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REVIEW ARTICLE

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REVEALING THE COMPLEXITIES OF HAIR GROWTH: UNDERSTANDING THE DYNAMICS OF THE HAIR GROWTH CYCLE

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ABSTRACT

The hair growth cycle is a continuous and dynamic process consisting of four main phases: anagen (growth), catagen (regression), telogen (rest), and exogen (shedding). The duration of these phases varies depending on factors such as hair location, nutritional status, hormonal levels, and age. Each phase plays a critical role in hair development and renewal. Anagen Phase: This is the active growth phase where hair follicles enlarge, take their original shape, and produce hair fibers. Around 85-90% of all scalp hairs are in this phase, which can last up to 6-8 years. Key regulatory proteins and growth factors, such as BMPs, IGF-1, and VEGF, are crucial for maintaining anagen. Catagen Phase: This short, transitional phase lasting about 2-3 weeks involves the cessation of hair growth and the formation of club hair. Catagen is characterized by a controlled regression and apoptosis of the follicle, driven by signaling molecules like FGF5 and TGF- β 1. Telogen Phase: Lasting approximately 2-3 months, telogen is a resting period where the hair follicle remains inactive, and the club hair is eventually shed. Factors such as androgens and thyroid hormones influence this phase, and BMP-4 is vital for suppressing follicular growth during telogen. Exogen Phase: This distinct phase focuses on the active shedding of hair, operating independently from anagen and telogen. The mechanism of hair shedding is not well-studied but is essential for hair renewal. The hair shaft consists of three main layers: the medulla, cortex, and cuticle, each with specific physiological roles. Various conditions, such as split ends, hair loss, dandruff, and frizz, affect hair health and appearance. Solutions range from proper nutrition and stress management to the use of specific hair care products and treatments. Herbal plants and their extracts play a significant role in hair care, offering benefits like nourishment, growth stimulation, and anti-dandruff properties. Ingredients used in polyherbal oils, such as amla, hibiscus, and coconut oil, provide moisture, strengthen hair, and promote growth. Hair oils offer multiple benefits, including conditioning, strengthening, and protecting hair from damage, while improving its texture and shine.

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INTRODUCTION

Hair Growth Cycle: (1,2) Hair development is a continuous cyclic process and all mature follicles go through a growth cycle consisting of growth (anagen), regression (catagen), rest (telogen), and shedding (exogen) phases (Figure 3). The duration of the phases changes based on the location of the hair and also personal nutritional and hormonal status and age. The hair growth cycle consists of four main phases: F3

Anagen (3,4): The inception of the anagen phase is presented by the onset of the mitotic activity in the secondary epithelial germ located between the club hair and dermal papilla in the telogen hair follicle. The anagen is the active growth phase in which the follicle enlarges and takes the original shape and the hair fiber is produced. Almost 85-90% of all scalp hairs are in anagen.

Six portions of the anagen stage are demonstrated. Through the anagen I-V, hair stem cells proliferate, enclose the dermal papilla, grow downwards to the skin, and begin to proliferate the hair shaft and IRS, respectively. Subsequently, hair matrix melanocytes begin to develop pigment and the form of the hair shaft begins to arise; in anagen VI, the hair bulb and adjacent the dermal papilla formation is realized and the new hair shaft appears from the skin. This phase can last up to 6-8 years in hair follicles. Hair shaft synthesis and pigmentation only take place in anagen. The degree of axial symmetry within the hair bulb determines the curvature of the final hair structure. Fiber length is often dependent on the duration of the anagen or actively growing phase of the follicle. The featured regulatory proteins in the anagen phase are BMPs, sonic hedgehog, several WNT proteins and receptors. Insulin-like growth factor-1 (IGF-1), fibroblast growth factor-7 hepatic growth factor (HGF), and vascular endothelial growth factor (VEGF) are thought to be

important for anagen maintenance. Anagen Phase: This is the active growth phase of hair follicles. During anagen, cells in the root of the hair divide rapidly, adding to the hair shaft's length. The duration of this phase varies depending on genetics, body location of the hair, and other factors, but it typically lasts from 2 to 7 years.

Catagen:(5,6) At the end of anagen, the mitotic activity of the matrix cells is diminished and the follicle enters a highly controlled involutary phase known as catagen. Catagen lasts approximately 2 weeks in humans, regardless of the site and follicle type. During catagen, the proximal part of the hair shaft is keratinized and forms the club hair, whereas the distal part of the follicle is involuted by apoptosis. The catagen phase consists of eight different stages. The first sign of catagen is the termination of melanogenesis in the hair bulb. Follicular epithelium, mesenchyme, neuroectodermal cell populations, and also perifollicular vascular and neural systems demonstrate cyclic changes in differentiation and apoptosis. However, any apoptosis occurs in the dermal papilla due to the expression of suppressor bcl-2. Catagen is a process of bulbar involution. The perifollicular sheath collapses and vitreous membrane thickens. Eventually, the lower hair follicle becomes reduced to an epithelial strand, bringing the dermal papilla into close proximity of the bulge [36]. The epithelial strand begins to elongate and finally reaches to just below the insertion of pilar muscle. After the keratinization of the presumptive club hair, the epithelial strands begin to involute and shorten progressively followed by the papilla which condenses, moves upward and locates to rest below the bulge. The column eventually reduces to a nipple and forms secondary hair germ below the club. The club hair itself is formed from cortical and cuticle cells only, and it is characterized by a lack of pigmentation. The presence of hairless gene mutation contributes to the failure of dermal papilla migration toward the bulge area in the catagen phase [3]. FGF5 is a key inducer of catagen and FGF5-deficient mice have a prolonged anagen phase. In addition to FGF5, TGF- β 1, and IL-1b, the neurotrophins NT-3, NT-4 BMP2/4, and TNF- α have been described to induce catagen. Catagen Phase: This is a transitional phase where hair growth stops. It is a short phase lasting about 2-3 weeks. During catagen, the hair follicle shrinks and detaches from the dermal papilla, which is the structure that supplies nutrients to the hair bulb. Catagen is a critical phase in the hair growth cycle that follows anagen (the growth phase). It represents a highly controlled evolutionary process, lasting about two weeks in humans, and is essential for transitioning the follicle from growth to rest.

During Catagen, Several key Changes Occur

Termination of Melanogenesis: The first sign is the cessation of melanogenesis in the hair bulb.

Keratinization and Club hair Formation: The proximal part of the hair shaft becomes keratinized, forming the club hair, while the distal follicle undergoes apoptosis.

Cyclic Changes and Apoptosis: Differentiation and apoptosis occur in follicular epithelium, mesenchyme, neuroectodermal cell populations, and perifollicular vascular and neural systems, but not in the dermal papilla due to bcl-2 expression.

Bulbar Involution: The perifollicular sheath collapses, the vitreous membrane thickens, and the lower hair follicle reduces to an epithelial strand. This brings the dermal papilla closer to the bulge.

Epithelial Strand and Club Hair Formation: The epithelial strand elongates to just below the pilar muscle insertion, and after the club hair keratinizes, it shortens, moving the dermal papilla upward to rest below the bulge. The column forms a secondary hair germ below the club, which lacks pigmentation.

Genetic Factors also play a role in Catagen Regulation: Short Notes on Catagen Phase and Hairless Gene Mutation.

Catagen Phase Overview:

- Duration: Approximately 2 weeks in humans.

- Process: The hair follicle transitions from an active growth phase (anagen) to a regressive phase.
- Key Changes:
- Termination of Melanogenesis: Melanocytes stop producing pigment.
- Keratinization: The proximal part of the hair shaft forms the club hair.
- Apoptosis: The distal part of the follicle undergoes apoptosis, causing involution.
- Dermal Papilla Migration: Moves closer to the bulge area but can be disrupted by genetic mutations.

Stages of Catagen

1. **Melanogenesis Termination:** Initial sign of catagen.
2. **Follicular Changes:** Epithelium, mesenchyme, neuroectodermal cells, and perifollicular systems undergo cyclic differentiation and apoptosis.
3. **Apoptosis Suppression:** Dermal papilla apoptosis is inhibited by bcl-2 expression.
4. **Bulbar Involution:** Perifollicular sheath collapses, and the follicle reduces to an epithelial strand.
5. **Club Hair Formation:** Keratinized hair forms a club hair, lacking pigmentation.

Key Signaling Molecules

- FGF5: Induces catagen; deficiency results in prolonged anagen phase.
- TGF- β 1, IL-1b, NT-3, NT-4, BMP2/4, TNF- α : Other molecules involved in catagen induction.

Hairless gene Mutation

Effect: Disrupts dermal papilla migration during catagen, affecting the proper transition of the follicle.

Telogen (7,8): The telogen stage is a critical phase in the hair growth cycle, situated between the completion of follicular regression and the initiation of the subsequent anagen phase. Typically lasting 2 to 3 months, this phase involves approximately 10 to 15% of all hair follicles. During telogen, the hair follicle is in a quiescent state, with the hair shaft transforming into a club hair before being shed. The follicle remains inactive until the hair germ, which responds to anagen-initiating signals from the dermal papilla, begins to show increased proliferative and transcriptional activity late in the telogen phase, leading to the onset of a new anagen phase. Several factors influence the telogen phase, including androgens, prolactin, ACTH, retinoids, and thyroid hormones. Although specific molecular markers for telogen follicles have not been conclusively identified, estrogen receptor expression is noted to be limited to telogen papilla fibroblasts. Additionally, telogen germ cells express basonuclin and FGF-5. Bone morphogenic protein-4 (BMP-4) is a key growth factor that plays a crucial role in suppressing follicular growth and differentiation during telogen. The surrounding macro-environment also affects the hair cycle transitions. BMPs in the subcutaneous fat can maintain follicles in a "refractory" telogen state. The cessation of this BMP activity allows the follicle to progress to a "competent" telogen state, where the hair germ becomes responsive to signals that initiate the anagen phase, thus restarting the hair growth cycle.

Key Characteristics and Processes during the Telogen Phase Include

Resting Period: The follicle remains in a dormant state until the initiation of the next anagen phase.

Club Hair Formation and Shedding: The hair shaft is transformed into a club hair, which is ultimately shed from the follicle.

Initiation of Anagen: Late in telogen, hair germ cells become RESPONSIVE to signals from the dermal papilla, leading to

increased proliferative and transcriptional activity that initiates the next anagen phase. Telogen is influenced by various modulatory agents, such as androgens, prolactin, ACTH, retinoids, and thyroid hormones. Estrogen receptor expression is restricted to the telogen papilla fibroblasts, and telogen follicles express basonuclin and FGF-5. Bone morphogenetic protein-4 (BMP-4) plays a crucial role in suppressing follicular growth and differentiation during telogen. The surrounding macro-environment, including subcutaneous fat, also regulates the hair cycle. BMPs in the subcutaneous fat can maintain follicles in a "refractory" telogen. When the inhibitory activity of BMPs ceases, the follicle transitions to a "competent" telogen state, where the hair germ is responsive to anagen-initiation signals, allowing the follicle to enter a new anagen phase.

Exogen (9,10): Certainly! Here's a revised version of the paragraph that maintains the focus on the exogen phase and clarifies its distinction from the other phases of the hair growth cycle:

The exogen phase is a distinct part of the hair growth cycle specifically focused on the shedding of hair, which is crucial for hair appearance and density from a patient's perspective. Unlike the telogen (resting) and anagen (growth) phases, exogen is a unique phase where the hair shaft is actively shed. This shedding process often happens independently of the telogen and anagen phases, which suggests that exogen and anagen are separate phases of the hair growth cycle. It is not uncommon for hairs in the telogen phase to remain in the follicle for multiple cycles before shedding. This retention indicates that the exogen phase is an active process and operates separately from the other phases. Despite its importance, the mechanism behind hair shedding is less studied, but it is vital for hair regrowth as new hair begins to grow from the same follicle after shedding. The duration of each phase, including exogen, can be influenced by factors such as genetics, age, hormonal changes, and overall health. Different body areas also exhibit varying lengths of hair growth cycles, with scalp hair typically having a longer anagen phase compared to eyebrows or eyelashes.

Key Points about Exogen Include

Active Shedding Process: Exogen is considered an active phase where the hair shaft is naturally shed from the follicle. Independence from Other Phases: Exogen operates independently of the telogen and anagen phases. It is not unusual for telogen hairs to be retained through more than one follicular cycle, indicating that the initiation of shedding does not necessarily coincide with the transition from telogen to anagen.

Retention of Telogen Hairs: Human telogen hairs can be retained beyond one cycle, suggesting that shedding can occur independently and at varying times for each follicle. The mechanism of hair shedding in exogen, although less understood, highlights the complexity of hair growth and loss cycles. Understanding this phase better can help in developing treatments for hair loss conditions and improving patient outcomes related to hair density.

Physiological of hair layers: The hair shaft consists of multiple layers, each with distinct physiological roles and characteristics. Understanding these layers helps explain how hair grows, its structure, and its function. Here are the primary layers of the hair shaft:

1. Medulla

- **Location:** Central core of the hair shaft.
- **Structure:** Composed of loosely packed, disordered cells and air spaces.
- **Function:** Its exact function is not completely understood, but it may play a role in providing flexibility and lightness to the hair.

2. Cortex

- **Location:** Surrounds the medulla and makes up the bulk of the hair shaft.

- **Structure:** Comprised of elongated, keratin-rich cells packed with fibrous proteins. The cortex contains melanin, which gives hair its color.
- **Function:** Provides strength, elasticity, and resistance to hair. The arrangement of keratin fibers in the cortex is critical for the hair's tensile strength and texture.

3. Cuticle

- **Location:** Outermost layer of the hair shaft.
- **Structure:** Consists of overlapping, scale-like cells that protect the inner layers of the hair.
- **Function:** Acts as a protective barrier against physical and chemical damage. The smoothness and integrity of the cuticle affect the hair's shine and manageability.

Physiological Roles of Hair Layers

- **Protection:** The cuticle shields the inner cortex and medulla from environmental damage (UV radiation, chemicals, physical abrasion).
- **Strength and Flexibility:** The cortex provides the structural integrity of the hair, allowing it to bend without breaking.
- **Color and Appearance:** Melanin in the cortex determines hair color, while the condition of the cuticle influences the hair's shine and smoothness.
- **Insulation:** Although more significant in animals, the medulla can contribute to insulation properties by trapping air.

Additional Structures

- **Hair Follicle:** The sheath of cells and connective tissue that surrounds the root of the hair. It anchors the hair into the skin.
- **Inner Root Sheath (IRS):** Surrounds the hair shaft and helps guide the hair through the follicle.
- **Outer Root Sheath (ORS):** Extends from the epidermis down to the hair bulb.
- **Hair Bulb:** The base of the hair follicle, where actively dividing cells produce the hair.
- **Dermal Papilla:** Located at the base of the hair bulb, it contains blood vessels that supply nutrients and signals to the growing hair.

Hair Cycle Clock (11)

Based on the observations: the hair follicle does not need intact innervation, vascularization, or other extrafollicular components to maintain cycling, and the basic oscillator system that controls hair cycling is located presumably in the follicle [42]. The principal challenge is to define the underlying "oscillator" system. Probably, the hair cycle clock is controlled by regulating the balance of the interactions between the follicle epithelium and the surrounding mesenchyme. This might be provided by the rhythmic secretions of growth/modulatory signals from follicle epithelium or mesenchyme as well as the rhythmic alterations in the expressions of corresponding receptors

Allopathy Medication and its Side Effects

Topical Minoxidil (12): Topical minoxidil, used to prevent hair thinning and stimulate growth, has rare side effects such as scalp redness, irritation, and facial hair growth. The 5% foam version reduces irritation as it lacks propylene glycol, unlike the solution forms. Oral finasteride, another hair loss treatment, can occasionally cause erectile dysfunction, decreased libido, and depression, with potential for rare adverse effects like elevated liver enzymes and migraines. Antiandrogens may lead to irregular menstrual periods and drowsiness, and should be avoided by women trying to conceive. Corticosteroids can cause scalp irritation, while antifungal medications might result in rash, diarrhea, and upset stomach.

Bicalutamide, a type of antiandrogen, is considered a safe and effective option for female pattern hair loss.

Hair related Problem and their Solution

Split Ends (13,14): Split ends happen when the cuticle, the hair's outer layer of protection, is harmed and begins to peel away, dividing the hair into two or more strands. Environmental damage, regular use of harsh hair care products, and excessive heat styling are generally the causes of this.

Resolution and Advice

- **Frequent cuts:** To get rid of split ends and stop them from going up the hair shaft, schedule frequent hair cuts.
- **Treatments for conditioning:** Reduce the possibility of split ends in your hair by using deep conditioning treatments to hydrate and nourish it.
- **Moderation in Heat Styling:** In order to reduce damage, use heat styling products sparingly and, when you do, use a heat protectant.

Hair Loss (15,16): Numerous variables, including as heredity, hormone fluctuations, stress, and underlying medical disorders, might be linked to hair loss. Thinning hair and, in extreme situations, bald patches can result from excessive hair loss.

Resolution and Advice

- **Balanced food:** To promote general hair health, make sure your food is high in proteins, vitamins, and minerals.
- **Stress Management:** To lessen the effects of stress-related hair loss, include stress-relieving activities in your daily routine.
- **Expert Advice:** If your hair loss is significant or prolonged, see a dermatologist or other healthcare provider.

Dandruff (Scalp Itching) (17,18)

The characteristic of dandruff is scalp flaking, which is frequently accompanied by irritation. It may be brought on by a yeast overgrowth, a dry scalp, or a reaction to hair products.

Resolution and Advice: Regularly exfoliate your scalp to get rid of dead skin cells and stop dandruff.

- **Anti-Dandruff Shampoos:** To manage dandruff, use certain shampoos with active components.
- **Keeping Your Scalp Clean:** To reduce dandruff, wash your hair frequently and maintain good hygiene on your scalp.

Frizz and Dryness (19,20): When hair is dehydrated, frizz and dryness develop, giving the hair an unmanageable, coarse texture. Excessive heat styling, outside conditions, and dehydration can all contribute to this.

Resolution and Advice

- **Deep Conditioning:** To replenish moisture and enhance the texture of your hair, use deep conditioning treatments.
- **Hydrating Products:** To keep the moisture balance in your hair in check, use hydrating shampoos and conditioners.
- **Minimize Heat:** To lessen frizz and dryness, use less heat styling products and use protective hairstyles.

Greasy Hair (21,22)

Sebaceous gland hyperactivity, which results in an excess of oil production on the scalp, is frequently the cause of greasy or oily hair.

Resolution and Advice

Gentle Shampooing: To manage oiliness, wash your hair on a regular basis using a moderate shampoo.

Lightweight Products: To prevent weighing down the hair, use lightweight haircare products.

Balanced Diet: To control oil production and enhance the general health of your hair, keep a balanced diet.

Thinning Hair (23,24)

Many variables, such as age, hormone fluctuations, and heredity, can cause thinning hair. It frequently shows up as less volume and density in the hair.

Resolution and Advice

- **Scalp Massage:** To encourage hair development, massage your scalp often to increase blood circulation.
- **Products for Thickening Hair:** To increase volume, use shampoos and conditioners that thicken hair.
- **Professional Consultation:** For individualized guidance and treatments, consult a dermatologist or trichologist.

Absence of Glow (25,26): A natural oil imbalance in the hair, product accumulation, or environmental damage can all contribute to dull and lifeless hair.

Resolution and Advice

- **Clarifying Shampoo:** To get rid of product residue and bring back shine, use a clarifying shampoo.
- **Natural Oils:** For more moisture and shine, use natural oils like coconut or argan.
- **Regular Trims:** Split ends can be cut off to provide the illusion of greater luster and health.

Shattering (27,28): Hair breakage happens when the hair shaft becomes fragile and weak, causing individual hair strands to break off. Chemical treatments, hard brushing, and overuse of heat styling are among of the causes.

Resolution and Advice

- **Protective Styling:** Choose hairstyles like braids or buns that put the least amount of strain on your hair.
- **Gentle Detangling:** Begin at the tips of your hair and work your way down using a wide-tooth comb.
- **Treatments for Proteins:** Use treatments high in protein to strengthen the hair shaft.

Hair oil can offer several benefits for hair health and appearance (48)

- **Moisture and Conditioning:** Hair oils help to moisturize and condition the hair, reducing dryness and frizz. They provide a protective barrier that helps retain moisture in the hair shaft.
- **Strengthening:** Some oils, like coconut oil and castor oil, are rich in nutrients that can strengthen the hair strands, reducing breakage and split ends.
- **Improving Hair Texture:** Regular use of hair oil can make hair softer, smoother, and more manageable by smoothing the cuticles and reducing roughness.
- **Promoting Hair Growth:** Certain oils have been shown to stimulate hair growth by improving circulation to the hair follicles and providing essential nutrients.
- **Preventing Hair Damage:** Hair oils can help protect the hair from environmental damage, heat styling, and chemical treatments by forming a protective layer.
- **Adding Shine:** Oils can enhance the natural shine of the hair, making it look healthier and more vibrant.
- **Scalp Health:** Massaging oil into the scalp can improve blood circulation, which may promote healthier hair growth and scalp condition.

Herbal Plants and their Uses:

BOTANICAL NAME	USES
<i>Acacia Concinna DC.(29,30)</i>	Pods extract is used as hair cleanser
<i>Arnica Montana Linn.(31)</i>	Flowers extract is used in hair oil as a tonic material.
<i>Betula Pendula (32,33)</i>	Extract of leaves is used as anti-dandruff
<i>Brassica spp.(34,35)</i>	seed oil is used as hair oil and useful for hair nourishment
<i>Calendula officinalis Linn.(36)</i>	flower extract is used in hair creams for smoothening effect
<i>Carthamustinctorius Linn.(37,38)</i>	alcoholic extract is used in hair tonics
<i>Centellaasiatica (Linn) urban(39)</i>	Whole plant extract is used for the growth
<i>Cocos nucifera Linn.(40)</i>	Kernel oil is a well-established hair oil, which is Arecaceae; Coastal parts of India used as such or as a basic raw material for preparing hair oils and tonics.
<i>Eclipta alba (Linn.)(41)</i>	Whole plant extract is useful for hair's nourishment
<i>Ficusracemosa Linn(42)</i>	Aerial root powder is mixed with coconut oil for Moraceae; Throughout India massage to check falling hairs.
<i>Juglansregia Linn(43)</i>	eaves and hull of fruits is used for hair dyeing.
<i>Lawsoniainermis Linn.(44)</i>	Leaves paste is used for hair dyeing and Lythraceae; Throughout India nourishment.
<i>Nardostachysjatamansi DC.(45)</i>	Extract of rhizome is used in hair tonics for their (Jatamansi), Valerianaceae; growth.
<i>Phyllanthusemblica Linn.(46)</i>	Fruit extract is used in oils for promotion of hair Euphorbiaceae; Throughout India growth.
<i>Salvia Linn.(47)</i>	Aqueous extract is used as hair conditioner.

Ingredients used in Polyherbal oil and its Uses:

INGREDIENTS	USES
<i>SEMECARPUS ANACARDIUM SEED</i>	Semecarpusanacardium oil has properties that help stimulate hair follicles, encouraging hair growth from dormant follicles and promoting thicker hair strands.
<i>PHYLLANTHUS EMBLICA</i>	Amla is one of the richest sources of vitamin C, which plays a crucial role in collagen production. Collagen is essential for maintaining hair structure and promoting hair growth.
<i>MURRAYA KOENIGII</i>	Curry leaves are rich in antioxidants, proteins, and beta-carotene, which nourish and strengthen hair follicles, promoting healthy hair growth.
<i>HIBISCUS ROSA-SINENSIS</i>	Hibiscus is rich in vitamins A and C, amino acids, and alpha hydroxy acids that nourish the scalp, strengthen the hair follicles, and promote hair growth.
<i>TRIGONELLA FOENUM-GRÆCUM</i>	Fenugreek seeds are rich in proteins and nicotinic acid, which are known to promote hair growth and strengthen hair follicles.
<i>RICINUS COMMUNIS</i>	Castor oil is rich in ricinoleic acid, which has anti-inflammatory and antimicrobial properties. It helps improve blood circulation to the scalp, stimulating hair follicles and promoting hair growth.
<i>SESAMUM INDICUM</i>	sesame oil is valued for its ability to nourish the scalp, strengthen hair follicles,
<i>SENA ALEXANDRINA</i>	hair care for its purported ability to enhance hair growth and improve overall hair health.
<i>COCOS NUCIFERA</i>	Coconut oil penetrates deeply into the hair shaft, moisturizing it from within. This helps in preventing protein loss from the hair, which can lead to stronger and healthier strands.

Popular oils for hair care include coconut oil, argan oil, jojoba oil, almond oil, castor oil, and olive oil. Different oils may offer slightly different benefits, so choosing one depends on your hair type and specific needs. It's important to use oils in moderation and find the right amount for your hair type to avoid greasiness.

Use of Semecarpus in Hair Oil (49): Semecarpusanacardium, also known as marking nut or bhilawa, has been traditionally used in Ayurvedic medicine for various purposes, including hair care. Here are some potential benefits of Semecarpusanacardium for hair growth:

- **Stimulates Hair Growth:** The seeds of Semecarpusanacardium contain compounds that are believed to stimulate hair follicles and promote hair growth.
- **Nourishes the Scalp:** It has moisturizing properties that can help nourish the scalp and keep it healthy, which is essential for supporting hair growth.
- **Anti-inflammatory Effects:** It may help reduce scalp inflammation, which can contribute to hair loss or hinder hair growth.
- **Improves Scalp Circulation:** By improving blood circulation in the scalp, Semecarpusanacardium can potentially enhance the delivery of nutrients and oxygen to the hair follicles, promoting healthier hair growth.
- **Strengthens Hair:** Regular use of Semecarpusanacardium oil or preparations may strengthen hair strands, reducing breakage and improving overall hair health.

- **Traditional Use:** In Ayurveda, it is often used in hair oils or pastes for its purported hair-strengthening and growth-promoting properties.
- **Caution:** While Semecarpusanacardium may offer potential benefits for hair growth, it is important to note that some people may be sensitive to its components, particularly the oil from the seeds. It can cause contact dermatitis or allergic reactions in sensitive individuals.

If you have sensitive skin or existing scalp conditions. Always perform a patch test and consult with a healthcare professional or an Ayurvedic practitioner before using it, especially.

CONCLUSION

In conclusion, Semecarpusanacardium, a key ingredient in Semecarpusanacardium oil, exhibits potent hair growth activities that set it apart from other herbal hair oils. Through its unique phytochemical composition, including anacardic acid and other bioactive compounds, it demonstrates significant potential in promoting hair growth and improving hair health. This natural oil not only nourishes the scalp but also enhances follicular strength and encourages robust hair growth cycles. Compared to other herbal oils, Semecarpusanacardium oil stands out for its scientifically supported efficacy and traditional use in hair care. Integrating this oil into regular hair care routines can potentially lead to visibly healthier and stronger hair over time.

REFERENCES

- Geyfman M, Plikus MV, Treffeisen E, Andersen B, Paus R. Resting no more: re-defining telogen, the maintenance stage of the hair growth cycle. *Biological Reviews*. 2015 Nov; 90(4):1179-96.
- Randall VA, Botchkareva NV. The biology of hair growth. *Cosmetics Applications of Laser & Light-Based Systems*. 2009 Jan 1:3-5.
- Mecklenburg L, Tobin DJ, Müller-Röver S, Handjiski B, Wendt G, Peters EM, Pohl S, Moll I, Paus R. Active hair growth (anagen) is associated with angiogenesis. *Journal of Investigative Dermatology*. 2000 May 1;114(5):909-16.
- Kanwar AJ, Narang T. Anagen effluvium. *Indian journal of dermatology, venereology and leprology*. 2013 Sep 1; 79:604.
- Lindner G, Botchkarev VA, Botchkareva NV, Ling G, van der Veen C, Paus R. Analysis of apoptosis during hair follicle regression (catagen). *The American journal of pathology*. 1997 Dec; 151(6):1601.
- Tobin DJ, Hagen E, Botchkarev VA, Paus R. Do hair bulb melanocytes undergo apoptosis during hair follicle regression (catagen)? *Journal of investigative dermatology*. 1998 Dec 1;111(6):941-7.
- Harrison S, Sinclair R. Telogen effluvium. *Clinical and experimental dermatology*. 2002 Jul 1; 27(5):389-95.
- Grover C, Khurana A. Telogen effluvium. *Indian Journal of dermatology, venereology and leprology*. 2013 Sep 1; 79:591.
- Higgins A, Glover M, Yang Y, Bayliss S, Meads C, Lord J. EXOGEN ultrasound bone healing system for long bone fractures with non-union or delayed healing: a NICE medical technology guidance. *Applied health economics and health policy*. 2014 Oct;12:477-84.
- Roussignol X, Currey C, Duparc F, Dujardin F. Indications and results for the Exogen™ ultrasound system in the management of non-union: a 59-case pilot study. *Orthopaedics & Traumatology: Surgery & Research*. 2012 Apr 1; 98(2):206-13.
- Paus R, Foitzik K. In search of the "hair cycle clock": a guided tour. *Differentiation*. 2004 Dec; 72(9-10):489-511.
- Paus R. Principles of hair cycle control. *The Journal of dermatology*. 1998 Dec; 25(12):793-802.
- Phillips TG, Slomiany WP, Allison R. Hair loss: common causes and treatment. *American Family Physician*. 2017 Sep 15; 96(6):371-8.
- Fiedler-Weiss VC. Topical minoxidil solution (1% and 5%) in the treatment of alopecia areata. *Journal of the American Academy of Dermatology*. 1987 Mar 1; 16(3):745-8.
- Olsen EA, Weiner MS, Delong ER, Pinnell SR. Topical minoxidil in early male pattern baldness. *Journal of the American Academy of Dermatology*. 1985 Aug 1;13(2):185-92.
- McClellan KJ, Markham A. Finasteride: a review of its use in male pattern hair loss. *Drugs*. 1999 Jan; 57:111-26.
- Arca E, Açıkgöz G, Taştan HB, Köse O, Kurumlu Z. An open, randomized, comparative study of oral finasteride and 5% topical minoxidil in male androgenetic alopecia. *Dermatology*. 2004 Aug 1;209(2):117-25.
- Neri RO. Antiandrogens. *Advances in Sex Hormone Research*. 1976 Jan 1; 2:233-62.
- Schneider HP. Androgens and antiandrogens. *Annals of the New York Academy of Sciences*. 2003 Nov; 997(1):292-306.
- Zoorob RJ, Cender D. A different look at corticosteroids. *American family physician*. 1998 Aug 1; 58(2):443-50.
- Isaksson M. Corticosteroids. *Dermatologic therapy*. 2004 Sep; 17(4):314-20.
- Ostrowsky B. *Candida auris* isolates resistant to three classes of antifungal medications—New York, 2019. *MMWR. Morbidity and mortality weekly report*. 2020; 69.
- Patel VM, Schwartz RA, Lambert WC. Topical antiviral and antifungal medications in pregnancy: a review of safety profiles. *Journal of the European Academy of Dermatology and Venereology*. 2017 Sep; 31(9):1440-6.
- Sekine T, Fukasawa N, Ikegami F, SAITO K, FUJII Y, MURAKOSHI I. Structure and synthesis of a new monoterpenoidalcarboxamide from the seeds of the Thai medicinal plant *Acacia concinna*. *Chemical and pharmaceutical bulletin*. 1997 Jan 15; 45(1):148-51.
- Behari M, Mohanty AM, Das D. Insights into the transport phenomena of iron ore particles by utilizing extracted Bio-surfactant from *Acacia concinna* (Willd.) Dc. *Journal of Molecular Liquids*. 2023 Jul 15; 382:121974.
- Kowalski R, Sugier D, Sugier P, Kolodziej B. Evaluation of the chemical composition of essential oils with respect to the maturity of flower heads of *Arnica montana* L. and *Arnica chamissonis* Less. cultivated for industry. *Industrial Crops and Products*. 2015 Dec 15; 76:857-65.
- Ciupercă OT, Ţebrencu CE, Iacob E, Creţu RM, Chiriac M, Ionescu E. Phytochemical screening and chromatographic fingerprint studies on ethanolic extracts of *Arnica montana* L. *Analele Stiintifice ale Universitatii "Al. I. Cuza" din Iasi*. 2016 Jul 1; 62(2):53.
- Beck P, Caudullo G, de Rigo D, Tinner W. *Betula pendula*, *Betula pubescens* and other birches in Europe: distribution, habitat, usage and threats.
- McVetty PB, Mietkiewska E, Omonov T, Curtis J, Taylor DC, Weselake RJ. *Brassica* spp. oils. In *Industrial oil crops 2016* Jan 1 (pp. 113-156). AOCS Press.
- Chauhan JS, Choudhury PR, Pal S, Singh KH. Analysis of seed chain and its implication in rapeseed-mustard (*Brassica* spp.) production in India. *Journal of oilseeds Research*. 2020; 37(2):71-84.
- Khalid KA, da Silva JT. Biology of *Calendula officinalis* Linn.: focus on pharmacology, biological activities and agronomic practices. *Medicinal and Aromatic Plant Science and Biotechnology*. 2012; 6(1):12-27.
- Singh N, Pandey MK, Sharma A, Prakash J. Indian medicinal plants: For hair care and cosmetics. *World Journal of Pharmaceutical Sciences*. 2014 Nov 1:1552-6.
- Zhou X, Tang L, Xu Y, Zhou G, Wang Z. Towards a better understanding of medicinal uses of *Carthamus tinctorius* L. in traditional Chinese medicine: a phytochemical and pharmacological review. *Journal of ethnopharmacology*. 2014 Jan 10; 151(1):27-43.
- Singh V, Nimbkar N. *Safflower (Carthamus tinctorius L.)*. Chapter. 2006 Nov 2; 6:167-94.
- Prakash V, Jaiswal NI, Srivastava MR. A review on medicinal properties of *Centella asiatica*. *Asian J Pharm Clin Res*. 2017;10(10):69-74.
- Hoque M, Rafi IK, Hossain MS. *Centella asiatica*: A mini review of its medicinal properties and different uses. *World Journal of Advanced Research and Reviews*. 2023;19(2):1185-91.
- Agyemang-Yeboah F. Health benefits of coconut (*Cocos nucifera* Linn.) seeds and coconut consumption. In *Nuts and seeds in health and disease prevention 2011* Jan 1 (pp. 361-367). Academic Press.
- Figueira CD, Santos RM, Campesatto EA, Lúcio IM, Araújo EC, Bastos ML. Biological activity of the *Cocos nucifera* L. and its profile in the treatment of diseases: a review.
- Mithun NM, Shashidhara S, Vivek Kumar R. *Eclipta alba* (L.) A review on its phytochemical and pharmacological profile. *Pharmacologyonline*. 2011;1(1):345-57.
- Paarakh PM. *Ficus racemosa* Linn.—an overview.
- Mandal SC, Saha BP, Pal M. Studies on antibacterial activity of *Ficus racemosa* Linn. leaf extract. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*. 2000 Jun; 14(4):278-80.
- Panth N, Paudel KR, Karki R. Phytochemical profile and biological activity of *Juglans regia*. *Journal of Integrative Medicine*. 2016 Sep 1; 14(5):359-73.
- Nirmla Devi T, Apraj V, Bhagwat A, Mallya R, Sawant L, Pandita N. Pharmacognostic and phytochemical investigation of *Juglans regia* Linn. bark. *Pharmacognosy Journal*. 2011 Sep 1; 3(25):39-43.

44. Sharma RK, Goel A, Bhatia AK. Lawsoniainermis Linn: A plant with cosmetic and medical benefits. *International Journal of Applied Sciences and Biotechnology*. 2016 Mar 31; 4(1):15-20.
45. Buddhadev SG, Buddhadev SS. Ayurvedic medicinal plant Lawsoniainermis Linn.: a complete review. *Pharma Science Monitor*. 2016 Apr 1;7(2).
46. Bhatt M, Kothiyal P. A review article on phytochemistry and pharmacological profiles of Nardostachysjatamansi DC-medicinal herb. *Journal of pharmacognosy and phytochemistry*. 2015; 3(5):102-6.
47. Sharma N, Sharma AR, Patel BD, Shrestha K. Investigation on phytochemical, antimicrobial activity and essential oil constituents of Nardostachysjatamansi DC. in different regions of Nepal. *J. Coast. Life Med*. 2016; 4(1):56-60.
48. Baliga MS, Dsouza JJ. Amla (Emblica officinalis Gaertn), a wonder berry in the treatment and prevention of cancer. *European Journal of Cancer Prevention*. 2011 May 1; 20(3):225-39.
49. Karimzadeh S, Farahpour MR. Topical application of Salvia officinalis hydroethanolic leaf extract improves wound healing process.
50. Boufadi MY, Keddari S, MOULAI-HACENE F, Sara CH. Chemical composition, antioxidant and anti-inflammatory properties of Salvia officinalis extract from Algeria. *Pharmacognosy Journal*. 2021; 13(2).
