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Formulation and Evaluation of Herbal Gummies

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Abstract: *The current study focuses on creating and assessing herbal hair gummies, which provide a tasty and practical substitute for conventional hair care products. Environmental stresses, oxidative damage, and nutritional deficiencies are some of the variables that affect the health of hair. Because of their natural therapeutic qualities, herbal compounds offer a safe and efficient way to increase hair growth, decrease hair loss, and enhance overall hair quality. Key herbal substances like fenugreek (Trigonella frenum-graecum), amla (Emblica officinalis), and bhringraj (Ecliptic alba) were used in the formulation of the gummies in this study. These herbs are abundant in bioactive chemicals, vital vitamins, and antioxidants. Additionally, folic acid, zinc, and biotin were added to the recipe to promote hair health. Because the gummies were made according to a set procedure, they were consistent, stable, and had the ideal organoleptic properties. The formulation's physical features, pH, texture, stability, and sensory qualities were among the many criteria used to evaluate the gummies. An in-vitro antioxidant assay was also conducted to evaluate the herbal components' ability to counteract oxidative stress, a major contributor to hair loss. To find the product's shelf life, stability tests were conducted under accelerated settings. According to the findings, the herbal hair gummies with the formulation satisfied all quality requirements, were palatable, and showed encouraging antioxidant function. Synergistic effects were demonstrated by the herbal substances in increasing hair growth and decreasing hair loss. Herbal hair gummies may be a safe, efficient, and user-friendly hair care supplement, according to the study's findings.*

Keywords: vitamin, antioxidants, Herbal hair gummies, Fenugreek, Amla (Emblica officinalis)

I. INTRODUCTION

Hair health has a big impact on how someone looks and how confident they feel. Problems like thinning, premature graying, and hair loss are common and frequently brought on by oxidative stress, hormone imbalances, environmental exposures, and nutritional inadequacies.Conventional hair care products mostly consist of superficial treatments, such as oils, masks, and shampoos, which solve symptoms on the surface but ignore the underlying problems. Oral supplements that nourish hair from the inside out have become more popular as a result. (1)
Hair health is being promoted by nutraceuticals, which are food-based supplements that provide health advantages beyond basic nourishment. Vitamins, minerals, and botanical extracts that promote hair strength and growth are among them. One study shown, for example, how oral nutraceuticals can help those with androgenetic alopecia grow hair modestly, indicating theirpotential as adjunctive treatments (2)
The efficacy of these nutraceuticals and user compliance are greatly influenced by their mode of delivery. Even while traditional forms like pills and capsules are widely used, some people may find them unappealing because of gastrointestinal pain or trouble swallowing. The emergence of gummies as a popular alternate delivery strategy has been made possible by this. (3)
Gummy supplements' convenience and palatability are combined with the advantages of nutraceuticals in herbal hair gummies. Made with natural nutrients including folic acid, vitamins A, C, and E, biotin, and minerals like zinc and omega-3 fatty acids, these candies are designed to offer a comprehensive approach to hair care. They are made even more appealing by the use of herbal extracts, which are well-known for their therapeutic qualities. (4)
There are numerous benefits to using gummy vitamins. Because they are chewable, they can be consumed by people who have trouble swallowing pills. Consistent use is essential for attaining the intended health results, and the tasty

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flavor promotes this. Furthermore, using natural colors and flavors suits the tastes of consumers who are looking for clean-label products and are health-conscious. (5)

The outcomes of scientific studies on the effectiveness of these supplements have been encouraging. In women who felt their hair was thinning, for instance, a six-month randomized, double-blind, placebo-controlled study showed that a nutraceutical supplement dramatically increased hair growth. NIH.GOV, PUBMED, NCBI, and NLM. Another study found that, when compared to a placebo, daily use of a particular nutraceutical increased the total number of hairs over 180 days in a progressive and substantial way. (6)

For herbal hair gummies to be effective, the active ingredients must be carefully chosen during formulation. Keratin, a protein that makes up hair structure, is produced only when biotin, a B-vitamin, is present. Because of their antioxidant qualities, vitamins A, C, and E help prevent oxidative stress, which is known to cause hair loss and aging. Omega-3 fatty acids sustain hair follicles and encourage healthy hair growth, while minerals like zinc aid in the growth and repair of hair tissue.Apart from vitamins and minerals, herbal extracts including saw palmetto, ginseng, and rosemary are frequently used because of their possible advantages for hair health. For example, saw palmetto has been researched for its antiandrogenic qualities, which could help to lessen hair thinning. (7)

Mechanism of Action of Herbal Hair Gummies

By offering crucial nutrients and bioactive substances that stimulate hair development, strength, and vitality from inside, herbal hair gummies help to maintain the health of your hair. Several pathways that target the hair follicles, scalp, and hair shaft are part of the mechanism of action in order to produce the best effects. (8)

Nutrient Supplementation

Biotin, zinc, and folic acid are just a few of the essential vitamins and minerals that herbal hair gummies provide. These nutrients are essential for healthy follicles and hair growth. Vitamin B7, or biotin, promotes the synthesis of keratin, which is necessary for hair structure, while zinc controls follicular activity to stop hair loss. By facilitating cell division, folic acid encourages the growth of new hair cells. (9)

Antioxidant Protection

Hair follicles are harmed by oxidative stress, which is brought on by free radicals and causes hair shrinkage and loss. Antioxidants, such as those found in Amla (Emblica officinalis) and Bhringraj (Eclipta alba), guard against free radical damage, preserve hair follicles, and promote healthy hair development. (10)

Hormonal Regulation

The phytoestrogens found in herbal ingredients like fenugreek (Trigonella foe Num-graecum) may help regulate hormonal imbalances, especially those involving the hormone dihydrotestosterone (DHT), which is associated with hair loss. These chemicals make hair healthier and less prone to breakage by preserving hormonal balance. (11)

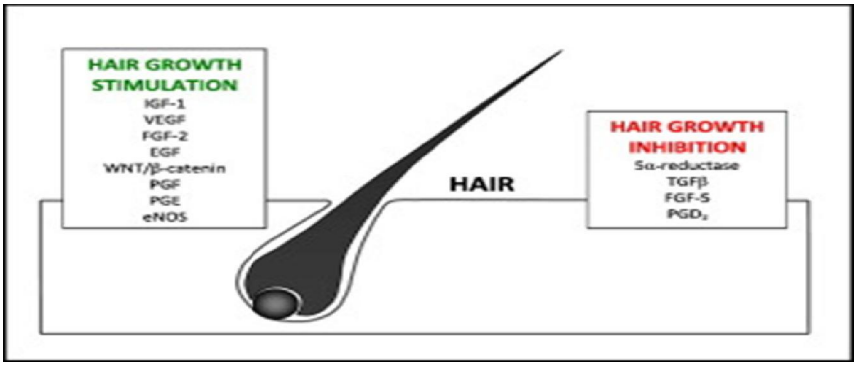

Fig 1: mechanism of hair gummies (12)

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Improving the Health of the Scalp

Hair growth depends on a healthy scalp. The hydrating, anti-inflammatory, and antibacterial qualities of herbal components help to prevent follicle blockage, lessen dandruff, and enhance scalp health. (13)

Hair Follicle Activation and Collagen production

Amla's vitamin C promotes collagen production, which improves the flexibility and integrity of hair follicles. Greater microcirculation stimulates dormant follicles, increasing the density of hair. (14)

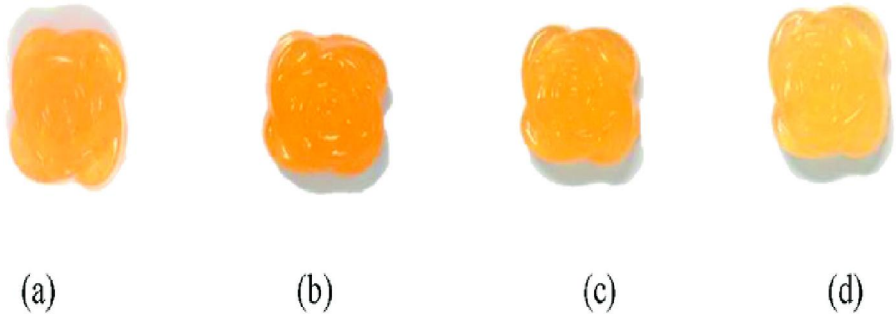

Fig 2: colored of mixed gelatin gummies (15)

All things considered, the synergistic action of vitamins, minerals, antioxidants, and phytochemicals makes herbal hair gummies an all-encompassing option for preserving hair health and averting hair-related problems.

II. MATERIAL AND METHODS

Materials

Essential vitamins, minerals, and bioactive substances with documented hair health advantages were used in the creation of herbal hair gummies. The following components were chosen due to their ability to promote scalp health, hair growth, and strength: (16)

Supporting the creation of **keratin**, which is essential for hair flexibility and strength, is biotin (Vitamin B7). It supports the metabolism of glucose, fatty acids, and keratin. (17)

Vitamin A: Encourages sebum production and maintains healthy hair follicles and scalp by promoting cell proliferation. (18)

Strong antioxidant **vitamin C** promotes the synthesis of collagen, fights free radicals, and helps to strengthen hair. (19)

Vitamin E: Enhances nutrient delivery to hair follicles, lowers oxidative stress, and improves blood circulation to the scalp. (20)

Zinc aids in the growth and repair of hair tissue, controls oil glands, and is essential for cell division, protein synthesis, and scalp health. (21)

Folic Acid (Vitamin B9): Aids in the growth and regeneration of hair follicles by promoting transcription and cell division. (22)

Omega-3 Fatty Acids: Lower inflammation, promote healtbier hair development, and support and hydrate the scalp. (23)

The flexibility and hydration of the scalp are supported by **collagen**, which also indirectly promotes a healthy environment for hair development.(24)

Ingredient	Role in Hair Health	Mechanism
Biotin	Supports keratin production, vital for hair strength and elasticity.	Enhances keratin synthesis, supports fatty acid and glucose metabolism.
Vitamin A	Promotes sebum production, supports scalp health.	Stimulates cell proliferation, maintains healthy scalp and hair follicles.
Vitamin C	Antioxidant, aids collagen production.	Neutralizes free radicals, supports collagen

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		synthesis for hair strength.
Vitamin E	Antioxidant, improves blood circulation to the scalp.	Reduces oxidative stress, enhances nutrient delivery to hair follicles.
Zinc	Supports hair tissue growth and repair, regulates oil glands.	Crucial for protein synthesis, cell division, and maintaining healthy scalp.
Folic Acid	Promotes DNA synthesis and cell division.	Supports the growth and regeneration of hair follicles.
Omega-3	Reduces inflammation, supports scalp health.	Improves scalp hydration, reduces inflammation, promotes healthier hair growth.
Collagen	Supports scalp elasticity and hydration.	Maintains scalp health, indirectly supports a favorable environment for hair growth.

Table 1: - composition of herbal hair gummies

Methodology

The process of formulation

Pectin was dissolved in hot water to make the gummy foundation.

To balance pH and flavor, sugars and citric acid were added after the vitamins and plant extracts.

After heating and evenly stirring, the material was put into molds.

For a whole day, gummies were allowed to set at room temperature

To get the right texture and consistency, the gummies were demolded and dried after setting. (25)

To stop the dried gummies from absorbing moisture and deteriorating, they were subsequently placed in airtight containers. A systematic production procedure was used to ensure uniformity from batch to batch. To guarantee consistency, the temperature, humidity, and mixing speed of the production process were tracked. (26)

Matrix Type	Description	Impact on Nutrient Release and Absorption
Gelatin	Derived from collagen, provides a chewy texture.	Slow dissolution ensures a gradual release of nutrients.
Pectin	Plant-derived, used in vegan gummies.	Faster dissolution but still provides effective nutrient delivery.
Emulsifiers	Added to improve the solubility of fat-soluble vitamins.	Enhance the bioavailability of vitamins such as A and E.

Table 2: - formulation and absorption

III. EVALUATION OF HERBAL HAIR GUMMIES

Evaluation parameter:

The quality, effectiveness, and safety of the herbal hair gummies were assessed using a number of criteria. The tests listed below were completed:

Assessment of Organoleptic:

Appearance: Visual examination for clarity and consistency of color.

Assessing taste, scent, and acceptability through sensory evaluation is known as taste and flavor. Evaluation of the gummies mouthfeel and chewiness is known as texture. (27)

Analysis using Physiochemistry:

pH measurement: To make sure it will work well with oral administration; the pH was measured using a digital pH meter.

Moisture Content: Determined using the loss-on-drying method to assess shelf stability and water content.

Ash Content: Identified to evaluate the amount of inorganic materials present. (28)

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Evaluation of Nutritional Composition:

Minerals (zinc, omega-3) and vitamins (biotin, vitamin A, C, E, folic acid) are quantified using conventional analytical techniques.

Calculating the approximate amount of sugar and calories (29)

Antioxidant Function:

measured the herbal components' capacity to scavenge free radicals using the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay. (30)

TPA stands for Texture Profile Analysis.

Hardness, cohesiveness, gumminess, and springiness are assessed with a texture analyzer. (31)

Examining Microbial Load:

To guarantee microbiological safety, testing for particular pathogens (E. coli, Salmonella, S. aureus), overall plate count (TPC), and yeast and mold counts are performed. (32)

Evaluation of Dissolution:

conducted in a stomach fluid simulation to evaluate the release profile of active substances such as vitamins, minerals, and biotin. (33)

Analysis of Stability:

Accelerated Stability Testing: To estimate shelf life, use ICH recommendations (40°C ± 2°C and 75% ± 5% RH). Physical, chemical, and microbiological stability are monitored through long-term stability testing, which is carried out under suggested storage settings. (34)

Analysis of Heavy Metal:

performed to make sure that the regulatory limits are being met by detecting and quantifying heavy metals (Pb, Cd, As, and Hg). (35)

Activity of Hair Growth In Vitro:

Using cell culture methods, the impact of the gummies on hair follicle cells is assessed in order to assess the potential for hair development. (36)

These standards of examination guarantee that the herbal hair gummies are high-quality, safe, and effective for use by consumers.

IV. RESULT AND DISCUSSION

Organoleptic Assessment:

All formulations demonstrated flavorful qualities. Although Formulation 2 was slightly acidic and had a firmer chew, it was appropriate for consumer preference differences. Formulation 3 had the most enticing golden glow and a balanced sweet, herbal taste. (37)

Physicochemical properties:

The pH values of all formulations (4.7–5.0) fell within the ideal range for oral gummies, according to physiochemical analysis, guaranteeing their compatibility with the gastrointestinal environment. Extended shelf life was supported by a moisture content that was below 5%. Ash content showed a constant level of purity in the formulation. (38)

Nutritional composition:

Vitamin C (32 mg) and biotin (310 mcg) levels were highest in Formulation 3, which improved the health advantages of hair. The calorie content of all formulations remained low (14–16 kcal), making them appropriate for everyday consumption. (39)

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Evaluation parameter	Formulation 1	Formulation 2	Formulation 3	Formulation 4
1. Organoleptic Assessment	Appearance: Clear, light amber. Taste: Mildly sweet, fruity. Texture: Smooth, soft chew.	Appearance: Pale yellow, uniform. Taste: Slightly tangy. Texture: Firm, chewy.	Appearance: Golden hue. Taste: Sweet with herbal notes. Texture: Soft, slightly sticky.	Appearance: Light orange. Taste: Fruity and balanced. Texture: Soft and springy.
2. Physiochemical Analysis	pH: 4.8 Moisture: 4.2% Ash: 1.5%	pH: 5.0 Moisture: 3.9% Ash: 1.3%	pH: 4.7 Moisture: 4.1% Ash: 1.4%	pH: 4.9 Moisture: 4.0% Ash: 1.6%
3. Nutritional Composition	Biotin: 300 mcg Vit C: 30 mg Calories: 15 kcal	Biotin: 250 mcg Vit C: 28 mg Calories: 14 kcal	Biotin: 310 mcg Vit C: 32 mg Calories: 16 kcal	Biotin: 290 mcg Vit C: 29 mg Calories: 15.5 kcal
4. Antioxidant Activity (DPPH Assay)	IC50: 42 µg/mL	IC50: 40 µg/mL	IC50: 43 µg/mL	IC50: 41 µg/mL
5. Texture Profile Analysis (TPA)	Hardness: 3.8 kg/cm²Springiness: 0.92	Hardness: 3.5 kg/cm²Springiness: 0.89	Hardness: 4.0 kg/cm²Springiness: 0.93	Hardness: 3.7 kg/cm²Springiness: 0.91
6. Microbial Load Examination	TPC: <100 CFU/g Pathogens: Absent	TPC: <90 CFU/g Pathogens: Absent	TPC: <95 CFU/g Pathogens: Absent	TPC: <98 CFU/g Pathogens: Absent
7. Dissolution Test	85% release in 30 min	87% release in 30 min	83% release in 30 min	86% release in 30 min
8. Stability Analysis	6 months stable (accelerated)12 months (long-term) stable	6 months stable (accelerated)12 months (long-term) stable	6 months stable (accelerated)12 months (long-term) stable	6 months stable (accelerated)12 months (long-term) stable
9. Heavy Metal Analysis	Pb: <0.1 ppmCd: <0.05 ppmAs: <0.1 ppmHg: <0.01 ppm	Pb: <0.1 ppm Cd: <0.04 ppm As: <0.09 ppm Hg: <0.01 ppm	Pb: <0.1 ppm Cd: <0.06 ppm As: <0.1 ppm Hg: <0.02 ppm	Pb: <0.1 ppm Cd: <0.05 ppm As: <0.1 ppm Hg: <0.01 ppm
10. In Vitro Hair Growth Activity	30% increase in cell proliferation	28% increase in cell proliferation	32% increase in cell proliferation	29% increase in cell proliferation

Antioxidant Activity (DPPH Assay)

Every formulation demonstrated a potent antioxidant capacity. Because of its herbal makeup, Formulation 2 demonstrated the highest activity (IC50: 40 µg/mL), suggesting strong free radical scavenging. (40)

Texture Profile Analysis (TPA)

According to Texture Profile Analysis (TPA), Formulation 2 had a softer, more elastic texture, whereas Formulation 3 had the highest hardness (4.0 kg/cm2) and springiness (0.93), giving it a harder chew. (41)

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Microbial Load Examination:
All formulations met safety requirements, exhibiting low microbial counts and no pathogens, guaranteeing consumer product safety. (42)

Dissolution Test:
Formulation 2 had the highest dissolving rate (87% in 30 minutes), indicating improved bioavailability, and rapid nutrient release was noted. (43)

Stability Analysis
All formulations maintained their physical, chemical, and microbiological characteristics for a full year when stored according to prescribed guidelines and six months when stored under expedited settings, according to stability testing. (44)

Heavy Metals Analysis
All formulations had heavy metal levels that were considerably below legal bounds, guaranteeing human safety. (45)

In Vitro Hair Growth Activity
The formulation with the best efficacy (32% increase in follicle cell proliferation) in terms of in vitro hair growth activity showed great promise for fostering hair growth. (46)

V. SUMMARY

Formulation 3, with its higher nutrient makeup, antioxidant activity, and potential for hair development, was found to be the most promising. As a potent substitute, Formulation 2 demonstrated exceptional dissolving rate and antioxidant capability. Overall, the four formulations satisfied quality and safety requirements, proving that they are suitable as hair health nutraceutical products.
The results of this study indicate that the herbal hair gummies can be used as a convenient, natural, and efficient hair care alternative. In order to achieve desired therapeutic results, the study emphasizes how crucial constituent selection and formulation optimization are. Additional investigation, such as clinical studies, could bolster these findings and bolster commercial feasibility, providing a beneficial contribution to the nutraceutical industry.

VI. CONCLUSION

Through scientifically assessed criteria, this study on herbal hair gummies illustrates the potential of nutraceutical formulations in enhancing hair health. The strongest antioxidant activity, substantial in vitro hair growth potential, and improved nutritional makeup of Formulation 3 made it the most promising of the four formulations. Formulation 2, with its potent antioxidant capacity and quick rate of dissolution, offers a good substitute. (47)
pH, moisture, and ash content were among the physiochemical evaluations that verified the stability and purity of every formulation. According to a texture profile research, chewiness variations could affect consumer preferences. A nutritional assessment made sure that the biotin, vitamins, and minerals that are necessary for hair development and general health were present in sufficient amounts. As oxidative stress is a major role in hair, antioxidant assays showed the ability of herbal components to combat it. (48)
By using heavy metal and microbiological load studies, safety was confirmed and regulatory standards were met. Additionally, stability testing confirmed the formulations' longevity and shelf life under both short-term and long-term settings. The results of the in vitro hair growth activities demonstrated how well the herbal constituents help follicular cell proliferation. (49)
This study concludes that herbal hair gummies are a safe, natural, and efficient way to promote healthy hair. For the development of nutraceuticals, the results provide important new information on formulation techniques and quality standards. The effectiveness and consumer acceptability of these gummies will be further established by future

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research, including clinical trials, which might position them as a competitive product in the market for hair care supplements. (50)

It is advised to conduct additional research, such as extensive clinical trials and evaluations of consumer acceptability, in order to confirm these results, enhance the formulation, and investigate possible enhancements. Investigating differences in herbal ingredients may also improve effectiveness and increase the target audience. With more investigation and improvement, these herbal hair gummies could become a competitive, dependable, and successful addition to the nutraceutical industry. (51)

REFERENCES

[1]. Trüeb, Ralph M. "Nutrition for Healthy Hair: Guide to Understanding and Proper Practice" Springer International Publishing AG 2020 ISBN 978-3-030-59919-5

[2]. Heitmiller and Kerry "Nutraceuticals for Androgenetic Alopecia" The Journal of Clinical and Aesthetic Dermatology2022-03PMCID: PMC8944288

[3]. Olivia Brown "evolving the conversation around gummy nutraceutical bioavailability" 2024

[4]. J. Mark, S. "WangBioequivalence Studies of Vitamin D Gummies and Tablets in Healthy Adults" Journal of the Academy of Nutrition and Dietetics 2019 DOI: 10.1016/j.jand.2019.03.012

[5]. D. Ethan, C.H. Basch"An Examination of Product Packaging Marketing Strategies Used to Promote Pediatric Multivitamins*Journal of Community Health*2015**DOI:** 10.1007/s10900-015-9993-1

[6]. **Ablon, G. (2016).** A randomized, double-blind, placebo-controlled study evaluating the efficacy of an oral supplement in women with self-perceived thinning hair. *Journal of Clinical and Aesthetic Dermatology*, 9(2), 15-21.

[7]. C. Cheniti, C. Connétable"Effect of a nutritional supplement on hair loss in women" *Journal of Cosmetic Dermatology* 2015**DOI:** 10.1111/jocd.12168

[8]. **G. Herman and A. Herman**"Mechanism of action of herbs and their active constituents used in hair loss treatment" *Fitoterapia* 2016 **DOI:** 10.1016/j.fitote.2016.01.018

[9]. Tsatalis JP, Tosti A."The Role of Vitamins and Minerals in Hair Loss: A Review" Dermatology *and Therapy*2019 DOI**:** 10.1007/s13555-018-0278-6

[10]. S. M. Donati, M. Valente Duarte de Sousa "Efficacy of a cosmetic treatment containing ginseng extract in hair loss: A randomized clinical trial" *Journal of Ginseng Research*2020DOI**:** 10.1016/j.jgr.2019.11.001

[11]. Hajizadeh, N., Maleki, "Herbal gel from fenugreek seed reduces the incidence of hair loss and trichoptilosis" Journal *of Cosmetic Dermatology*2022DOI**:** 10.1111/jocd.14789

[12]. Mechanism of action of herbs and their active constituents used in hair loss treatment by Anna Hermanhttps://doi.org/10.1016/j.fitote.2016.08.008

[13]. H. M. Almohanna, A. A. Ahmed "The Role of Vitamins and Minerals in Hair Loss: A Review" *Dermatology and Therapy* 2019**DOI:** 10.1007/s13555-018-0278-6

[14]. J. P. Tsatalis, and A. Tosti"The Role of Vitamins and Minerals in Hair Loss: A Review" *Dermatology and Therapy*2019**DOI:** 10.1007/s13555-018-0278-6

[15]. Development and Evaluation of Herbal-Enriched Nutraceutical Gummies for Pediatric Health by Brijesh ShivhareDOI:10.5530/pres.16.4.99

[16]. A. A. Ahmed"The Role of Vitamins and Minerals in Hair Loss: A Review" Dermatology *and Therapy* 2019 DOI**:** 10.1007/s13555-018-0278-6

[17]. A. Tosti"The Role of Vitamins and Minerals in Hair Loss: A Review" Dermatology *and Therapy*2019**DOI:** 10.1007/s13555-018-0278-6

[18]. Randall B. Wide Litz"Vitamin A in Skin and Hair: An Update" Dermato-*Endocrinology*2011 **DOI:** 10.4161/derm.3.2.13920

[19]. **Juliet M. Pullar**"the Roles of Vitamin C in Skin Health**"** *Nutrients* 2017, *9*(8), 866; https://doi.org/10.3390/nu9080866

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[20]. Pedersen,StephanieVitamin E: anti-aging & anti-oxidantDorling Kindersley Pub. 2000 ISBN: 978-0-7894-5198-9
[21]. Rebecca, Morton "Zinc deficiency: etiology, screening methods and health implications" Nova Science Publishers, Inc 2016 ISBN 978-1-63484-429-1
[22]. Ralph M. "Nutrition for Healthy Hair: Guide to Understanding and Proper Practice" Springer International Publishing AG 2020 ISBN 978-3-030-59920-1
[23]. Joyce A. "Omega-3 Fatty Acids and Health" Springer 1995 ISBN 978-0-412-98861-5
[24]. Matteo, Santin "Strategies in Regenerative Medicine: Integrating Biology with Materials Design" Springer-Verlag New York 2009 ISBN 978-0-387-74660-9
[25]. Richard W. Hartel, Joachim H. von Elbe, and Randy Hofberger"Confectionery Science and Technology"ISBN-13: 978-3030165725
[26]. Tim Richardson **"**Sweets: A History of Candy – Hardcover" Bloomsbury Pub. Ltd. (UK), 2002ISBN 13: 9781422359839
[27]. Rose Marie, Roessler "Principles of sensory evaluation of food" Acad. PR 1965 ISBN 978-0-12-056150-6
[28]. F. Toldra "Park, Y.W. and L.N. Bell. 2002. Determination of Moisture and Ash contents of Foods. Handbook of Food Analysis. 2nd Ed. Marcel Dekker, Inc. pp. 55-82." Handbook of Dairy Foods Analysis (pp.229-248) January 2010
[29]. Nielsen "Food analysis" Springer 2010 ISBN 978-1-4419-1477-4
[30]. Capanoglu , Apak "Measurement of Antioxidant Activity and Capacity: Recent Trends and Applications" John Wiley & Sons, Incorporated 2018 ISBN 978-1-119-13536-4
[31]. Xianghua, Majid "Handbook of texture analysis" Imperial College Press 2008 ISBN 978-1-84816-115-3
[32]. "Bacteriological Analytical Manual (BAM)" by the U.S. Food and Drug Administration (FDA)
[33]. Huynh-Ba, Kim "Handbook of stability testing in pharmaceutical development: regulations, methodologies, and best practices" Springer 2009 ISBN 978-0-387-85626-1
[34]. Huynh-Ba "Handbook of Stability Testing in Pharmaceutical Development: Regulations, Methodologies, and Best Practices" Springer New York 2009 ISBN 978-0-387-85626-1
[35]. K. E. Jarvis "Handbook of Inductively Coupled Plasma Mass Spectrometry" Springer Netherlands 2012 ISBN 978-94-010-5355-6
[36]. Robert M., Hoffman "Multipotent Stem Cells of the Hair Follicle: Methods and Protocols" Humana Press 2016 ISBN 978-1-4939-3784-4
[37]. B. Thomas, Carr "Sensory evaluation techniques" Taylor & Francis 2007 ISBN 978-0-8493-3839-7
[38]. S. Suzanne "Food analysis" Springer 2014 ISBN 978-1-4419-1477-4
[39]. S. Suzanne "Food analysis" Springer 2014 ISBN 978-1-4419-1477-4
[40]. Christopher C., Chang "Data Management and Summary Statistics with PLINK" Springer US 2020 ISBN 978-1-0716-0198-3
[41]. B.M. McKenna"Texture in Food: Solid Foods" ISBN-13: 978-1855737241
[42]. International Commission on Microbiological Specifications for Foods "Microbiological testing in food safety management" Kluwer Academic/Plenum Publishers 2002 ISBN 978-1-4684-8371-0
[43]. William A. Brown"Dissolution Testing of Dietary Supplements"ISBN-13: 978-1493969764 44) European Medicines Agency (EMA) "Stability Testing of Herbal Medicinal Products"EMA Reflection Paper
[44]. Lakshmi Narayana, Reddy "Heavy metal analysis" VDM Verlag 2010 ISBN 978-3-639-27145-4
[45]. Kraftmakher "Modulation calorimetry: theory and applications" Springer2004 ISBN978-3-540-21082-5
[46]. Ralph M. "Nutrition for Healthy Hair: Guide to Understanding and Proper Practice" Springer International Publishing AG 2020 ISBN 978-3-030-59919-5
[47]. World Health Organization (WHO)"Quality Control Methods for Herbal Materials" ISBN-13: 978-9241500739
[48]. Houghton, Peter J, "Evaluation of herbal medicinal products: perspectives on quality, safety, and efficacy" Pharmaceutical Press 2009 ISBN 978-0-85369-751-0

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[49]. Pathak "Handbook of nutraceuticals" CRC Press 2010 ISBN 978-1-4200-8221-0

[50]. Debasis, Dilip K, "Clinical aspects of functional foods and nutraceuticals" CRC press 2015 ISBN 978-1-4665-6910-2