

AURRELLE

The Evidence Beneath the Light

Lucine's wavelengths weren't chosen arbitrarily — they're grounded in a real, growing body of independent, peer-reviewed research on red light and near-infrared therapy for hair. Here's the actual science, with every source linked so you can read it yourself.

Why the Scalp, Not Just the Strand

The hair you can see is already finished. By the time a strand leaves the scalp, it's dead keratin — a fiber a hairdryer can smooth, dry, or damage, but never actually grow. The part of the story that matters happens underneath, in the follicle: a small, living structure shaped by microcirculation, hormones, immune activity, inflammation, and available cellular energy.

Every follicle moves through a cycle. Anagen is the active growing phase, sometimes lasting years. Catagen is a brief transition. Telogen is a resting phase before the strand releases and the cycle starts again. Stress, illness, hormonal shifts — postpartum change, perimenopause, thyroid fluctuations — can push large numbers of follicles into telogen at once, which is why shedding sometimes appears suddenly rather than gradually.

This is the real reason a scalp-first approach is a different category of care than styling. A dryer changes how a strand looks within minutes. A follicle changes on a timeline measured in weeks and months. Comfort and finish are immediate; density, shedding, and shaft thickness are slow variables that only show change with sustained, repeatable input.

For women specifically, this distinction shows up around a set of life events that don't affect men's hair biology the same way. Postpartum hormonal shifts can push a large proportion of follicles into telogen simultaneously, producing the shedding many new mothers notice around three to six months after delivery. Perimenopause and menopause bring their own hormonal changes that can thin hair gradually over years rather than suddenly. Chemical services — coloring, relaxing, keratin treatments — add a separate, cumulative mechanical and chemical stress to the shaft itself, layered on top of whatever is happening at the follicle level. And hair texture changes the physics of drying entirely: dense, curly, and coily hair patterns require different airflow, moisture handling, and heat distribution than straight hair, which is a separate engineering problem from anything related to scalp biology, but one that shapes how any scalp-directed technology needs to actually reach the scalp through the hair itself.

What Photobiomodulation Actually Does

Photobiomodulation (PBM) is the study of how specific wavelengths of red and near-infrared light interact with living tissue — not as heat, and not as a cosmetic treatment applied to the visible hair,

but as a biological signal absorbed by cells beneath the surface.

The published mechanism most frequently cited involves mitochondria — specifically an enzyme called cytochrome-c oxidase, which absorbs light at these wavelengths and increases the cell's production of ATP, its basic energy currency. More available cellular energy is theorized to support the metabolic demands of an active hair follicle, alongside effects on local circulation and inflammatory signaling. Light doesn't "grow hair" directly. It's studied as an input into the biological environment that determines whether a follicle thrives or struggles.

This matters for how any red-light claim should be read: PBM is a mechanism under active study, not a guaranteed outcome. The studies below report real, measured results in real participants — but individual response varies, and none of this replaces medical evaluation for a diagnosed scalp or hair condition.

How to Read This Kind of Research

Not all studies carry the same weight, and it's worth understanding what separates a stronger piece of evidence from a weaker one before reading the summaries below.

Sham-controlled versus uncontrolled. The strongest studies compare an active treatment group against a "sham" group — participants who use an identical-looking device that doesn't actually emit therapeutic light. This matters because hair growth naturally fluctuates, and people photographing their own hair tend to notice improvement they're hoping to see. A sham comparison controls for that bias. Several studies below use this design; where a study doesn't, that's noted.

Objective counting versus visual impression. The more rigorous studies use standardized photography of a marked, fixed scalp area and count actual hairs — rather than relying on a participant's or investigator's general impression of "looking fuller." Counted-hair studies are harder to run and produce smaller sample sizes, but they produce more reliable numbers.

Sample size and study design. A multicenter randomized trial with dozens or hundreds of participants carries more statistical weight than a single case report. That doesn't make case reports worthless — they can document a specific, unusual, or particularly clear result — but a case report describes what happened to one person, not what to expect on average.

What's actually being measured. Density (hairs per square centimeter), shaft thickness (diameter of individual strands), shedding (often measured via a "pull test," where a gentle tug either does or doesn't release loose hairs), and overall coverage are four genuinely different measurements. A study reporting improvement in one doesn't necessarily mean improvement in all four — which is exactly why the summaries below specify which outcome each study actually measured, rather than using a single vague word like "improvement."

Why 660nm and 850nm, Specifically

Not all red light is the same, and wavelength selection isn't arbitrary. Lucine's optical system uses two channels: a nominal 660 nanometer visible-red wavelength and a nominal 850 nanometer near-infrared wavelength.

The 660nm channel sits inside the exact range used across the visible-red hair research summarized below — including studies using precisely 660nm, and others using closely adjacent wavelengths like 655nm and 675nm. Visible red light of this wavelength interacts primarily with tissue near the surface.

The 850nm channel sits inside the broader 820–880nm near-infrared band used in combined-spectrum protocols. Near-infrared light penetrates further, extending the interaction deeper into scalp tissue than visible red alone can reach.

Used together, the two wavelengths are intended to create complementary coverage — surface and depth — rather than relying on a single wavelength to do both jobs. This dual-channel logic is the direct throughline between the published research below and the specific hardware choice inside Lucine.

The Published Research

What follows are summaries of independent, peer-reviewed studies on red light and near-infrared therapy for hair, prioritizing research conducted in women or with distinct female treatment arms, since that's the population most directly relevant to Lucine's design intent. Each summary states the population, wavelength, duration, and reported outcome, with a link to the original source so you can read the full study yourself.

Lanzafame et al. — visible red light in women. This controlled study photographed defined scalp zones in female participants before and after 16 weeks of 655nm red-light exposure, using repeatable photography and counted hair totals rather than subjective before-and-after impressions. Two tracked zones moved from 153 to 221 counted hairs and from 108 to 209 respectively. Across the active treatment group, the mean reported increase was 48.07%, compared with 11.05% in the sham (inactive-device) control group. The methodological detail worth noting here isn't just the percentage — it's that a defined zone and objective counting method produce a more credible record than an uncontrolled photo comparison. [Read the study](#)

Jimenez et al. — a multicenter randomized trial with female treatment arms. This larger study included both men and women with pattern hair loss, using global photography and objective hair counting across multiple research centers. The female treatment arms specifically reported gains of approximately 20 terminal hairs per square centimeter over 26 weeks, compared with approximately 3 hairs per square centimeter in the sham group. The research team included investigators affiliated with the University of Miami Miller School of Medicine, Cleveland Clinic, and the Wellman Center for

Photomedicine. [Read the study](#)

Yoon et al. — a 16-week controlled study using 655nm light. This Korean multicenter, randomized, double-blind trial evaluated a targeted scalp-light protocol for androgenetic (pattern) hair loss. One individual case published within the study — a 62-year-old woman with Ludwig grade II pattern loss — showed a 25% increase in hair density and a 3.1% increase in shaft thickness after 16 weeks. Density and thickness are measured separately because visible fullness can improve from more hairs, thicker hairs, or both — this study tracked them as distinct endpoints rather than one combined "improvement" score. [Read the study](#)

Palma et al. — a case study using the exact 660nm wavelength. This case report followed a 31-year-old woman with alopecia areata (an autoimmune condition causing patchy hair loss) through baseline, day 7, day 14, day 21, and a four-month follow-up. A defined 7.5 × 3.5 centimeter area received continuous-wave 660nm red light daily for 21 days. The report documented visible regrowth as early as day seven, with no reported relapse at the four-month follow-up. Because this study used exactly 660nm — not an adjacent wavelength — it's directly relevant to the specific red-light channel Lucine uses. [Read the study](#)

Chandrashekar et al. — 675nm light across 14 sessions. This Indian clinical study photographed three identified female participants before and after approximately four months of 675nm laser treatment, alongside male participants in the same protocol. The mixed-group hair-count change across the full study population was 17.19%. The three female cases add a direct dermatoscopic (magnified scalp imaging) record of part-line and density change specifically in women over the treatment period. [Read the study](#)

Rodrigues et al. — a split-scalp design isolating PBM's added effect. Published in **Lasers in Medical Science** (2025), this study evaluated 660nm photobiomodulation as an addition to 5% topical minoxidil, a widely used over-the-counter hair loss treatment. All nine female participants applied minoxidil twice daily to their entire scalp; one randomly assigned side of the scalp additionally received red light, while the other side received an inactive sham light. Both sides improved over the study period, but the side receiving both minoxidil and PBM showed a stronger reduction in telogen-phase (resting/shedding) hairs than the minoxidil-only side. The split-scalp design is a particularly useful structure because it isolates the light's specific contribution within the same person, rather than comparing separate groups. [Read the study](#)

Kim et al. — a combined-spectrum protocol tracked at 12 and 24 weeks. This study used a multi-wavelength protocol combining 630–690nm red light, 820–880nm near-infrared, and 910–970nm infrared — a broader combined-spectrum approach rather than a single isolated wavelength. Across 24 completers, hair density increased by 8.57 hairs per square centimeter at 12 weeks and 15.06 hairs per square centimeter at 24 weeks. Shaft thickness increased by 11.57 micrometers and 15.04 micrometers at the same two checkpoints, tracked as a separate measurement from density. [Read the study](#)

Gerkowicz et al. — red LED light in a women-dominated telogen effluvium cohort. Telogen effluvium is a form of diffuse shedding often triggered by stress, illness, or hormonal change — distinct from pattern hair loss. In a cohort where 135 of 140 participants were women, this study reported negative pull-test rates (a clinical measure of active shedding, where a "negative" result indicates shedding has reduced) of 86.8% in the treatment group versus 48.1% in comparison, for uncomplicated telogen effluvium. Where pattern hair loss was also present, the figures were 78.7% versus 46.2%. It's worth noting a pull test measures active shedding specifically — it doesn't measure density, thickness, or coverage, which is why credible reporting on hair health tracks these as separate outcomes rather than one single number. [Read the study](#)

What the Research Shows, Taken Together

Across these eight independent studies — spanning different research teams, different countries, different exact wavelengths within the red and near-infrared range, and different hair conditions — a consistent pattern emerges: photobiomodulation is associated with measurable movement in the specific outcomes that actually matter for hair health. Not a single vague "improvement" score, but distinct, separately tracked measures: hair count, visible density, shaft thickness, active shedding, and scalp condition.

No individual study proves that any specific consumer device — including Lucine — will reproduce these exact results. These are studies of the wavelengths and the biological mechanism, using dedicated research-grade light sources and controlled protocols, not studies of Lucine itself. What this research does establish is the scientific rationale for selecting 660nm and 850nm specifically, out of the much broader range of light wavelengths that exist.

The Heat Side of the Equation

The wavelength research above addresses one half of what happens during a drying-and-styling routine. The other half is heat itself, and the research on that side is worth including for the same reason: it shapes why Lucine's engineering treats the scalp and the styling heat as two separate problems rather than one.

A widely cited 2011 study by Lee et al. examined hair-fiber damage as a function of drying temperature and found progressively greater surface damage to the cuticle as temperature increased — an intuitive finding, but one that was actually measured rather than assumed. [Read the study](#) A more recent 2025 study by Zi et al. built a repeated-drying model and reported lifted cuticles along with deterioration across moisture, mechanical strength, and protein-structure measures of the hair fiber after repeated heat exposure under controlled test conditions. [Read the study](#)

What neither of these heat-damage studies address — and what the premium hairdryer industry doesn't yet have a widely adopted framework for — is *cumulative* scalp exposure over months and

years of ordinary use. A single drying session's temperature is only one variable; the fuller picture includes duration, distance from the scalp, airflow pattern, how wet the hair is when drying starts, and how often the routine repeats across a lifetime of hair care. This is the reasoning behind Lucine's InfraSonic system, which cycles airflow and temperature dynamically rather than holding one uninterrupted peak heat state throughout a drying session — a design response to the heat-damage research, running independently from and alongside the separate 660nm/850nm optical system, which can be used with or without InfraSonic active.

How Delivery Method Changes the Real-World Picture

The research above establishes that specific wavelengths, delivered consistently, are associated with measurable outcomes. But the studies themselves were conducted using dedicated research-grade light sources, not consumer hairdryers — so it's worth addressing directly how photobiomodulation reaches people outside a lab setting today, and where a handheld dual-purpose device fits into that picture.

The most established consumer category is dedicated caps and helmets — devices like Capillus, iRESTORE, and Theradome, which use multiple laser or LED diodes arranged around the scalp. These devices are purpose-built for photobiomodulation alone; a session typically means sitting still, wearing the device, and doing nothing else for the duration. Clinic-based photobiomodulation sessions follow a similar single-purpose logic: a dedicated appointment, at a dedicated location, for a treatment that doesn't fit into an existing routine.

Both approaches share the same underlying friction: they ask for a new, separate ritual. The research on consistency is intuitive even without a citation — a treatment only works if it's actually used on schedule, and a treatment that competes with an already-busy routine is harder to sustain than one that's built into a routine that already happens daily. Hair drying is one of the few beauty behaviors most women already do multiple times a week, often more.

This is the specific gap Lucine's design targets: rather than adding a new appointment or a new device to remember, the same object already used to dry and style hair also delivers the 660nm and 850nm wavelengths, through a clearly separated ritual (Cool Shot, then the optical system, held at a defined distance for a defined time) that sits inside a routine that's already happening rather than competing with it. This is a design and behavioral argument about adherence and consistency — it is separate from, and doesn't change, the underlying photobiomodulation research summarized above, which was conducted independently of any delivery device.

How This Shaped Lucine's Design

Lucine's five-pod optical system delivers both wavelengths together through a dedicated ritual, separate from ordinary drying and styling: begin with Cool Shot at approximately 20°C, activate the

dual-wavelength light, hold the optical face approximately 2–3 centimeters from the scalp, and complete each zone for 15 minutes, five sessions per week.

This protocol reflects the same variables the research above treats as essential: a defined area, a consistent distance, a repeatable duration, and a measurement mindset that separates immediate comfort from slower structural change. Aurrelle's own recommended tracking timeline follows the same logic — scalp comfort and drying experience are the earliest signals, shedding and root strength are mid-range indicators around 4–12 weeks, and visible density or coverage change is a longer-term measure typically assessed from three months onward.

Frequently Asked Questions

How long does it take to see results from red light therapy on the scalp?

Across the studies summarized above, the earliest measured checkpoints were typically around 8 to 12 weeks, with more pronounced changes reported at 16 to 26 weeks. One case study reported visible regrowth as early as day seven, but that was a single documented case, not an average across a study population. Photobiomodulation is a cumulative, slow-timeline process — it isn't designed to produce an overnight change, and any claim suggesting otherwise should be treated with skepticism.

Does red light therapy work the same way for women as it does for men?

The underlying mechanism — cellular energy production via cytochrome-c oxidase, effects on local circulation and inflammatory signaling — isn't inherently sex-specific at the cellular level. However, the *causes* of hair thinning often differ meaningfully between women and men: hormonal patterns, pattern hair loss presentation, and conditions like postpartum shedding or telogen effluvium are more common or present differently in women. That's precisely why this page prioritizes studies with dedicated female treatment arms or women-only cohorts, rather than relying on research conducted primarily in men and assuming the results transfer directly.

Is 660nm better than other red-light wavelengths?

The research doesn't establish a single "best" wavelength — it establishes that a range of wavelengths within the red and near-infrared spectrum, roughly 630–680nm for visible red and 820–880nm for near-infrared, are associated with measurable outcomes across multiple independent studies. 660nm sits centrally within that visible-red range and has direct research using that exact wavelength, which is why it was selected — not because adjacent wavelengths like 655nm or 675nm are known to be inferior.

Can red light therapy help with hair loss caused by any condition, or only certain types?

The studies above cover several distinct causes of hair thinning: androgenetic (pattern) hair loss, telogen effluvium (stress or illness-related shedding), and alopecia areata (an autoimmune condition). The mechanisms and expected response can differ by underlying cause, which is exactly why a proper diagnosis matters before assuming any treatment — light-based or otherwise — is the right approach. If the cause of hair thinning is unclear, that's a conversation for a dermatologist or trichologist, not something to self-diagnose from a research summary.

Why does this page compare Lucine to research studies instead of showing Lucine's own clinical trial data?

Because those are two different things, and conflating them would be misleading. This page explains the published, independent science behind the *wavelengths* Lucine uses — research conducted by unrelated academic and clinical institutions, using dedicated research equipment, published in peer-reviewed journals you can read yourself via the links above. It is not a clinical trial of the Lucine device. Aurrelle's own examination process, involving Lucine users specifically, is a separate body of information from the third-party research summarized on this page.

Regulatory Context for This Device Category

Laser and light-based hair growth devices exist as a recognized regulatory category in some markets. In the United States, for example, the FDA has cleared multiple devices in this category through its 510(k) pathway as Class II low-risk medical devices, including at least one device specifically cleared for female androgenetic alopecia. This regulatory history is useful context for understanding that photobiomodulation for hair is an established, recognized device category with real precedent — not a fringe or unregulated claim space. It is not a statement that Lucine itself holds any such clearance or classification; Lucine is marketed as a beauty and wellness device, and any specific regulatory status should be confirmed directly with Aurrelle rather than inferred from this general category context.

A Note on What This Page Is — and Isn't

To be direct about the limits of this page: the research above is real, independently published, peer-reviewed science — every study is linked to its original source so you can read it in full, verify the methodology, and draw your own conclusions. It is the scientific foundation for *why* Lucine uses the wavelengths it uses.

It is not a clinical trial of the Lucine device itself, and it should not be read as a guarantee of any specific personal result. Individual response to any hair or scalp treatment varies based on the underlying cause of hair thinning, overall health, consistency of use, and factors no single study can control for. If you have a diagnosed scalp condition, active hair loss with an unclear cause, or any concern about a light-based device, the right first step is a conversation with a qualified healthcare

professional — not a consumer device, however well-designed.

Aurrelle Global Ltd. — aurrelle.com — This document summarizes independent, peer-reviewed research. It is not a clinical trial of the Lucine device.