution for oily scalp to recover a healthy scalp.

## Dr Sabrina Leoty-Okombi

**BASF, LYON, FRANCE**

Dr Sabrina Leoty-Okombi is a R&D project Leader in BASF Beauty Care Solutions based in Lyon, France. She has a background of Pharmacist, completed by a PhD in medicinal chemistry. She works in BASF Beauty Care Solutions R&D team to develop active ingredients. Since 2016 she has been coordinating activities of an innovation platform on skin microbiota and has been a featured speaker at industry and research events dedicated to skin microbiota.

# Effects of Curl Type On Scalp Lipids & Proteins, FTIR Studies

KEYNOTE

**Samuel Gourion-Arsiquaud 1, Rezma Shrestha 1, Paul A. Cornwell 1**

1 - TRI Princeton, 601 Prospect Avenue, Princeton, NJ, 08540, USA

## ABSTRACT

Common scalp flaking disorders, such as dandruff (DD) and seborrheic dermatitis (SD) are correlated with heightened sebaceous gland activity. It is well known, for example, that peaks in scalp sebum levels at birth and at puberty are associated with high levels of DD and SD. In this presentation we will investigate the effects of hair curl type and hair habits on scalp lipid levels and composition, and how these might relate to scalp condition.

Data will be presented that were collected during a large health human volunteer study, carried-out in South Africa and the US. In this study scalp sebum lipids were analysed using an infra-red spectrometer attached to an optical probe, allowing FTIR measurements to be made in a clinical setting.

Results will be shared to show that age is an intrinsic factor that drives scalp sebum levels and composition. Sebum and free fatty acid levels were lower in older panellists. These differences were sustained, even after a week of repeated hair washing, confirming this was a true intrinsic factor. Data will also be presented to show that sebum levels are higher in panellists with lower regular hair wash frequencies, particularly panellists with Walker Type 4 hair. Differences in sebum levels across hair curl types disappeared after a week of repeated hair washing across all panellists.

Together these findings will start to untangle the intrinsic and extrinsic factors affecting scalp sebum levels and composition. In this presentation, it will be argued, there are two opposing factors; age driving the sebum levels down and lower wash frequencies driving the levels up. Ethnic differences do not seem to be a major factor. These findings provide evidence that that increased scalp scaling and inflammation in panellists with Type 4 hair may, indeed, be related to higher sebum levels and to washing habits.

## Dr Samuel Gourion-Arsiquaud

**TRI PRINCETON, NEW JERSEY USA**

Dr. Gourion-Arsiquaud is the molecular and structural analysis expert at TRI. He uses various spectroscopic and microscopic techniques for the characterization of biomaterials and the study of biological modifications associated with specific conditions like treatment, drug use, disease, age or environmental factors.

Dr. Gourion-Arsiquaud's expertise lies in multiple biophysical techniques with a special emphasis on vibrational spectroscopies (FTIR & Raman) for bio-material sciences. He has more than 10 years of research experience, including technique development, project design and coordination, as well as a successful track record of achievements. Over the years, Dr. Gourion-Arsiquaud extended the application of its biophysical techniques, to diverse biological tissues; Bone, teeth, nail, hair and skin.

Dr. Gourion-Arsiquaud received a doctorate in Biochemistry with a specialization in Biophysics from the University of the Mediterranean (France) in 2005. He began his career at the Hospital for Special Surgery (HSS)/Weill Cornell Medical College studying the mechanisms of biomineralization via analyses of the mineral and matrix properties in mineralized tissue (bone, teeth). Aftre as associate researcher, Dr. Gourion-Arsiquaud has been examining the structural and functional analysis of Lipid/Protein interactions involved in the host - defense mechanism at Rutgers University.

Since he joined TRI in 2011 Dr. Gourion-Arsiquaud developed innovative tests, research areas and product evaluations relevant to cosmetic sciences, material analysis and medical applications; from technology development to product design and performance evaluation on hair, nail and skin care products. He also developed several long-standing external collaboration with academic leaders at local universities (Cornell, HSS, Rutgers, Columbia, University of Pittsburg).

Dr. Gourion-Arsiquaud was promoted to Director Skin & BioSubstrates in May 2017 to reflect his developing stature as leader of this important growing Cosmetic Business within TRI.

# The Role of the Microbiome in Scalp Health, Hair Follicle Biology, & Disease

**Dr Kimberley Capone**

## ABSTRACT

The cutaneous immune system is in constant interaction with the microbiome in healthy skin, where hair follicles provide unique anatomical niches. Human hair follicles are colonized by complex microbial communities that differ from the skin surface microbiota and serve as a reservoir to repopulate the skin surface after disruption. Within the first few days of life, infants often present with a rash called erythema toxicum neonatorum that manifests around hair follicles on the face, trunk, arms, and legs. This rash is hypothesized to be a result of exposure to microbiota triggering an immune response in and around hair follicles. This may represent an important initial stage in skin and hair follicle colonization and immune system development. The immunology of the hair follicle is such that there are immune-enhanced compartments adjacent to immune-privileged sites that are critical for hair follicle cycling and regeneration. This suggests a structure with an immune system that must carefully control colonization compartmentally as microbiota may enhance inflammation in an otherwise immune-privileged area, leading to hair cycle dysregulation. Current understanding of the scalp and scalp hair follicle microbiomes and implications for scalp health and disease will be discussed.

## Dr Kimberley Capone

**NY**

Kimberly Capone is a pioneer and established expert in microbiology, immunology and the human microbiome field where she created new business opportunities across multiple brands over 13 years at Johnson & Johnson Consumer, Inc. Areas of concentration included infant and adult skin, vaginal, gut, and oral health. She is an expert in skin health and development, having designed and directed numerous clinical trials, both fundamental and applied, in the investigation of novel aspects of skin health, skin care technologies and formulations. Dr. Capone is adept at translating science into products and claims and linking clinical and consumer insights for breakthrough product propositions. She also served as Chief Scientific Officer for FemTec Health, Inc. and led the Research & Development team in the creation and advancement of the scientific strategy to address women's health. Under her leadership, the R&D team was responsible for all product development including novel probiotics, dietary supplements, and skin and personal care solutions to address women's health and wellness needs. Dr. Capone is currently Principal Consultant with Capone Consulting Group, where she provides strategic advisory services for the consumer and healthcare sectors.
Dr. Capone received her B.S. in Biology from Northeastern University in Boston, MA, and her Ph.D. in Microbiology and Immunology from Northwestern University in Chicago, IL.

Dr. Capone has authored numerous peer-reviewed journal articles, is a co-inventor on several patents, and has been an invited speaker at many national and international microbiome, dermatology, and pediatric conferences.

# Why Is Textured Hair So Fragile?

KEYNOTE

**Trefor Evans 1**

1 - TRI Princeton, 601 Prospect Avenue, Princeton, NJ, 08540, USA

## ABSTRACT

In 2012, a paper by Bryant and coworkers1, listed breakage as the single biggest hair-related issue for women of African descent. Over the years, I've heard many, often quite complex, theories being put forth as potential explanations for this occurrence; but, during the past decade, the relatively new single fiber fatigue testing approach has yielded a simple, logical and, in retrospect, even a rather instinctive explanation2. The first half of this presentation will review this measurement technique and the explanations it invokes. That is, solutions to a problem cannot be identified until the root cause(s) is/are understood.
One part of TRI's recent Textured Hair Consortium project saught to further adapt this insightful new technique to hair of differing curl strength. Specifically, as part of this work, we procured and tested hair from over 50 different panelists who lived in New Jersey, USA and Cape Town, South Africa. All collected samples were "typed" using both the L'Oreal and Andre Walker curl scales. The second half of the presentation will discuss findings – where some beliefs and ideas were further reinforced; but other unforeseen occurrences were also discovered that have the potential to radically alter some well-established hair dogmas (irrespective of hair type).

Notwithstanding, outcomes do suggest strategies by which underlying causes might be mitigated – which will also be discussed. But, on top of this, perhaps the biggest finding from this work was that the topic of hair breakage appears to be substantially much more complex than previously conceived. These ideas will be further explored in a second presentation on Day 2.

1) Bryant, H., Porter, C., Diridollou, S., and Yang, G., Hair problems, Physical Characteristics and grooming practices based on ethnicity, J.Cosmet.Sci., 59, 182-183, (2008).

2) Why is African Hair so Fragile? Cosmetics & Toiletries, Vol. 135(6), 38-44, June 2020

## Dr Trefor Evans

**TRI PRINCETON, NEW JERSEY USA**

Dr. Trefor Evans has worked in the Hair Care industry for over 30 years. The first half of his career was spent as a scientist and manager in the product development labs of large consumer goods companies (Unilever, Helene Curtis). Since joining TRI in 2007 he has held the roles Director of Measurement Services and Director of Research and now has the title Institute Fellow.

Dr. Evans is highly active in the hair care industry through many working relationships with companies of every shape, size and background. He is a regular presenter at International hair conferences and has been an invited speaker at many technical meetings and symposia worldwide. Additionally, he has served as Chairman for the past five iterations of the International Conference on Applied Hair Science. He has published numerous articles in the scientific literature and trade magazines and is co-author and co-editor of the book "Practical Modern Hair Science". He writes a regular column on hair testing and hair science for Cosmetics and Toiletries magazine and serves on their Scientific Advisory Board. Dr Evans possesses a Ph.D. in the area of physical analytical chemistry and has spent his career using instrumental testing approaches to support the development, launch and maintenance of many international cosmetics products and brands. Such approaches also continue to be at the heart of fundamental research programs that have resulted in seven patents and have thrice been awarded by the Society of Cosmetic Chemists.

He regularly teaches and facilitates training classes on the topics of hair science and hair product claims which have been held in the US, Europe and Asia. He also teaches a customizable 1-man, 1-day course that has been conducted on-site at numerous client companies. He guest-lectures on Hair Science and the Hair Care Industry for a variety of academic cosmetic programs and has instructed at various educational events organized by the Society of Cosmetic Chemists (SCC). He has previously served on the SCC's Education Committee and currently sits on their Committee on Scientific Affairs.

He is also an Adjunct Professor at the University of Cincinnati and is Editor-in-Chief for the Journal of Cosmetic Science.

# The Effect of Fibre Twist On the Fatigue Behaviour of High Curl Type Hair

**Rebecca Lunn, Thomas Davies**

## ABSTRACT

Breakage is a major concern for consumers particularly for those with high curl type hair. Hair which is highly curled or crimped has an elliptical cross-sectional shape. The combination of this fibre shape and extensive grooming practises leads to hair breakage which is undesirable to the consumer. Higher curled type hair often has a lower break stress and strain than fibres than other hair types. Premature breakage of higher curl type fibres, occurring exclusively in the dry state at extensions often of less than 20%, is attributed to the inherent structural flaws in the twist of the fibre or flaws produced by grooming procedures. It has been proposed that some internal crack propagation develops within the fibres which results in fibre failure.

This presentation will discuss the how geometrical twist and styling procedures which bend and twist the hair can influence fibre breakage via fatigue testing.

## Rebecca Lunn

**DIA-STRON LTD, UK**

Rebecca studied a B.Sc. in chemistry at Cardiff University. She stayed on to complete her PhD in applied inorganic chemistry. In 2007 she started her career as a Research Scientist in the biopolymers synthesis team at Croda. After a year she moved to the role of Lead Applications Scientist within the hair care applications team working on claims substantiation. In 2016, Rebecca took on the position of Senior Hair Research Specialist in the Global Hair care centre at Lonza before joining Dia-Stron in 2018. She is currently the Head of Applications, responsible for further developing the knowledge of hair and other non-hair fibre applications within Dia-Stron in addition to over-seeing their in-house contract testing services. She has an interest in understanding single fibre fatigue of hair fibres as well as increasing her knowledge on the use of natural fibres within composite materials.

# Ethnic Hair and Scalp - A Comparative Study

**Ali N. Syed, Maliha Syed**

Avlon Industries, Inc.

## ABSTRACT

Curly hair, encompassing wavy, curly, and coily hair under its umbrella, is impressively different than straight hair in structure and properties. In this work, the physical properties of curly and coily (Type 3 and Type 4) hair were comprehensively compared with those of straight (Type 1) hair. The authors establish an objective methodology to characterize the degree of curl in the hair. Then, using this methodology, hair samples with varying degree of curl were evaluated for porosity, ease of wet and dry combing, elasticity, fiber ellipticity, cleansing damage, and moisture content. Structure-property relationships were established to explain why properties incrementally change with increasing degree of curl.

Furthermore, the scalp associated with curly and coily hair was characterized using biometric techniques and compared with the scalp associated with straight hair. Specifically, the scalp's moisture content and transepidermal water loss (TEWL) were quantified and compared between African, Latinx, and Caucasian individuals. Cleansing damage was evaluated by studying the effect of various detergents on moisture loss and TEWL of the hair and the scalp.
The findings herein guide formulators on how to create effective products specific to each hair type (i.e. Type 1, Type 2, Type 3, and Type 4) and their associated scalp.

## Ali N. Syed

**AVLON INDUSTRIES, INC.**

Dr. Ali N Syed is an innovative entrepreneur of hair and skin care products, with several impressive letters following his name (BSc Honours, MSc, MBA, and PhD). Since 1984, Dr. Syed has served as the Founder and Master Chemist of Avlon and Salon Commodities, which manufacture hair care products under the brand names of Affirm, KeraCare, FiberGuard, Texture Release, Uberliss, and As I Am.

The study and research of curly and coily hair, and their associated scalp, has been Dr. Syed's lifelong passion, having over 40 years of experience as a formulator of ethnic hair care products. He has contributed to the literature regarding textured hair through 21 published magazine articles, 7 journal articles, and 3 book chapter publications. His approach to product development is science driven, holding over 45 patents for his technological advancements ranging from permanent straightening systems, maintenance and styling products for naturally curly and coily hair, smoothing systems for wavy hair, bond-building technology, to permanent, semi-permanent and temporary hair colors for all hair types.

## Mahliha Syed

**AVLON INDUSTRIES, INC.**

Dr. Maliha Syed is a research scientist, using her diverse background in chemistry, economics, and polymer science & engineering to formulate cosmetic technologies.

She graduated from the George Washington University in 2009 with a bachelor of science in chemistry and economics. As an undergraduate she investigated natural sunscreens and performed research for a national pipe remediation project at the National Institute of Standards and Technology. She completed her PhD in polymer science & engineering at the University of Southern Mississippi. Her dissertation research specialized in thermodynamic, volumetric, and hydrogen bonding patterns of dendritic polymers.

After completing her PhD in 2015 she joined Avlon as a Principal Scientist where she currently formulates ethnic skin and hair care products.
She has published 3 journal articles and has received various fellowships and awards including the Young Scientist Award from the National Society of Cosmetic Chemists (SCC) in 2022, Chapter Speaker Award for Best Paper in 2017 from the Midwest SCC, and first-place poster at the 2014 Annual SCC Meeting.

# The Role of Matrix/Intermediate Filament Interactions on the Shape & Cosmetic Properties of Curly Hair

**Manuel Gamez-Garcia**

Fairleigh Dickinson University, USA

## ABSTRACT

In the past it has already been proposed that the segregation of ortho and para cortical cells found in curly hair may be the cause of its curvature. In this paper experimental observations will be presented indicating that the role of cortical cell segregation is also a necessary condition for the biomechanical stabilization of the shape of curly hair. Because of its shape, curly hair when stretched responds by developing internal torsional stresses. These stresses which can be decomposed in shear and principal tension stresses at 0 and 45 degrees respectively, are better stabilized by the tilted filaments in the ortho cortical cells. Straight hair when stretched develops mainly tension stresses in parallel, i.e. at 0 degrees with respect to the main fiber axis. Therefore, straight hair as it has already been reported contains mainly para cortical cells in its cortex; namely, because it does not require ortho cortical cells with tilted filaments. The observations also indicate that different degrees of curliness require different degrees of torsional stabilization, as a result the cosmetic behavior of hair with different textures varies. The effects of curly hair shape stabilization on some important cosmetic properties, and its role on IF denaturation and shape damage will also be discussed.

## Dr Manuel Gamez-Garcia

**FAIRLEIGH DICKINSON UNIVERSITY, USA**

Manuel Gamez-Garcia received his Master's degree in Electrochemistry from the Tokyo Institute of Technology in Japan, and his PhD in Engineering Physics in the field of Polymers from the Ecole Polytechnique in Montreal, Canada.

In his long career Manuel has held various manager positions related to personal care at Croda, Inc., Dow/Amerchol Corporation, Firmenich, Ciba, BASF, and Ashland Specialty Ingredients, Currently, he is an Adjunct Professor at Fairleigh Dickinson University

KEYNOTE

# Why Is Textured Hair So Fragile? Part II

**Trefor Evans 1**

1 - TRI Princeton, 601 Prospect Avenue, Princeton, NJ, 08540, USA

## ABSTRACT

Single fiber fatigue experiments have re-shaped the way we think about hair breakage where findings are able to explain inconsistencies that arise from traditional tensile testing. But, having embraced these principles, we must also accept implications that perhaps do not fit within our current conceptions.

As shown in Part 1, fatigue theory provides a simple, top-line explanation that aptly illustrates the nature of the fundamental issues. But in testing hair from numerous individuals, we also unearth additional underlying complexity in terms of variations in the nature of this breakage. So, while trends are seen with altering curl type, there is still huge variability within any specific curl classification.

Notwithstanding, we are learning how breakage behavior can predictably be manipulated; but this too has complexity, because it is not always readily clear as to whether such changes are beneficial or detrimental. Outcomes also make us question some of our fundamental hair beliefs – for example, there is the suggestion of widespread structural differences from individual to individual. Of particular interest; why does hair from some individuals appear so resistant to breakage.
It would be wonderful to report that this work had answered all hair breakage-related questions; but, in actuality, it perhaps has opened several cans of worms. It has, at least, greatly increased our learning curve and now allows us to ask more pertinent questions in on-going follow-up work.

## Dr Trefor Evans

**TRI PRINCETON, NEW JERSEY USA**

Dr. Trefor Evans has worked in the Hair Care industry for over 30 years. The first half of his career was spent as a scientist and manager in the product development labs of large consumer goods companies (Unilever, Helene Curtis). Since joining TRI in 2007 he has held the roles Director of Measurement Services and Director of Research and now has the title Institute Fellow.

Dr. Evans is highly active in the hair care industry through many working relationships with companies of every shape, size and background. He is a regular presenter at International hair conferences and has been an invited speaker at many technical meetings and symposia worldwide. Additionally, he has served as Chairman for the past five iterations of the International Conference on Applied Hair Science. He has published numerous articles in the scientific literature and trade magazines and is co-author and co-editor of the book "Practical Modern Hair Science". He writes a regular column on hair testing and hair science for Cosmetics and Toiletries magazine and serves on their Scientific Advisory Board. Dr Evans possesses a Ph.D. in the area of physical analytical chemistry and has spent his career using instrumental testing approaches to support the development, launch and maintenance of many international cosmetics products and brands. Such approaches also continue to be at the heart of fundamental research programs that have resulted in seven patents and have thrice been awarded by the Society of Cosmetic Chemists.

He regularly teaches and facilitates training classes on the topics of hair science and hair product claims which have been held in the US, Europe and Asia. He also teaches a customizable 1-man, 1-day course that has been conducted on-site at numerous client companies. He guest-lectures on Hair Science and the Hair Care Industry for a variety of academic cosmetic programs and has instructed at various educational events organized by the Society of Cosmetic Chemists (SCC). He has previously served on the SCC's Education Committee and currently sits on their Committee on Scientific Affairs.

He is also an Adjunct Professor at the University of Cincinnati and is Editor-in-Chief for the Journal of Cosmetic Science.

# Indian Hair Oil Market: Consumer Habits & Oil Benefits

**Pankhuri Chandani**

Dabur Research and Development Center, India

## ABSTRACT

Hair of different ethnicities differ in basic physical properties. Moreover different haircare practices specific to a geographical region or culture further impact the hair properties. Oiling is traditional practice followed widely in India even today in almost every household irrespective of region, socio-economic strata and age.

This presentation will give information about physical characteristics of Indian hair, elaborate traditional Indian hair care practices, throw some light on Ayurveda and its relevance in hair care, give a glimpse of commercial Indian haircare industry. Also, this presentation will help in linking the traditional practices with scientific evidences and decode benefits of oiling on scalp, for example how it helps in hair growth etc. and how it gives cosmetic hair benefits like better strength, shine enhancement etc. Also, lot of Indian hair oil preparations have Ayurvedic herbs, which are reported to have beneficial effects on hair properties.

## Pankhuri Chandani

**DABUR RESEARCH AND DEVELOPMENT CENTER, INDIA**

Pankhuri Chandani has a background in Biotechnology. In 2013 she started her career in Personal Care with Unilever, India in Hair Appraisal Team and worked on instrumental evaluation and claims substantiation. Thereafter, she worked in Product Performance Evaluation Department of L'Oreal Research & Innovation Center, India and got exposure in Hair and Skin Instrumental Evaluation and Claims. She is currently working as Principal Scientist and leading the Product Performance Evaluation Department of Dabur India Ltd, one of the biggest Ayurvedic FMCG in India. She is responsible for Scientific Evidence Generation for Publications, Claims and Patents through Instrumental Evaluations, Clinical Studies, Sensory Evaluations, and Qualitative Consumer Studies for Skin and Hair Care for India and International Business Units of Dabur. Her core strength lies in Hair Evaluations.

# Novel No-Lye Relaxer Formulation for Textured Hair Management

**Tosin Dania, Marc Beuché, Blessing Ali, Osarenren Igbinoba, Björn Klotz, Jürgen Falkowski and Hans-Martin Haake**

BASF

## ABSTRACT

Hair relaxers are chemical hair care formats and formulations designed to straighten curly and kinky hair to enhance their appearance and manageability. They achieve these by denaturing proteins of keratin intermediate filaments and matrix and by breaking down disulfide bonds which all are responsible for the curled shape of the hair fibers. Relaxers can be broadly classified into lye-relaxers, no-lye relaxers, or thio-based relaxers.

No-Lye relaxers are advantageous with respect to reduced scalp irritation and lower risk of hair damage. They are typically two-phase systems based on Guanidine carbonate and Calcium hydroxide which are stored in different containers before use and subsequently mixed at required quantity. This procedure typically degrades the used chemicals and starts to release malodors within minutes after mixing.

BASF proposes a next level no-lye relaxer. This new approach delivers hair straightening performance by an innovative combination of emollients, consistency agents, relaxing agents and solubilizers in a stable format that allows its ingredients to coexist without activation. These unique formulations have several advantages, like easy preparation, no extra packaging, and no other related materials. Furthermore, the drawback of immediate malodor formation which is associated with commercially available products can be avoided.

Subjective and objective performance measurements on Afro and Afro Caribbean hair using a new 3D evaluation method have given very positive results with respect to straightening efficacy, straightening retention and less frizz even at high humidity conditions and after repeated washing cycles.

## Tosin Dania

**DABUR RESEARCH AND DEVELOPMENT CENTER, INDIA**

Tosin Dania is the Technical Services manager for BASF Personal Care business in Sub Sahara Africa. He received a MSc in Analytical & Environmental Chemistry from The University of Ibadan in Nigeria in 2005, and a Diploma in Cosmetics Science from SCS UK by Distance Learning in 2010.

Since 2006, Tosin has worked diversely and successfully in the homecare, personal care, and medicaments industry, leading, and managing teams catering to regional consumer needs in streams such as Performance and Claims management, R&D Portfolio Management, R&D Support, and Technical Services. He is well regarded across Africa and contributes severally to the development of gazettes and standards across the personal care and home care sectors.

In his spare time, he is reading, learning about cultures, or running.

# Preliminary Investigation Into the Impact of Bleach On Curl Shape & Integrity

**Dr Ronak Rughani**

L'Oréal, USA

## ABSTRACT

Straight and Curly hair differ in their structural organization and thus are impacted different extents when exposed to chemical treatments like bleach. However, in the studies reported, the impact of bleach on curl patterns were not tracked which is critical to consumers perception of damage. The purpose of this presentation is to show an initial attempt to compare impact of bleach treatments on the biophysical properties and on the curliness of different curl patterns. A modified bleaching protocol was adopted to ensure that consumer perceivable curl elongation was achieved. This talk will specifically focus to compare and contrast the changes in these biophysical properties and curl elongation of different hair types using the modified bleach process. At the end, we will attempt to correlate the obtained results with structural differences.

## Dr Ronak Rughani

**L'ORÉAL, USA**

Ronak Rughani, PhD, is the Assistant Vice-President in Advanced Research group at L'Oreal R&I and the Head of the Hair Science & Technologies. He has over 15 years of research and innovation experience in hair science, leading the biophysical and chemical characterization, structural and functional research, and new technology development to address our consumer needs on hair care.

Ronak leads a team of scientists with focus on understanding the unique structure of curly hair and developing innovative solutions specifically to address the key tensions of curly hair consumers of all diversities. To-date, he has filed more than 30 patents, co-authored multiple scientific publications and book chapters, and strongly contributed to critical product launches to improve consumer's hair health.

Ronak, a native of Tanzania, is a strong believer that "Learning is a never-ending process – it starts in the womb and ends in a tomb", and continues to apply his learning to innovate, educate, and advocate for healthy products that improve wellness and quality of life.

Ronak received his PhD in Chemistry from University of Delaware and led research and discovery projects at Procter & Gamble prior to joining L'Oreal.

# Clinical Evaluation of a Scalp Treatment Intended for Dry Scalp

**Draelos, Zoe D. 1 and Tippelt Arujo, S. 2**

1 Zoe Diana Draelos, MD - Dermatology Consulting Services, PLLC, High Point, NC
2 Shelly Tippelt Araujo, Associate Director, R&D Claims & Performance Testing, Aveda, Blaine MN

## ABSTRACT

Self-perceived dry scalp is a common problem created by inadequate scalp exfoliation. It can be socially debilitating. Scalp dryness can be clinically captured as an increase in trans-epidermal water loss (TEWL) through barrier disruption and a subsequent decrease in hydration, which requires restoration of an optimal scalp environment, including barrier repair, to address. This research examined the ability of a 98% naturally derived scalp treatment to increase scalp hydration, decrease scalp barrier damage, enhance desquamation, improve scalp softness/suppleness, and reduce self-perceived dry scalp after a single and 4 weeks use.

This single blind study in 32 subjects with self-perceived dry scalp involved a 1-week washout phase followed by a 4-week test phase. Average baseline scalp conductance was ≤ 30.0 µS and TEWL increased during washout. The effect of nightly application of the scalp treatment on hydration & barrier integrity, along with softness/suppleness, desquamation, and comfort, was examined over 4 weeks of home use. Evaluations were performed at baseline and after 1, 2, & 4 weeks. Embedded in the use phase was a split-head assessment of the scalp treatment versus no treatment approximately 1 & 8 hours following a single use at the test facility.

Scalp hydration was evaluated by measuring changes in skin conductance while barrier integrity was evaluated by measuring TEWL. A dermatologist graded scalp softness/suppleness and desquamation using 5-point scales while scalp comfort was assessed subjectively by the panelists via questionnaire.

Use of the scalp treatment significantly ($p \leq 0.0001$) improved hydration by over 100% after a single use immediately and overnight. This benefit continued through 4 weeks of nightly use. Scalp barrier integrity improved by at least 15% following repeated use. Scaling was significantly ($p \leq 0.006$) reduced by 35% following a single use and by up to 93% after repeated uses over 4 weeks. Softness/suppleness significantly improved ($p \leq 0.001$) by 37% overnight and 98% after 4 weeks. Significant improvement ($p < 0.05$) in hydration & feel was observed by subjects after a single application of the scalp treatment. Significant ($p < 0.001$) improvement was cumulatively perceived in all parameters: scalp feel, hair appearance, and hair feel after 4 weeks of scalp treatment use.

## Zoe Diana Draelos, MD

Zoe Diana Draelos, MD, is a research and clinical board-certified dermatologist and a Fellow of the American Academy of Dermatology. She is in solo private practice in High Point, North Carolina, and a Consulting Professor of Dermatology at Duke University. In 1988, she founded Dermatology Consulting Services, PLLC, to initiate and perform research in aging skin, acne, rosacea, psoriasis, atopic dermatitis, actinic keratoses, eczema, and aesthetic procedures in the cosmetic, OTC drug, and pharmaceutical arenas. Prior to pursuing a medical career, Dr. Draelos completed an undergraduate degree in Mechanical Engineering and was elected a Rhodes Scholar. A member of Sigma Xi research honorary and Alpha Omega Alpha medical honorary, she is author of 14 books including Cosmetics in Dermatology and Hair Cosmetics. She is the editor of Cosmetic Dermatology: Products and Procedures (third edition) and Cosmeceuticals (fourth edition) with translations into 7 languages. She has contributed chapters to 44 textbooks, written 173 posters, served as the principle investigator on 862 studies, written 650 published papers, served on or contributed to 38 journal editorial boards, functioned as the editor-in-chief of the Journal of Cosmetic Dermatology for 10 years, and was a past member of the Board of Directors of the American Academy of Dermatology and the American Society for Dermatologic Surgery. She was elected Vice-President of the American Academy of Dermatology. She is recognized as a pioneer in cosmetic dermatology and received a lifetime achievement award from Health Beauty America for her research and the 2008 DermArts award for her contributions to dermatology. In 2010, she received the Albert Kligman Innovation Award and in 2016 she was awarded a Presidential Citation from the American Academy of Dermatology for her research contributions to advance the specialty. She received the prestigious Maison deNavarre award from the Society of Cosmetic Chemists for her contributions to the art and science of cosmetics in 2017. In 2019, she was the inaugural recipient of the Florence Wall Award from the Society of Cosmetics Chemists honoring her as the most influential woman in cosmetic science.

KEYNOTE

# Methods for Substantiating Claims for Textured Hair Care Products

**Ernesta Malinauskyte 1, Leila Sorrells 1**

1 – TRI Princeton, 601 Prospect Avenue, Princeton, NJ, 08540, USA

## ABSTRACT

Hair claims substantiation testing is a crucial process that helps to verify the effectiveness of hair care products and treatments. Consumers rely on hair care claims made by manufacturers, such as claims of hair strengthening, repair, or enhanced shine, and most importantly expect that these claims are backed by scientific evidence. Hair claims substantiation for textured hair currently has a smaller repertoire than straight or wavy hair. The talk will provide an overview of hair claims substantiation testing methods for breakage, friction, curl length, and shine/sheen evaluation using Walker type 3 and 4 hair. The importance of selecting (i) the appropriate substrate, (ii) critical details of the treatment, and (iii) tress handling will be discussed, as well as the challenges and limitations of these methods. The presentation will also highlight popular methods for straight hair that can be transferred to textured hair testing without significantly modifying conditions.

## Dr Ernesta Malinauskyte

**TRI PRINCETON, NEW JERSEY USA**

Dr. Ernesta Malinauskyte earned her PhD in Chemical Engineering at Kaunas University of Technology (Lithuania). She has ~12 years of academic and professional experience in food engineering and hair sciences.

Currently, at TRI Princeton in the role of Hair Research Director, Ernesta is responsible for leading a team of results-driven researchers investigating all textures fiber interactions with hair care, chemical & physical treatments, environmental insults (UV, particles, and ozone), as well as developing new claims substantiation methods for all types of hair and devices. Ernesta with the team also work on expanding TRI research capabilities in analytical sciences, the microbiome, and hemp products use for textile & skincare areas.

Ernesta often pushes the boundaries to make things better at TRI. This includes modification and enrichment of the work environment so the true potentials of interns, technicians, junior and experienced scientists are enabled.

Ernesta is an active member of the research community via publishing and giving the presentation on research and hair science topics in academic environment, industry, and hairdresser communities.

# Overcoming the Challenges of Measuring the Attributes of Textured Hair

**Roger L. McMullen & Timothy Gillece**

Ashland Inc., Bridgewater, NJ, USA

## ABSTRACT

The physicochemical properties of hair from various ethnic and racial backgrounds are unique. A key distinguishing feature of ethnic hair is its texture. Historically, most hair research was conducted on straight hair of Caucasian descent. Researchers are now aware that investigations of human hair must consider hair from a multitude of diverse sources. Textured hair contains a three-dimensional geometry that allows it to form complex fiber assemblies with unique attributes. Herein, we provide an overview of some of the work we have completed with textured hair and point out key differences between African, Caucasian, and mixed-race hair.

In this presentation, we examine some of the differences in the various properties of hair from different ethnicities and attempt to understand how this influences the overall macroscopic behavior of a hair fiber assembly. We first investigated some of the macroscopic features of the various hair types including the optical properties, acoustic properties, and overall three-dimensional structure of the hair fiber assembly. Next, we sought to gain a better understanding of the morphological and ultrafine structural characteristics of the different hair types. This was achieved by analyzing intact hair fibers as well as hair fiber cross sections (obtained with a cryomicrotome) using field emission scanning electron microscopy (FESEM). The lipid characteristics and water management properties were also compared for these hair types. FTIR spectroscopic images of hair cross sections allowed us to elucidate differences in the level and distribution of lipids in the hair types. Overall, we observe distinguishable behavior in various types of hair that, at times, require us to utilize discrete methods of analysis.

## Roger L. McMullen

**ASHLAND INC., BRIDGEWATER, NJ, USA**

Dr. Roger McMullen has over 20 years of experience in the personal care industry with specialties in optics, imaging, and spectroscopy of hair and skin. Currently, he is a Principal Scientist at Ashland, LLC and leads the Material Science team in the Measurement Science department. Roger has over 30 publications in peer-reviewed journals and textbooks. He is also the author of Antioxidants and the Skin, 2nd edition and founded the online news magazine The Cosmetic Chemist. Roger received a B.S. in Chemistry from Saint Vincent College and completed his Ph.D. in Biophysical Chemistry from Seton Hall University.

Roger actively engages and participates in educational activities in the personal care industry. He frequently teaches continuing education courses for the SCC and TRI-Princeton. In addition, Roger is an Adjunct Professor at Fairleigh Dickinson University and teaches Biochemistry to students pursuing M.S. degrees in Cosmetic Science and Pharmaceutical Chemistry. Prior to pursuing a career in science, Roger served in the U.S. Navy for four years on board the USS YORKTOWN (CG 48). He is fluent in Spanish and Catalan and currently is learning to play the classical guitar.

# Understanding Scalp Skin With & Without Dandruff: An In-Vivo Raman Study

**Paul Pudney**

Unilever, UK

## ABSTRACT

Although skin covers most of the body it is known not to be uniform, this is most likely so it can cope with the different stresses on the anatomically different areas. One area that has shown some differences but has not been widely studied is the scalp. The scalp is a difficult area to access using the standard configuration of the in-vivo Raman instrument hence a new smaller pen shaped probe has been developed1. It allows the window to be placed against the subject in more curved and recessed areas of subject's body and also for them to be more comfortable whilst the measurements take place. The scalp SC show significant differences from the 'normal' SC of the volar forearm. These differences will be described in this talk. Using the same Raman probe a comprehensive study of dandruff and the effect of antidandruff shampoo with zinc pyrithione (ZnPTO) has been completed2. This talk will describe these differences and how they are resolved using the shampoo2.

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2) E. Y. M. Bonnist, P. D. A. Pudney, L. A. Weddell, J. Campbell, F. L. Baines, S. E. Paterson and J. R. Matheson International Journal of Cosmetic Science, 36, 347–354 (2014)

## Dr Paul Pudney

**UNILEVER, UK**

Paul has a BSc in chemistry from Liverpool University and obtained a PhD in Physical Chemistry from the University of East Anglia 'Spectroscopic studies of adsorbates on metal single crystal surfaces' under supervision of Prof Michael Chesters . After post-doctoral studies at the Leverhulme Centre for Innovative Catalysis and the Interdisciplinary Research centre in Surface Science at Liverpool University he worked at the synchrotron at Daresbury before joining Unilever in 1994.

Paul is now a science leader in measurement and recently moved to Unilever's Beauty & Wellness and Personal Care Science & Technology group and based at the Material innovation factory (MIF) in Liverpool University and Port Sunlight. He has applied spectroscopy in a number of innovative ways to gain further understanding of both consumer products and their behaviour when they interact with our consumers. Examples include quantifying the complex microstructures of soft solid materials by confocal Raman spectroscopy such as foods and behaviour of molecules in ice using IR. He developed a novel in-situ Triboligical Raman instrument to help understand lubrication in a Soft Elasto-Hydrodynamic Contact to understand 'feel'. He has developed in-vivo Raman spectroscopic capability to measure and understand the delivery of actives to and their effect on the body, such as to the skin, scalp, axilla and oral mucosa as well as hair.

He has >60 peer reviewed publications. He was nominated as one of the 'Prominent Young Vibrational Spectroscopists' by Vibrational Spectroscopy journal in 2004. He won the Meggers award in 2013, as well being runner up in 2012. He was elected as Fellow of the Society of Applied Spectroscopy in 2015.

# Are Fatigue & Failure of Hair Influenced by Ethnicity? First Lessons From the Weibull Parameters

**Leila Berriche 1,2, Ranju Prasad Mandal1, Jessica Welzel1, Rolf Bayersdoerfer1, Volkmar Vill2, Franz J. Wortmann 3,4**

1 Henkel AG& Co KGaA, Hamburg and Duesseldorf, DE
2 University of Hamburg, Hamburg, DE
3 University of Manchester, Manchester, UK
4 F & GW – Consultants, Aachen, DE

## ABSTRACT

Attributes such as length, shape, curvature, strength, and pigmentation of natural hair fibres are primarily determined by genetics, but also influenced by weathering, consumer habits, and age among other factors. It is well documented that Asian, Caucasian, and African hair differ in melanosome size, thickness, strength, and ability to stretch (1–4). However, the resilience of an unaltered material may be attributed to cracks and flaws generated by fatigue, that eventually lead to breakage (5). Using constant strain fatigue/failure experiments and Weibull analysis, we initially assessed whether Caucasian, Chinese, and Indian hair show a difference in failure behaviour. In addition, considering that cumulative deterioration is associated with natural aging, we subsequently tested segmented Indian hair from root to tip. With this we aimed to investigate whether Weibull parameter values change along the hair length and how such an effect may be interpreted.

Unaltered round to oval shaped, straight, Caucasian, Chinese, and Indian single fibres were crimped and cyclically fatigued (CYC802, Diastron) to a constant strain of 5% for 500000 cycles (approx. 55% rh, 22 oC). The experimental design was suitable to apply the Weibull analysis. Weibull-plots yield the characteristic lifetime (break of 63.2% of the fibres) and the slope of the regression line, as an indicator of the failure mode. Caucasian hair showed a significantly higher characteristic lifetime than Chinese and Indian hairs. Both Caucasian and Indian fibres showed a slope lower than 1, indicating a constant failure rate. In contrast, Chinese hair showed an induction phase up to ~9000 cycles, followed by a sudden increase of failure (slope>1).

For root, middle, and tip segments of Indian hair, the characteristic lifetime significantly dropped from 30.4k (ln a = 10.32 ± 0.21) to about 19.6k (ln a = 9.88 ± 0.25) cycles. In contrast, the slope increased from 1.48 (±0.10) for root and middle to 2.28 (±0.16) for the tip, indicating an accelerated failure. Interestingly, unsegmented Indian hair showed a significantly higher characteristic lifetime than the tip and the lowest slope (0.56 ±0.05) among all the segments.

Our investigations show that our method is suitable to explore the influence of ethnicity on hair resilience as well as the influence of natural aging. We postulate that characteristic lifetime and failure performance across the analysed hair types may be influenced by a complex fibre history. This history may, beyond ethnicity, include the structural state, the lipid composition, the accumulation of cracks and flaws generated with aging, or even the size of melanosomes. We find it interesting to note that Chinese hair showed a rather large induction phase prior to failure and a higher slope. One may argue that Chinese hair may have better strength (in withstanding cycles), but lower resilience.
The lessons from the investigation are complex and raise more questions: What does fatigue do to the hair? What conditions influence the results? How do Weibull parameter values relate to hair failure and how may their changes be interpreted?

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## Leila Berriche

**TRI PRINCETON, NEW JERSEY USA**

Leïla berriche is a split-site PhD student from the university of Hamburg and working fully at Henkel in the team science of hair (Hamburg, Germany). She graduated with a BSc and MSc´s degree in molecular and cellular biology major skin biology from the university of Claude Bernard (Lyon, France). She has worked on human skin equivalents (IBCP, Lyon) and the metabolism of the human hair follicle (Stratford, Manchester), these experiences led her to complete a journey with a dead matter, the human hair fiber, under the supervision of 5 amazing Supervisors. Life-expectancy, or characteristic lifetime is something that we all want to be able to predict, who doesn´t want to know how long is left to complete the journey?

We only get to know when organs, or a certain number of cells start to fail. From the diagnosis, either there is a treatment to heal or to postpone the final failure. Of course, all the process depends on the rate of propagation, the slope.

# Developing New Quantitative Geometrical & Structural Mechanical Parameters to Better Classify Straight, Wavey, Curly, and Kinky Hair Phenotypes

**Dr. Michelle K. Gaines**

Assistant Professor, Department of Chemistry & Biochemistry, Spelman College, Atlanta Georgia

## ABSTRACT

Hair is a natural polymeric and highly complex biocomposite system, which has been traditionally challenging to characterize and thus develop functional personal care products for consumers. The goal of this research is to use quantitative methods to identify new geometric parameters, which will be more representative of all curl patterns – straight, wavy, curly, kinky. These new parameters will help consumers determine the kinds of personal care product ingredients that will best resonate with their natural hair type. The goal is also to correlate these new parameters with its mechanical and interfacial surface properties. In this work, several distinguishing geometric features (ellipticity, curl morphology, and cuticle structure) were identified and compared among each of the curl types. Hair fiber mechanics were compared between the curl types by measuring force as a function of applied displacement, thus allowing the relationship between stress and applied stretch ratio to be measured as a hair strand uncurls and stretches to the point of fracture. From the resulting data, correlations were made between fiber geometry, hair porosity, and mechanical performance. The data will be used to establish quantitative distinctions between hair of different curl patterns.

## Dr. Michelle K. Gaines

**ASSISTANT PROFESSOR, DEPARTMENT OF CHEMISTRY & BIOCHEMISTRY, SPELMAN COLLEGE, ATLANTA GEORGIA**

Michelle Gaines, Ph.D., is an assistant professor in the Department of Chemistry & Biochemistry at Spelman College. She received her B.S. in Chemical Engineering & Biomolecular Engineering at Michigan State University in 2003, and she earned her Ph.D. in Materials Science & Engineering at North Carolina State University in 2008. Her dissertation research was on the interfacial chemistry of nanoparticles and block copolymer materials. Gaines has a rich, interdisciplinary research background in polymer materials chemistry, nanocomposite interfacial behavior, inorganic molecular chemistry, electronic carbon-based nanomaterials, and biophysics of collective cell behavior. She is using this expertise, developed during her postdocs, to explore her research interests.

Gaines' research is themed around studying the interfacial properties of soft materials. Our objective is to measure energy dissipation within thermo-responsive colloidal microgel particle systems and block copolymer materials, to develop next-generation separators in lithium-ion batteries and self-actuating biosensors. The Gaines lab also explores the interfacial chemistry between cells and hydrogels on biological interfaces, as a means to develop a synthetic 3D culture microenvironment to control cell behavior. The aim is to gain a sophisticated understanding on how cells respond to specific controlled variances in the material properties of the extracellular matrix, to predict strategies to issue control over cell behavior in physiological systems. Our goals are achieved by marrying Polymer Synthesis, Materials Science, Cell Biology & Spectroscopy.

# PRESENTER ABSTRACTS

## Posters

# Human Hair Profile by Mass Spectroscopy: A Preliminary Study About Curvature & Age

**Carla Scanavez 1*, Daniela Zimbardi 2, Marcel Pratavieira 3, Mario Sergio Palma 4**

1, 2 Natura Cosméticos S/A, Cajamar, São Paulo, Brazil
3 Former with Natura Cosméticos S/A, Cajamar, São Paulo, Brazil
4 Institute of Biosciences, Universidade Estadual Paulista UNESP, Rio Claro, São Paulo, Brazil

## ABSTRACT

Meeting consumer demand for effective hair care products in a very competitive market has driven the cosmetic industry to generate research and an ever-deep understanding of hair fiber and the performance of actives. In this context, proteomic studies have emerged both for the characterization and understanding of molecular alterations in hairs after chemical transformation and for finding new health and damage markers for hairs.

In the present study, we compared the protein profile by mass spectroscopy for natural brown straight hair and after bleaching, natural brown curly hair and after straightening, and natural gray straight hair. The extraction process generated a soluble protein fraction and a second insoluble fraction that was digested again and used for protein identification. We identified about 148 total proteins and focused on understanding the keratin profile.

We found differences between keratins present in straight, curly, and gray hair and even after oxidative and reducing treatments.

In general, a large number of keratins showed a constant presence in threads of different curvatures even after straightening and between brown and gray. These are like cytoskeletal type I and cuticular type II keratins, in addition to keratin associated proteins (KAPs).

In natural brown curly hair were identified 58 proteins that reduced to 55 after straightening with commercial ammonium thioglycolate among these 34 common proteins. The main changes observed after straightening were among KAPs, apparently in straightened hair disulfide bridges are reformed and adapt to more stable (insoluble) protein conformations similar to curly hair before treatment. A greater number of keratin intermediated filaments (KIFs) proteins are degraded by straightening (reduction) than in comparison the bleaching process (oxidation). The straightening procedure seems to damage type II basic keratins more than type I acidic keratins.
The bleaching process of natural brown straight hair appears to affect cortex matrix KAPs proteins of the HGT (high glycine-tyrosine) type more than the HS (high sulfur) type.

In natural brown and natural gray straight were identified 72 proteins in brown versus 47 proteins in gray, a reduction of about 35% in KAPS to this particular case, which may indicate reduced keratin biosynthesis in follicles with natural aging, which corroborates our data obtained by other technique such as X-ray microtomography of increased internal cortex porosity in gray hair and with the fact that gray hair is considered to be thinner and naturally showing more frizz .

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# Evaluating the Efficacy of 3-Point Bending Test on Multi-Ethnic Hair Types

**Xuzi Kang**

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## ABSTRACT

The 3-point cantilever bending technique is a test used to measure the strength and flexibility of the hair. It involves applying a force at a specific point between two supports and measuring the amount of deflection at the middle point. The amount of deflection measured can be used to calculate various properties of the hair, such as its stiffness, toughness, etc. The applicability of this test has been mostly limited to straight hair, with its effects on multi-ethnic hair largely undetermined. In this research, the effectiveness of the 3-point bending test on multi-ethnic hair is scrutinized, and the preliminary evidence suggests promising outcomes when employing this test on multi-ethnic hair.

# Extraction & Analysis of Curly Fibre Image Features: A Proof-of-Concept Study

**Gabriela Daniels 1 , Affan Hameed 1 , Danka Tamburic 1 , Sergio Benini 2 , Mattia Sarvardi 2**

1 – London School of Fashion, UK, 2 – University of Brescia, Italy

## ABSTRACT

**Introduction**

Although the analyses of the curvature of single fibres based on image analysis have been reported, researchers are still facing significant challenges. The image acquisition process of a relatively small 3D object such as a single fibre is challenging, the extracted image features differ and so do the approaches to data analysis. This ongoing project aims to explore accessible technology, such as using a single hair fibre image, to extract geometric features that are reliable representations of the fibre's curvature so that hair fibres used for experimentation can be described in precise terms. The second goal is to explore if fibre responses to cosmetic treatment could be detected and quantified via this method.

**Methods**

Single hair fibres of curl type 7 were sourced from two donors. 60 randomly selected fibres were photographed under controlled condition before (t0) and after a treatment comprising 15mins of submersion in 5ml of Dimethicone 350cpi followed by 15mins of rest at t=22°C, RH=45% on absorbent paper (t1). Each fibre was attached to a white card, suspended vertically and photographed with DSLR Canon 250 camera (macro lens 100mm, automatic setting). The following image features were extracted from the JPEG files representing each fibre at t0 and t1: the number of intersects, the estimated number of curves, whole fibre mean curvature, quartile curvatures (four quartiles) and the normalised fibre area. Unpaired t-test was conducted to compare the features of the t0 and t1 fibre images and Pearson correlations between the different features were explored. Based on these features, eight images were excluded as outliers. Of the remaining images, 80% were used as a training dataset and the remaining 20% for testing the classifying algorithm.

**Results**

A range of possible image features was considered. The final list of features was guided by the measurements reported by Loussouarn et al (2007) in their hair curl classification study. However, for very high curl types, there is no regular curl crest pattern and, in addition to the individual curls' diameter, the fibre itself exhibits curvature. Hence new, mathematically generated fibre features were extracted. Based on the initial feature analysis, 8 observations (images) were excluded as outliers due to image quality. The statistical analysis identified significant differences ($p<0.05$) between t0 and t1 in the estimated number of curves (decline), fibre mean curvature (increase) and in the quartile curvatures (q1 and q2 =decrease; q3 and q4=increase). Positive correlation between 4th quartile and mean fibre curvature was detected ($r=1$); weak negative correlation between the estimated number of curves and mean fibre curvature was detected, too ($r=-0.09$). This suggests that the number of fibre's tight turns was reduced, but the degree of whole fibre curvature and that of the lower two quartiles along its length increased. The other features did not register statistically significant results, however other treatments might impact those. Based on the above features, the classifying algorithm reached a chance level performance above 50% (f1 score for t0=58%; f1 score for t1=55%). The result suggests that geometric image features could be extracted from a single frontal image of a single hair curly fibre. Some of these features were altered by the treatment. It is hypothised that the treatment effect softened the cuticle, thus reducing the fibre's bending and torsional stiffness. This resulted in some relaxation of curls and twists and the increase in the fibre's mean curvature (the fibre takes on a less kinky and more wavy shape).

KEYNOTE

# A Comparison of Walker & L'Oréal Curl Typing Methods

**Paul Cornwell, Jennifer Van Wyk, Katerin Mateo**

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## ABSTRACT

**Objectives**

The aim of this work was to investigate how the Walker system of hair curl categorisation correlates with the L'Oréal system.

**Methods**

Female panellists, aged 18-55, were recruited in New Jersey, in the United States, and in Cape Town, South Africa. Approximately 120 panellists were recruited in each country. Panellists were split evenly into three groups based on their natural curl type: wavy (Walker Type 3) or curly (Walker Type 3) or kinky (Walker Type 4). Visual assessment of Walker curl type was performed by trained assessors in each country. Small samples of hair were also obtained from the panellists and L'Oréal hair typing was performed on hair samples from 114 of the New Jersey panellists and 22 of the South African panellists.

**Results**

Analysis of the data showed that the Walker and L'Oréal curl typing systems correlated reasonably well. Walker Type 3 correlated best with L'Oreal Types II to IV. Walker Type 3 correlated best with L'Oreal Types III to V. Walker Type 4 correlated best with L'Oreal Types V to VIII.

**Conclusions**

Both curl typing systems have advantages and disadvantages. Neither is perfect. The Walker system is quick, non-invasive and looks at the whole head, but is very dependent on the quality of the trained assessor. The L'Oréal system is precise and scientific, but requires the removal of hair samples, significant laboratory testing time and only looks at a very small set of hair fibres from particular parts of the scalp. Given that both techniques correlated reasonably well, we would suggest that the faster expert assessment using the Walker system is the preferred method for large clinical studies.

# Characterizing Hair Damage & Prevention Using IR Spectroscopy & Validating the Findings Via DSC

**Anwar Zahar**

Scientist, Innovation, Aveda, Blaine, MN

## ABSTRACT

Fourier Transform Infrared (FTIR) spectroscopy is a powerful, nondestructive, and fast technique that measures the amount of cysteic acid generated on human hair surface to indicate damage caused to hair by external aggressors like chemical treatments, heat, or UV. In this work, hair fibers were bleached or flat ironed and analyzed using the FTIR. It was found that the amount of cysteic acid, determined by the ratio of cysteic acid to amide-1 peak heights (1040 cm-1/1650 cm-1), increases linearly with both types of treatments. Full formulations were also evaluated for their ability to reduce the amount of cysteic acid generated, and thus prevent hair damage due to heat and chemicals. These results were validated using Differential Scanning Calorimetry (DSC), a method used in the haircare industry to understand the integrity of the protein structure of hair fibers.

Under the conditions of these studies, FTIR can be used to effectively screen both raw materials and full formulations to provide damage prevention benefits to hair fibers, as well as make damage protection claims on hair care products.

# Effects of Treatments on Textured Hair Porosity

**Ayinoluwa Abegunde, Marquita Braxton, Leila Sorrells, Ernesta Malinauskyte**

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## ABSTRACT

Hair porosity is often discussed in mainstream hair care circles, referring to the degree to which substances may penetrate hair fibers. It is often believed that an increase in hair damage through heat and/or bleaching treatments will lead to an increase in hair porosity. While much work is done in this area for European hair types, the same cannot be said for textured hair, partly due to the difficulties this curlier hair presents in being manipulated. In this work, we have designed an adapter to allow for contact angle measurements of textured hair and evaluated the effects of multiple treatments on this measurement. We have chosen to evaluate the impact of dyeing, bleaching, blow-drying, flat ironing, and relaxing on hair hydrophobicity.

# Quantifying High Curl Hair via 360° Video Analysis

**Nina Ninua, Mehdi Doumi**

L'Oréal, USA

## ABSTRACT

**Introduction**

There is a need for inclusive evaluation methods designed for complex high-curl pattern hair. Current methods for evaluating high curl patterns are restricted to static, two-dimensional images which fail to capture the volume, space-filling, and three-dimensional attributes of these curl patterns. To quantify the hair holistically, we have developed a hair characterization method that utilizes videos of rotating hair tresses that are then quantified by our custom in-house software. Our metrics relate to curl definition, frizz, volume, density, and overall disorder of hair tresses which are most relevant to consumer perception of produce performance on high-curl pattern hair.

**Methods**

Our video-capture system utilizes a DSLR camera to record videos of rotating tresses at 60 fps (1080p). Once the videos are captured, they are uploaded for post processing using our proprietary software (Matlab) where image processing algorithms are applied to the groups of videoframes, resulting in a set of metrics that quantify the hair tress. A typical study uses six tresses per treatment group, at room temperature, and compares average values of each metric of each tress pre- and post-treatment.

**Results**

A case study was run comparing the product performance of two leave-in styling products designed to increase curl definition and decrease frizz. Six high-curl pattern tresses were used per treatment group and rotating videos of each hair tress were taken pre- and post-treatment. After treatment with both products, there were statistically significant results for overall reduction in disorder (at least 2X for both products) and product differentiation. Compared to an existing instrument (Bossa Nova's Rumba), our video-based metrics showed a similar correlation to fiber alignment/curl definition, but with improved sensitivity and product differentiation for this high curl pattern.

**Conclusion**

New methods for quantifying visual attributes of high curl patterns are necessary for inclusive product performance evaluation. Our method can be used to analyze the hair more holistically, accurately, and adds a visual component more relevant to consumers. More work needs to be done to link the metrics with expert and consumer perception of curl definition, and as our video database grows, we can build opportunities for A.I/machine learning approaches to quantifying complex high-curl patterns.

**Keywords**

High Curl Patterns, Video Analysis, Matlab, Curl Definition, Disorder

# The Koyld Hair Guide:
# A Joy Filled Guide to Fulfilling your Koily Hair Dreams

**Ayinoluwa Abegunde**

TRI Princeton, USA

## ABSTRACT

In the era of prioritizing self-love and confidence, we're frequently told to practice self-love without being guided towards how to achieve lasting self-love and confidence. If you are struggling to truly feel beautiful, mentally, and physically, then this energizing and interactive hair guide is for you.

The Koyld Hair Guide is a revealing and relatable book that will guide you on your journey to self-love, self-confidence, and positive self-image through conversations about our hair. Hair Scientist, Hair Artist, and Consultant, Ayinoluwa Abegunde struggled to see the beauty in her hair and understand how to care properly for it. Within a short time, she began conquering those deep insecurities and is now teaching women all over the world how to properly care for their hair with science-backed data. Through the Koyld Hair Guide, Ayin equips readers with the honest and heart-felt advice, research, and exercises that she used to build her hair-confidence and finally learn how to love herself fully.

You can only care long term for something you truly love. First, she guides you through forming a healthy hair mindset and then provides science-backed step-by-step instructions for caring for our natural hair. This empowering guide provides practical advice and exercises that will help you finally satisfy your innate desire to whole-heartedly love and care for yourself. You deserve it.

# Textured Hair Engine – How Brands Can Use Customer Intelligence to Drive Innovation

**Winifred Awa, Soraya Hausl**

Carra Labs, UK

## ABSTRACT

Textured hair care brands are still lacking innovation especially for consumers with the tightest patterns. The customer has long been vocal about their needs and wants. To create the product of tomorrow, brands must start listening to deeply understand this customer. This begins with data!

We have developed Carra Textured Hair Engine™ which indexed the world's textured hair data into actionable insights to drive innovation in haircare. We have mapped and aggregated 10 million data points from across the web and social media that talk specifically about textured hair. This data is then combined with our hair diagnostic taken by our community, as well as trend analysis and product data, covering brands, reviews and ingredients. We apply various machine learning models such as natural language processing to analyse and structure the various topics, identifying theme clusters, common pain points and shared concerns. These techniques are enriched and validated by our rich domain knowledge allowing us to refine insights and place them in the appropriate context.

Our presented work focuses on the tightest hair texture (type 4) and highlights which concerns are especially relevant for this consumer, how their hair care routines differentiate from other textured hair types, as well as nuances and trends regarding the questions and problems they discuss.

# Demonstrating Antioxidant & UV Protection of Hair Using Electron Spin Resonance (ESR) Spectroscopy

**Devin Filiatrault**

Principal Technician, Innovation, Aveda, Blaine, MN

## ABSTRACT

It is known that exposure to ultraviolet (UV) radiation causes hair damage by oxidative degradation of proteins, lipids, dye molecules, and melanin in hair, resulting in the formation of free radicals. The process of free radical generation and oxidative damage in hair is typically studied by its downstream effects such as color fade, increased porosity, decrease in tensile strength, and decrease in thermal stability. Protective materials like antioxidants and UV filters can reduce UV damage to hair by quenching free radicals and absorbing UV light, respectively. In this work, melanin was used as the indicator molecule for hair damage and hair color degradation, because UV exposure in hair results in the formation of stable melanin radicals that can be measured with Electron Spin Resonance (ESR) spectroscopy.

Virgin level 4 hair was treated with solutions of antioxidants and UV absorbers in an inert carrier, as well as with emulsion format leave-in hair treatments containing such raw materials. Hair samples were placed in an ESR spectrometer and exposed to UV light, and the rate of melanin radical formation within each sample was measured. It was found that hair treatments containing antioxidant and UV absorbers were able to significantly reduce the rate of melanin radical formation when compared to placebos.

This method enables the evaluation of individual and combinations of raw materials as well as leave-in formulations for their antioxidant and UV protective ability on hair fibers and hair color.

# Spring Into Action:
# A Vibrant Journey Into the Bounce of Coiled Hair

**Xuzi Kang**

TRI Princeton, USA

## ABSTRACT

The measurement of coiled hair movement has been a complex challenge, largely due to its unique characteristics. In engaging with individuals who have coiled hair types (4A, 4B, 4C), it is found that what really matters isn't the motion of individual strands, but rather the 'springiness' or 'bounciness' of small hair tresses. In this study, we introduce a hair compression test, specifically designed to assess the resilience (or so-called bounciness) of coiled hair tresses. This allows us to quantitatively evaluate their bounciness and resistance to external forces, which will be a great guide for product choice for people who love headphones. The findings of the study shed light on an intriguing aspect: common styling or moisturizing products don't enhance the bounciness of hair. Instead, the selection of appropriate shampoo or a smart cocktail of products may hold the key to maintaining the springiness/bounciness of coiled hair. Call for more potent products: join us in this insightful exploration of coiled hair dynamics!

# Hair Ageing & Subjective Wellbeing in Black Women (Age>59) with High Curl Type & Living In the UK

**Gabriella Daniels, Young-Jin Hur, Ameerah Khadaroo, Caroline Searing, Dion Terrelonge, Hannah Zeilig**

London School of Fashion, UK

## ABSTRACT

**Introduction**

The natural fragility of high curl types is well documented, and so are the impact of alkaline hair relaxers on the fibre and scalp. However, ageing of very curly/textured hair is not documented yet. Whilst the research in more effective cosmetic treatments for high curl types is gathering critical mass, there is a lack of understanding of the motivations and priorities in selecting hair styles and treatments and in commercial organisations such knowledge is siloed as marketing related. This inter-disciplinary project straddles cosmetic science, gerontology and psychology in order to explore: i) The evolution of hair styling and management practices of Black women from the perspective of ageing. ii) The impact that of age-related hair changes have on subjective well-being.

**Methods**

The study was based on a mixed methods approach, incorporating an online survey (Qualtrics XM, USA) followed by quantitative data analysis using SPSS version 28.0.0.0 (IBM, USA), and a series of in-depth semi-structured interviews followed by thematic analysis using NVivo version 12 (QRS International, USA). The quantitative stage was conducted first to identify themes and questions which could be explored in depth in the qualitative stage. The study was approved by University of the Arts London's Research Ethics Sub-Committee.

**Results**

The quantitative data (n=46, age=60-80) identified a statistically significant age-related shift in hair styles away from chemical hair relaxing, braiding, weaving and extensions, but hair colouring was not impacted by age. A perception of decreased hair manageability with age was noted. Current hair style attractiveness was positively correlated with satisfaction with current hair colour, length and texture. The qualitative research stage explored the hair ageing perceptions and hair management motivations and more depth (n=10, age=59-67). Three main themes were identified via the thematic analysis: ageing hair's health and management (267 references); hair and identity (297 references); Wellbeing (185 references). In agreement with the survey data, hair management was perceived to become harder with age, with participants being particularly challenged by managing hair greying, whilst hair texture and length were varied. Hair styling choices were influenced by the desire to adopt techniques, products and procedures that were less product intensive and involved less time and effort. For most participants, their hair had a very strong association with their cultural identity, they had high hair awareness and engaged in social comparisons based on hair presentation. Overall, age did not diminish the desire to maintain hair as a personal attribute important for personal wellbeing and social interactions, but it impacted on the choices and effort that women were prepared to put into their hair management.

The project relied on a convenience sampling approach, hence generalising the findings is not possible, but the outcomes suggest that hair ageing is one aspect of subjective wellbeing, and the balance between perceived healthy hair management and effort is equally important.

# On the Map – Skin Actives for Scalp Care

**Margaret Dwyer 1, Emmanuel Martin 1, Remo Campiche 1, Samuel Gourion-Arsiquaud 2, Matthieu Jomier 3, Mélanie Waeckel 1, Fabrice Guillemard 1**

1 - DSM Personal Care, 2- TRI Princeton, 3- Newtone Technologies

## ABSTRACT

Scalp conditions such as itchiness and flaking are key concerns for consumers. This is stimulating interest in the role skin care ingredients could play in treating such symptoms if added to hair and scalp care products. Two conditions commonly associated with an oily and flaking scalp are increased transepidermal water loss (TEWL) and sebum secretion. As such, consumers are actively searching for solutions to address these concerns. Saccharide isomerate (commercially known as PENTAVITIN®), is a 100% natural, plant-derived bioactive that supports stratum corneum hydration and water retention leading to improved moisturization. An innovative proof-of-concept in-vivo study demonstrated that saccharide isomerate, when used in a shampoo, reduces TEWL and sebum levels significantly. To extend on these promising findings, in collaboration with our partners TRI Princeton and Newtone Technologies, we trialed pioneering, scalp 3D color mapping technology to visualize changes in scalp sebum levels and hydration following treatment with a shampoo containing Saccharide isomerate. Here, we present key data from our clinical study and full details of our 3D scalp mapping approach and proof-of-concept study. We also include visualizations of the improvements observed in scalp sebum and scalp hydration levels after seven days' frequent use of a shampoo formulation containing 0.5% Saccharide isomerate compared to placebo.

# A New Tool To Human Hair In Vivo Damage Diagnosis & Product Recommendation

**Carla Scanavez 1, Paula Oliveira 1, Gustavo Gomes 1, Lucas Prado 1, Vitor Paciello, Ana Carolina, Gustavo Cheles 2, Conrado Vitor 3**

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## ABSTRACT

Brazil is the largest hair care market in Latin America, with emphasis on sales of products such as shampoo and conditioners. This market is one of the most favored in Brazil due to this economic moment, which is expected to grow at a CAGR of 3.52% during the years 2023 to 2028, according to research carried out by MORDOR INTELLIGENCE (2023).

In this scenario, studies carried out by EUROMONITOR (2022) predict a significant increase in the purchase of hair care products, with emphasis on the growth in demand for items against hair loss, scalp care and anti-aging products. In addition, consumers are avoiding investing in simpler products to purchase more expensive products, in order to guarantee the most appropriate hair treatment, since one of the biggest concerns nowadays are scalp healthy. Besides the demand for specific products that suit different types of hair (various curvatures and colors) is increasingly high, making it necessary to look in depth at the diagnostic stage for adequate product recommendation.

The objective of this work is to share a small part of a long journey of research and development of an objective tool for the assertive diagnosis of hair damage and the recovery of damage by cosmetics treatments with a future look at the recommendation of specialized products.

We start with our own methodology for evaluating the single hair fiber texture by images analyzing in an algorithm based on GLCM (Gray Scale Co-occurrence Matrix) and second order statistics. The next step was the evolution and scalability to measure hair strands and later on step to measure hair of volunteers.

The first step was to adapt the process of image acquisition from the microscope to a smartphone coupled to magnifying lens device and standardize this acquisition, with parameters such as illumination and angle of incidence of light on the hair strands. Healthy and damaged hair strands were used such with oxidative, thermal, and physical damage eg. like brushing and to different hair curvatures.
The second step was an assessment of the tool built on a pilot scale with 72 volunteers with damaged hair of different curvatures that were initially classified as damaged by a trained hairdresser. This pilot consisted of monitoring the volunteers' hair for a week at different times, T0 - hair as it arrived and after washing with shampoo, T1 – after one treatment with shampoo and conditioner and T7 - after at least four times treatment with the product.

This panel showed significant differences in damage classification between the images collected at different times for the same volunteer, revealing the tool's ability to measure damage and hair repair after 7 days of product repairing treatment. From that moment on, we built a bank of hair images with different degrees of damage and curvature, improved the image capture system with a smartphone and developed a rational based on the degree of damage for product indication.

# Time To Get Vibrational Spectroscopy Out Of The Laboratory & Start Using This Technique For Clinical Studies

**Jessica Turner, Samuel Gourion-Arsiquaud**

TRI Princeton, USA

## ABSTRACT

Fourier Transform InfraRed (FTIR) spectroscopy has been used to characterize various biological tissues including skin, teeth, and bone. This vibrational spectroscopic technique is largely underestimated by the hair and personal care industry. Indeed, this versatile technique can be used at different levels from advanced research to marketing and claim substantiation, from ex-vivo experimentation to clinical evaluations. In this poster, we highlight the versatility of this method by describing different types of clinical applications:

Sebum distribution on the scalp and along hair fibers
Hair damage related to chemical hair treatments
3D scalp mapping to visualize scalp hydration, sebum content or product deposition

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