Cyberspace Chat

John P. Cole, MD *Alpharetta, Georgia, USA* john@forhair.com, and
Bradley R. Wolf, MD, FISHRS *Cincinnati, Ohio, USA* wolf@wolfhair.com


John P. Cole


Bradley R. Wolf

This issue's notes by Dr. Bradley Wolf.

An Examination of the Potential Benefits of Caffeine, Niacinamide, and Panthenol

Dr. Jerry Cooley writes: Over the last couple years, I've recommended various topical caffeine products either as a minoxidil alternative or complement. These include shampoos like Hair Surge or topical leave-ins like Nioxin's Diamax, which has been rebranded as Pantene Age Defy and Head &Shoulders Advanced Thickening Tonic. Caffeine seems to have advantages over minoxidil in that the vehicle is non-irritating/non-allergenic and it does not seem to disrupt the hair cycle (no shedding when beginning therapy). Even if people are non-compliant with daily therapy, it seems to work. Here's more scientific backing for caffeine, from Ralf Paus no less.

Thought I'd pass it along… The conclusion of this article: "This study reveals new growth-promoting effects of caffeine on human hair follicles of both genders at different (molecular, cellular and organ) levels."[1]

Dr. Robert Haber adds: I just read about caffeine metabolism, something I've not done before. Caffeine is rapidly absorbed and enters all body compartments, so it most likely does find its way to hair follicles, and may very well impact growth factors locally. This warrants more study; e.g., what levels of caffeine are required to impact TGF and IGF, and are tissue levels from a cup of coffee adequate? Are balding rates less in regions where the per capita consumption of coffee is dramatically more than other areas? This could be a fun area of research.

Dr. Bessam Farjo asked: Jerry, the work on caffeine has been published a few times now but it's all *in vitro* or animal. I'm not aware of *in vivo* studies, are you? Are you saying results are comparable to topical minoxidil in your experience?

Dr. Cooley replied: Bessam, no, I'm not saying caffeine is comparable to minoxidil. I do not know how it compares in terms of efficacy. What I'm saying is that I'm mildly impressed with its hair thickening ability and very satisfied with its tolerability and patient acceptance. I get a significant amount of complaints about minoxidil: scalp irritation, shedding, dislike of daily usage. I don't get this with the caffeine products I mentioned. Not aware of any *in vivo* studies but I don't expect any either. It's strictly an over-the-counter ingredient that does not require FDA approval; there's no incentive for anyone to spend the $$ on clinical studies.

Dr. Bradley Wolf added: I've used Diamax on my own follicles for over a year and think it helps. I spray it over minoxidil foam. It kind of puts a goo on your follicles but not the obnoxious type that liquid minoxidil does. It apparently has a short-acting follicle coating and "root lift" effect and a longer-acting thickening effect due to cellular hypertrophy. It contains caffeine, panthenol, and niacinamide. It has none of the negative that minoxidil has and it smells great. P&G bought the Nioxin Company to roll out Diamax. They spent years working on Diamax. A new formulation that has double the strength of active ingredients called Diamax Advanced is available. I agree with Jerry. Great for women with low diameter follicles, gives them some hope.

Discussion

Caffeine

In 2007, the effect of caffeine and testosterone on the proliferation of human hair follicles *in vitro* was studied. In this study by Fischer et al, hair follicles from 14 biopsies, taken from the vertex areas of male AGA patients, were cultivated for 120-192 hours *in vitro* with normal William's E medium (control) or William's E medium containing different concentrations of testosterone and/or caffeine. Significant growth suppression of hair follicles treated with testosterone was seen, which was counteracted by caffeine in concentrations of 0.001% and 0.005%. Moreover, caffeine alone led to a significant stimulation of hair follicle growth.[2]

There are now numerous over-the-counter hair care products available containing caffeine in combination with a variety of additional chemicals. Some of the products include: Ultrax Labs Hair Surge Caffeine Hair Loss Hair Growth Stimulating Shampoo (caffeine, ketoconazole, saw palmetto), Alpecin C1 Hair Energizer Shampoo with Caffeine (caffeine, panthenol, niacinamide), Alter Ego—Super Hair Follicle Stimulation Blend (Kenyan coffee, green tea, nettle tea), Syoss Men Hair Growth Shampoo with Keratin & Caffeine (caffeine, keratin), and Diamax (caffeine, panthenol, niacinamide). Nioxin advertises that its Diamax "is proven to: 1. Increase the diameter of each existing hair strand. 2. Penetrate hair and make it fuller and more manageable. 3. Strengthen hair resilience against breakage." (from package labeling).

In the Fischer article referenced by Dr. Cooley, caffeine was shown to enhance hair shaft elongation, prolong anagen duration, and stimulate hair matrix keratinocyte proliferation. Female hair follicles showed higher sensitivity to caffeine compared to male hair follicles. Caffeine counteracted testosterone's effect in male hair follicles. In male and female hair follicles, caffeine enhanced IGF-1 protein (insulin like growth factor expression).[1]

In an additional double-blind, randomized clinical trial comparing the effectiveness of a local solution of minoxidil and caffeine, 60 patients were divided to two equal groups. The first group received minoxidil topical solution 2.5% and the second group received caffeine + minoxidil topical solution 2.5%. The method of treatment was the same in both groups (1 milliliter

of solution was applied twice a day) and follow-up was by computation of hair numbers on area of scalp alopecia. Both groups were followed in 7 stages: at the beginning of study and at days 7, 30, 60, 90, 120, and 150. Results showed that the caffeine + minoxidil topical solution 2.5% was more effective than minoxidil topical solution alone. There was a significant statistical difference between the groups.[3]

A study by Davis et al. examined the ability of a novel leave-on technology combination of caffeine, niacinamide, panthenol, dimethicone, and an acrylate polymer (CNPDA) to affect the diameter and behavior of individual terminal scalp hair fibers as a new approach to counteract decreasing fiber diameters. Their conclusion was that CNPDA significantly increased the diameter of individual, existing terminal scalp hair fibers by 2-5µm, which yields an increase in the cross-sectional area of approximately 10%. Beyond the diameter increase, the CNPDA-thickened fibers demonstrated the altered mechanical properties characteristic of thicker fibers: increased suppleness/pliability (decreased shear modulus) and better ability to withstand force without breaking (increased break stress).[4]

Niacinamide

Niacinamide can be made from niacin in the body. Niacin is converted to niacinamide when it is taken in amounts greater than needed by the body. Niacin and niacinamide are easily dissolved in water and are well-absorbed when taken by mouth. Niacin and niacinamide are required for the proper function of fats and sugars in the body and to maintain healthy cells. At high doses, niacin and niacinamide can have different effects. Niacin might help people with heart disease due to its beneficial effects on clotting. Niacin deficiency can cause a condition called pellagra, which causes skin irritation, diarrhea, and dementia. Pellagra was common in the early twentieth century, but is less common now, since foods are now fortified with niacin.[5]

In a pilot study evaluating the efficacy of topically applied niacin derivatives, octyl nicotinate and tetradecyl nicotinate, for treatment of female pattern alopecia, 60 female subjects with Ludwig types I-III female pattern hair loss were evaluated in a double-blinded, placebo-controlled (40 active, 20 placebo) design using standardized 35mm photographic analyses for assessment of efficacy after 6 months of application. This study demonstrated statistically significant increase in hair fullness on blinded 35mm photographic analysis. Long-term topical application of nicotinic acid derivatives offers promise for providing benefit in female alopecia and warrants further study.[6]

Panthenol

If you read the label on most skin or hair care packages, you'll find panthenol listed. This ingredient is known for moisturizing, thickening, and boosting hair's body quotient. What's more, panthenol is so famous that P&G built an entire line of products around it: Pantene Pro-V. Panthenol is mostly used as a humectant, a substance that helps retain moisture. Panthenol's molecular structure allows it to attract moisture from the atmosphere and bind to water molecules. Panthenol helps moisturize hair and skin and stops both from getting dehydrated. In addition, because panthenol also spreads evenly on the surface of the hair strand, it forms a smooth film over hair cuticles that enhances light reflection and makes hair appear shinier and glossier. What's more, the smooth film also gives hair strands "slip" to discourage nasty knots or tangles.

Dexpanthenol or D-Panthenol is the more stable alcohol form of Pantothenic acid (B5). When applied topically, D-Panthenol is absorbed by the skin where it is converted into Pantothenic acid.

The topical use of panthenol is based on good skin penetration and high local concentrations of panthenol when administered in an adequate vehicle, such as water-in-oil emulsions. Topical panthenol acts like a moisturizer, improving stratum corneum hydration, reducing transepidermal water loss, and maintaining skin softness and elasticity. Activation of fibroblast proliferation, which is of relevance in wound healing, has been observed both *in vitro* and *in vivo* with panthenol. Accelerated re-epithelization in wound healing, monitored by means of the transepidermal water loss as an indicator of the intact epidermal barrier function, has also been seen. Panthenol has been shown to have an anti-inflammatory effect on experimental ultraviolet-induced erythema. Beneficial effects of panthenol have been observed in patients who have undergone skin transplantation or scar treatment, or therapy for burn injuries and different dermatoses. The stimulation of epithelization, granulation, and mitigation of itching were the most prominent effects of formulations containing panthenol. In double-blind placebo-controlled clinical trials, panthenol was evaluated for its efficacy in improving wound healing. Epidermal wounds treated with panthenol emulsion showed a reduction in erythema, and more elastic and solid tissue regeneration.[7]

Summary

The brief literature search synopsized above indicates that there may be value in over-the-counter products containing compounds such as caffeine, niacinamide, and panthenol. All compounds were used *in vitro* or applied topically, not ingested. Studies on the effects of drinking coffee or tea were not encountered. Caffeine concentration was listed in study (1) as 0.005-0.0005% and in study (2) as 0.001% and 0.005%. In all studies in which caffeine was tested, it was identified as a stimulator of human hair growth *in vitro*. Niacin's derivatives were examined in only one study but they demonstrated a statistically significant increase in hair fullness. Panthenol appears to be ubiquitous in hair care products. I find it interesting that the beneficial effects of panthenol have been observed in patients who have undergone skin transplantation or scar treatment. A study of panthenol's effect on healing applied post-operatively to a patient who has undergone hair transplantation would be interesting. Rightly so, most attention is given to medications that reverse and/or stop miniaturization, the hallmark symptom of the inherited hair loss we treat. Most of our patients (and their physicians) are looking for any advantage they can find in the treatment of hair loss. Maybe safe, relatively inexpensive, over-the-counter compounds that increase hair follicle diameter by as little as 2-5 microns and make a visible difference should be considered and recommended.

References

1. Fischer, T.W., et al. Differential effects of caffeine on hair shaft elongation, matrix and outer root sheath keratinocyte proliferation, and TGF-β2-/IGF-1-mediated regulation of hair cycle in male and female human hair follicles *in vitro*. *Br J Dermatol.* 2014 May 16. doi: 10.1111/bjd.13114.

⇨ page 180

Cyberspace Chat *from page 179*

2. Fischer, T.W., U.C. Hipler, and P. Elsner. Effect of caffeine and testosterone on the proliferation of human hair follicles *in vitro. Int J Dermatol.* 2007(Jan); 46(1):27-35.
3. Golpour, M. Rabbani. Comparing the effectiveness of local solution of minoxidil and caffeine 2.5% with local solution of minoxidil 2.5% in treatment of androgenetic alopecia. *Journal of Mazandaran University of Medical Sciences.* 2013; 23:29-36.
4. Davis, M.G., et al. A novel cosmetic approach to treat thinning hair. *Br J Dermatol.* 2011(Dec); 165 (Suppl)3:24-30. doi: 10.1111/j.1365-2133.2011.10633.x.
5. http://www.nlm.nih.gov/medlineplus/druginfo/natural/924.html
6. Draelos, Z.D., et al. A pilot study evaluating the efficacy of topically applied niacin derivatives for treatment of female pattern alopecia. *J Cosmet Dermatol.* 2005(Dec); 4(4):258-61.
7. http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=4678&loc=ec_rcs#x291◆