

Caffeine: Powerbank for hair



Dermatology

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ABSTRACT

There has been remarkable research in the field of hair regeneration in the last decade to combat the mounting burden of hair loss disorders in humans. It has paved the way for better understanding of the pathogenesis and genetic basis of hair loss. Modern technologies in the fields of genetics, stem cells and hair transplantation have augmented the development of novel treatment modalities for alopecia.

Caffeine is novel concept in hair care therapy because it reduces and slows down the process of baldness and also stimulates hair growth. Caffeine inhibits the activity of the 5- α -reductase enzyme and allows a renewed growth phase of the hair. Caffeine prevents dihydrotestosterone (DHT) production from testosterone hence compromised c-AMP generation and energy output reversed.

Caffeine also arouses capillary vessel microcirculation in the skin of the head, thereby contributing to nurture hair bulbs and prevents premature hair loss.

INTRODUCTION

Although hair disorders are not life threatening, their profound impact on social interactions and on patients' psychological well-being is undeniable. The demand for treatments for hair loss fuels a multi-billion dollar industry.

Although both men and women can suffer significant hair loss, over 50% of men will suffer with Male Pattern Baldness (MPB), also known as androgenetic alopecia, at some point in their lives. The reason behind hair loss is a genetically inherited sensitivity to Dihydrotestosterone (DHT) and 5- α -reductase.

Hair requires 10 times higher energy supply to remain in Growth phase (Anagen)

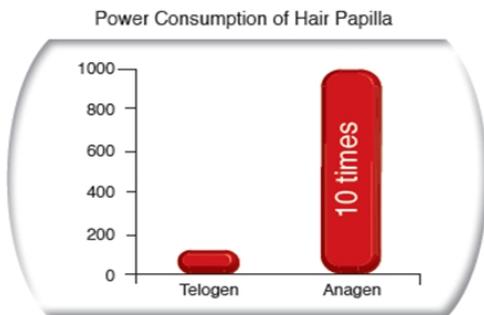


Figure 1: requirement of energy in different phases of hair cycle

5- α -reductase is an enzyme that converts testosterone into the more active dihydrotestosterone (DHT), which is responsible for baldness. DHT results in shortening of anagen phase of the hair growth cycle, most of the hair goes into telogen phase with hair follicle miniaturization and reduction of hair roots.¹

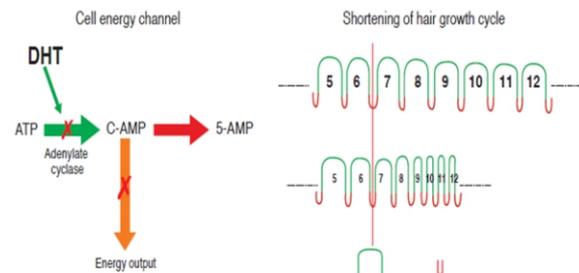


Figure 2: impact of dihydrotestosterone on energy output and hair growth cycle

PROBLEM WITH CURRENT TREATMENT OPTIONS

- Topical minoxidil use leads to increased hair shedding during the first months of the treatment as the drug stimulates telogen follicles to re-enter anagen but because of this, patient discontinue its use.
- Main side effect of topical minoxidil is hypertrichosis, which is more common with the 5% concentration.
- Irritation is more common with the 5% solution due to its higher content in propylene glycole.
- Finasteride is not indicated in women. Long term use is needed for visible results (minimum 6 months)
- Finasteride is only approved for men 18 years of age or older. Topical finasteride is not effective for AGA.
- A review study published in 2011 shows that objective evidence of efficacy is limited, but it may be considered as a treatment for patients who fail topical minoxidil²

CAFFEINE

- Caffeine, a naturally occurring purine based alkaloid, is frequently used as a hydrophilic model substance in skin penetration experiments.
- At concentrations <2%, caffeine acts as a vasodilator, improving blood flow to the scalp to nurture hair bulbs. At higher topical concentrations (i.e., >2%) caffeine tends to be vasoconstrictive.
- It is also a natural antioxidant.
- Caffeine improves barrier functions in the skin.³

EFFECT OF CAFFEINE ON TESTOSTERONE

Caffeine is being increasingly used in cosmetics due to its high biological activity and ability to penetrate the skin barrier.

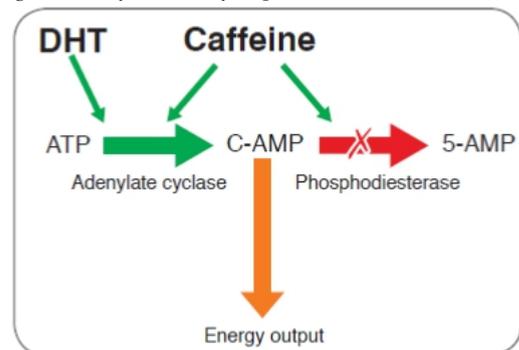
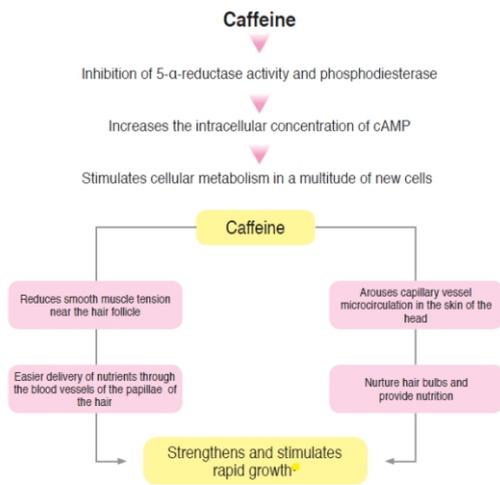


Figure 3: impact of caffeine on energy output

- Caffeine helps to regulate the effects of testosterone levels.
- Caffeine inhibits the activity of the 5- α -reductase enzyme

and allows a renewed growth phase of the hair.

- By inhibiting it, caffeine prevents DHT production from testosterone hence compromised c-AMP generation and energy output reversed. Thus, premature hair loss is prevented.¹
- Caffeine counteracts DHT-induced miniaturization of the hair follicle by inhibiting phosphodiesterase (PDE). Inhibiting PDE activity increases the intracellular concentration of cAMP, and it prevents 5-AMP generation from c-AMP. Thus, by doing so it stimulates cellular metabolism in a multitude of new cells.⁴



CAFFEINE: POWERBANK FOR HAIR

- Caffeine counteracts the reduction in natural energy compound at the hair root by providing active ingredient at the root thus promoting an extended growth phase.
- Caffeine reduces smooth muscle tension near the hair follicle causing an easier delivery of nutrients through the blood vessels of the papillae of the hair.
- Caffeine also arouses capillary vessel microcirculation in the skin of the head, thereby contributing to nurture hair bulbs.
- It strengthens and stimulates rapid growth by regularly providing nutrients with blood to the hair.¹
- As a result, premature hair loss is prevented, hair root activity is increased and the speed of hair growth is improved.⁵

- 1.Enhances hair shaft elongation
- 2.Prolongs anagen duration
- 3.Stimulates hair matrix keratinocyte proliferation.
- 4.Improvement in barrier function
- 5.Counteracts testosterone-enhanced TGF-β2 protein expression in Hair follicles.
- 6.Enhances IGF-1 protein expression.⁶

PENETRATION OF CAFFIENE

The ability of caffeine to penetrate the hair follicles and to stimulate the human hairgrowth in vitro may have an important clinical impact on the management of androgenetic alopecia, a common problem in men of all ages.

Teichmann et al. and Lademann et al. demonstrated that a 2-min contact of a shampoo with caffeine was sufficient for the formulation to penetrate deeply into the hair follicles and remain there for up to 48 h, even after washing of the hair.⁷

Caffeine shampoo that applied daily has been shown to remain on the scalp even after a short application period. This promotes

the absorption of caffeine into the scalp and the hair follicle is provided with the energy needed to continue producing hair. As a result, premature hair loss is prevented, hair root activity is increased and the speed of hair growth is improved.⁵

Study, Year and Design	Aim	Patients and Method	Results	Conclusion
Fischer TW et al., 2007, <i>in vitro</i> study.	To evaluate the effect of caffeine and testosterone on the stimulation of human hair follicles	Scalp biopsy samples (n=14) were obtained from the vertex areas of males with AA; and they were cultivated in vitro for 120-192 hours with testosterone and/or caffeine of different concentrations	Testosterone 5 µg/mL significantly suppressed the growth of hair follicles. This effect was counteracted by caffeine at 0.001% and 0.005% concentrations	Caffeine significantly stimulated the in vitro growth of hair follicles
Brandner JM et al., 2006, double-blind placebo controlled randomized clinical trial	To test the hypothesis that inhibition of phosphodiesterase by caffeine can counteract the effect of testosterone on skin barrier function	The study participants received a hydroxyethylcellulose gel preparation (HEC) with or without 0.5% caffeine. The HEC/caffeine preparation was applied on one forearm, whereas HEC without caffeine was applied on another forearm for 7 days. The transepidermal water loss (TEWL) was calculated before treatment initiation and at the end of the study	Although the basal TEWL did not vary significantly between male and female participants, the use of caffeine significantly decreased TEWL in male skin than in female skin	Caffeine is effective in improving the barrier function in male skin

Table 1: clinical evidences for the use of caffeine for treating androgenetic alopecia

Caffeine	Minoxidil
Vasodilatation	Vasodilatation
Inhibits DHT	No evidence
Prolongs anagen phase	May prolong anagen phase
No evidence	Shortens telogen phase
Promote hair growth	Promote hair growth
Effective for men and women	Effective for men and women
Reduces miniaturization	No known mechanism
High skin penetration	Poor penetration
Stimulates growth factors	Stimulates growth factors
Reduces TGF-β2 protein	No evidence

Table 2: Mechanism comparison of caffeine with minoxidil

Caffeine	Minoxidil
Rare sensitivity	Skin irritation at moderate rate, burning, stinging, redness
None	Early minoxidil hair loss (4-6 weeks) before showing results
None	Hypertrichosis
None	Systemic effects noted 1. Cardiovascular 2. Weight gain 3. Swelling of hand and feet
None	Severe allergic reactions

TABLE 3: Safety comparison of caffeine with minoxidil

Conclusion

Many of today's treatments associated with 'thinning hair' are focused on two of the key aspects of the condition. Over-the-counter or prescription medications are often focused on improving scalp hair density while high-quality cosmetic products work to prevent further hair damage and minimize mid-fibre breakage. Despite this, most currently marketed products are ineffective, evidenced by the fact that the FDA has approved only two treatments for hair loss. Recently there have been dramatic advances in our understanding of the molecules and pathways regulating hair follicle formation and hair growth. Caffeine based formulations significantly increases the diameter of individual, existing terminal scalp hair fibres. Beyond the diameter increase, it increases suppleness/pliability (decreased shear modulus) and better ability to withstand force without breaking (increased break stress).

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