CHHATTISGARH STATE MINOR FOREST PRODUCE CO-OPERATIVE FEDERATION, LTD.
"Van Dhan Bhawan" Sector 24, Atal Nagar, Nawa Raipur (C.G.)
E-mail: mfpfed.cg@nic.in Website: www.cgmfpfed.org

No./MFP/PROS/RD/PROD-TECH/23-480/2024/5899 Raipur, Date: 06/05/2024

To,

Dr. Sumit kumar singh (PI),
Assistant Professor
School of Biochemical Engineering
IIT (BHU) Varanasi
Uttar Pradesh - 221005
E-mail Id: sumit.bce@iitbhu.ac.in

Sub: Signing of MoU project titled "Biochemical Transformation Of Natural Products Into Functional Bioactive Cosmetics - Reg.

Ref: Letter No./MFP/PROS/RD/PROD-TECH/23-480/2024/3494 Dated 11.03.2024.

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With reference to the above cited letter regarding the projects titled" Biochemical Transformation Of Natural Products Into Functional Bioactive Cosmetics". The MoU has been signed and copy of signed MoU enclosed with this letter.

With Regards,

Encls : Copy of MoU.

(B. Ananda Babu)
Additional Managing Director (D)
CGMFP Federation, Raipur

End. No./MFP/PROS/RD/PROD-TECH/23-480/2024/5900 Raipur, Date:06/05/2024
Copy to for necessary action:-

1. **Dr. Pranjal Chandra (Co-PI),** Associate Professor School of Biochemical Engineering IIT (BHU) Varanasi U.P. E-mail Id: pranjal.bce@iitbhu.ac.in
2. **Dr. Preeti Chauhan (Co-PI),** Institute of Medical Science (BHU) Varanasi U.P.

Additional Managing Director (D)
CGMFP Federation, Raipur

C.M.F.P. Fed. Raipur
08 MAY 2024
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Tehsil- SADAR, Dist-VARANASI

Please write or type below this line

Memorandum of Understanding for Biochemical transformation of natural products into functional bioactive cosmetics

Indian Institute of Technology (Banaras Hindu University) Varanasi is an Institute of national importance created by an Act of the Parliament through the Institutes of Technology (Amendment) Act, 2012 vide Gazette Notification dated 29.06.2012., acting through the Principal Investigator (PI) of this project, having its office at School of Biochemical Engineering, P.O. IIT(BHU) Varanasi, Varanasi, U.P.-221005, India, hereinafter referred to as "IIT (BHU)," of the FIRST PART.

AND

Chhattisgarh State Minor Forest Produce Co-operative Federation Limited, Van Dhan Bhawan, Sector-24 Nava Raipur, Atal Nagar, RAIPUR (C.G.), registered under Chhattisgarh Cooperative Societies Act, 1960 and acting through its **Managing Director (Trade),** here-in-after called the **"CGMFP,"** which expression shall include its assigns and successors, of the SECOND PART.

The aforesaid institutions are hereinafter referred to individually as the "Party"and collectively as the "Parties."

Whereas IIT(BHU) is one of the premier institutes to provide meaningful education, to conduct original research of the highest standard, and to provide leadership in technological innovation for the industrial growth of the country. IIT(BHU) imparts andundertakes cutting-edge research in various areas of science; engineering, design; management, and humanities

Whereas

(i) the "CGMFP' is the three-tier Co-operative organization created to promote the trade and development of Minor Forest Produce in the interest of MFP gatherers, on co-operative pattern. The main tasks of the "CGMFP" are:

a. Collection and trade of Tendu leaves
b. Implementation of many socio-economic welfare schemes for the tendu leaves gatherer families like footwear distribution, scholarship schemes for education of their children, Insurance schemes for the members of the Tendu leaves gatherers; distribution of profit from the trade of Tendu leaves in the form of differed wages etc.
c. Promotion of Minor Forest Produce based processing units
d. Conservation, development, and sustainable utilization of minor forest

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produce

e. Promotions of cultivation of minor forest produce species including medicinal, aromatic and dye plants etc.

(ii) **Dr. Sumit Kumar Singh, Assistant Professor,** IIT(BHU), **Dr. Pranjal Chandra, Associate Professor, IIT (BHU), and Dr Priti Chauhan, Assistant Professor, Faculty of Ayurveda, Institute of Medical Sciences, BHU have** submitted a proposal (Proposal) dated February 29, 2024, with the "CGMFP' for a project ("Project") titled as " **Biochemical transformation of natural products into functional bioactive cosmetics**." The Proposal aims at performing thorough research and development of products for human hair and skin. The key activities of the proposed work includes:

- Development of anti-greying upcycled hair product
- Development of anti-hair loss product
- Development of hair-densifying product
- Development of skin refining product
- Development of anti-wrinkle product

(iii) The "CGMFP" has, through its letter ("Sanction letter") No./MFP PROS/RD/PROD-TECH/23-480/2024/3494 dated 11/03/2024 sanctioned the Project subject to the Cost approved in the Sanction Letter. A copy of the Sanction Letter is appended in Annexure B to this Agreement.

(iv) Whereas **Dr. Sumit Kumar Singh, School of Biochemical Engineering** (hereinafter referred to **as "IIT (BHU) Principal Investigator"), Dr. Pranjal Chandra, School of Biochemical Engineering** (hereinafter referred as "**IIT (BHU) Co-Principal Investigator**), and **Dr. Preeti Chauhan, Faculty of Ayurveda (hereinafter referred as "IMS BHU Co-Principal Investigator**) will initiate the Project. He and his research team at IIT (BHU) will execute the obligations of non-disclosure of Confidential Information received from "CGMFP".

Whereas the Parties desire to record the broad terms and conditions that are jointly accepted and agreed to in this MoU as contained hereunder.

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This MoU shall be deemed to commence (effective date) from the day of signing of the MoU by both parties.

1. **Definition**

   a. "CGMFP" know-how shall mean and include all know-how of methods, materials, software, designs, patterns, formats, proprietary technical literature, and information developed, owned, and provided by the "CGMFP," which are required for the project.

   b. IIT(BHU) know-how shall mean and include all know-how of methods, materials, software, designs, patterns, formats, proprietary technical literature, and information developed, published, or otherwise owned and provided by IIT(BHU), which are required by the project.

   c. "CGMFP" personnel shall mean the personnel or research and development engineers of the "CGMFP" deputed for the project

   d. IIT(BHU) Principal investigator research team shall comprise of the Principal Investigator and the co-Investigator participating in the project(s).

2. Items/ areas of collaboration/deliverables:

   Technical specifications of the project are given in the **Annexure A** to this MoU.

3. **Activities and Obligations**

   a. The "CGMFP" shall be responsible for providing the funds required for the project, as identified in Annexure B. The "CGMFP" may depute appropriate "CGMFP" personnel to participate in the project, as per mutual agreement. The "CGMFP" will provide its facilities and resources for the execution of the project.

   b. The "CGMFP" will provide the know-how which may be deemed necessary for the project

   c. The "CGMFP" shall use the IIT(BHU) know-how only to conduct the project and prevent it from unauthorized usage or falling into unauthorized hands.

   d. Any equipment purchases made according to this MoU will be the property of IIT(BHU).

4. **Intellectual Property Rights:**

   - Ownership of any intellectual property (including but not limited to

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confidential information, know-how, patents, copyrights, design rights, rights relating to computer software, and any other industrial or intellectual property rights) developed jointly during the course of this MoU shall be owned by IIT(BHU).

- The parties recognize that the commercialization and disposition of the intellectual property may be subject to separate agreements and discussions as needed, with due consideration for the collective interests.
- The IPR policy of the IIT(BHU) institute-sponsored projects will be applicable and IIT(BHU) will be the sole applicant for the patent application/IPR.

5. Effective date, duration, termination of the MoU:

The MoU shall be effective from the effective date, upon signatures of the Parties and shall remain in force for a period of one (1) year. The parties may extend the term by written agreement signed by both the parties.

The project work may be terminated by either party by giving the other party a written notice of 60 days, mentioning sufficient cause for such termination. However, both parties will ensure that the provisions of this MoU shall continue to apply to all activities in progress until their completion. Clauses relating to the intellectual Contractors, Governing Laws and Conflict Resolution and clause 16 and 17 shall survive the termination or expiration of this MoU.

6. Milestones

The actionable milestones to be achieved by IIT(BHU) are appended in the **Annexure-A** to this MoU.

7. Payment

Financial specifications will be as per the cost sanctioned by CGMFP Federations through letter No No./MFP PROS/RD/PROD-TECH/23-480/2024/3494 dated 11/03/2024 (Annexed as Annexure B) to this MoU. All Cheques/RTGS will be drawn in favor of Registrar, IIT(BHU) Varanasi. The payment shall be made by the "CGMFP" within 15 calendar days from the date of receipt of invoice from IIT(BHU). There is no GST involved in this sponsored research project.

The payment shall be disbursed in the following manner:

First Installment	Initial- at the signing of the agreement	80%

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Second Installment	On 6th Month	20%

8. Confidentiality:

a. Confidential Information includes all communication of information disclosed in documentary or tangible form between the Parties, including oral, written, and machine- readable forms, pertaining to the above, which is indicated as confidential. In the case of such information disclosed orally or visually, the Disclosing Party shall confirm in writing the fact and general nature of each disclosure within (30) days after it is made.

b. The confidential information includes information:

   i. Disclosed by or on behalf of the disclosing party to the receiving party

   ii. Otherwise learned or ascertained by the receiving party from inspection and/or evaluation of samples(s) identified by the Disclosing party as confidential and provided to the receiving party by or on behalf of the Disclosing party (sample(s)) and/or,

   iii. Otherwise learned or ascertained by the receiving party from the disclosing party.

c. The receiving party will not disclose confidential information of Disclosing party to any other person and use at least the same degree of care to maintain the information confidential as receiving party uses in maintaining as confidential its own confidential information, but always at least a reasonable degree of care; due diligence will be taken by both parties in maintenance of confidential information.

d. The receiving party will use the confidential information only for the above mentioned purpose.

e. The receiving party will restrict disclosure of the confidential information of the disclosing party solely to those employees, subsidiaries, parent and affiliated companies of receiving party having a need to know such information in order to accomplish the purpose stated above.

f. This MoU imposes no obligation on the receiving party with respect to

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any portion of the confidential information received from the disclosing party which:

1. Was known to the receiving party prior to the disclosure by the disclosing party
2. Is lawfully obtained by the receiving party from a third party other than unauthorized disclosure
3. Is independently developed by the receiving party, or
4. Is disclosed by the disclosing party to a third party without a duty of confidentiality on the third party
5. Is required by law or decree.

g. The confidential information shall remain the sole property of the Disclosing party.

h. The obligation of non-disclosure of the confidential information shall survive for 3 years after the expiry/termination of this MoU.

9. Limitation of Liability

Neither Party, nor any of their affiliates nor their or their affiliates respective directors, officers, employees, subcontractors, or agents shall be liable to the other Party for any special, incidental, indirect, or consequential damages (including, but not limited to, contract. negligence and tort liability) in connection with or arising out of this MoU. Furthermore, it is agreed that the funds received for this project are non-transferable.

10. Publicity:

Neither party shall use the name of the other party or its employees in any advertisement, press release, or publicity with reference to this MoU without written approval of the other party, except for necessary government disclosures.

11. Independent Contractors:

For the purposes of this MoU, the parties hereto are independent contractors and nothing contained in this MoU shall be construed to place them in relationship of partners, principal and agent, employer/ employee or joint ventures.

12. The parties agree that this MoU constitutes a legal, valid and binding agreement of each party, and is enforceable against each party in accordance with its terms.

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13. Amendment:

Any amendment or variation to this MoU shall be made by a written MoU between the parties.

14. Governing Laws and Conflict Resolution

This MoU shall be constructed, governed, interpreted, and applied in accordance with the laws of India. The Parties shall attempt in good faith to resolve promptly any dispute arising out of or relating to this MoU by negotiation. If the matter cannot be resolved in the normal course of business, within ten (10) days after the dispute arises, any interested Party shall give the other Party written notice of any such dispute not resolved, after which the dispute shall be referred to Director, IIT (BHU) and MD, CG-MFP Federation Limited, who will jointly resolve the dispute in a spirit of independence, mutual respect, and shared responsibility. In case an amicable settlement of any disputes arising out of or relating to this MoU is not achieved within thirty (30) days after written notice is received, such dispute shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act, 1996 (as amended from time to time), by one (1)/sole arbitrator appointed by the Director, IIT(BHU) Varanasi. The seat of the arbitration shall be Varanasi. The arbitration shall be conducted in the English language, and the award shall be final and binding upon the Parties. Each Party shall bear its own costs of the arbitration unless the arbitrator otherwise directs.

15. Force Majeure:

Each Party shall be excused from the performance of the MoU only to the extent that the performance is prevented by conditions beyond the reasonable control of the affected Party. The Party claiming excuse for the delayed performance will promptly notify the other Party and will resume its performance as soon as performance is possible.

16. IIT (BHU) MAKES NO WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, TO THE "CGMFP" OR ANY THIRD PARTY, AS TO ANY MATTER INCLUDING, BUT NOT LIMITED TO, WARITANTY OF FITNESS FOR PARTICULAR PURPOSE, OR MERCHANTABILITY, EXCLUSIVITY OR RESULTS OBTAINED FROM USE.

In witness thereof, the Parties hereto have signed this MoU on the effective date mentioned hereinbefore.

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DATE:

For and on behalf of,

Chhattisgarh State Minor Forest Produce Cooperative Federation Limited

Signature

Name:
Designation:

(Manivasagan S.)
I.F.S.
Conservator of Forest
General Manager & Executive Director
C.G. State Minor Forest Produce
Co-oprative Federation, Nawa Raipur

For and on behalf of,

Indian Institute of Technology (Banaras Hindu University) Varanasi

Signature 12/3/24

Dr. Sumit Kumar Singh
Assistant Professor
School of Biochemical Engineering
Indian Institute of Technology (BHU)
Varanasi-221005, U.P. INDIA

Name: Dr. Sumit Kumar Singh (PI)
Designation: Assistant Professor
School of Biochemical Engineering, IIT (BHU)

Signature: 12/3/24

Dr. Pranjal Chandra
Associate Professor
School of Biochemical Engineering
Indian Institute of Technology (BHU) Varanasi
Varanasi-221005, Uttar Pradesh

Name: Dr. Pranjal Chandra (Co-PI)
Designation: Associate Professor
School of Biochemical Engineering, IIT (BHU)

Signature: Preeti. Chouhan 12/3/24

Dr. Preeti Chouhan
Assistant Professor
Department of Prasutitantra
Faculty of Ayurveda, IMS, BHU

Name: Dr. Preeti Chauhan (Co-PI)
Designation: Assistant Professor
Faculty of Ayurveda, IMS (BHU)

12/3/2024

Head
Dept. of Prasuti Tantra
Faculty of Ay. IMS

WITNESSES:

Anuradha Sawaiyan
Manager (PMU)

Chitresh Singh Parihar
(Tax Assistant

Signature: 12/3/2024

समन्वयक
Coordinator
Name : Prof. Vikash Kumar Dubey
Designation: Coordinator, School of Biochemical Engineering, IIT (BHU)

Coordinator
समन्वयक
स्कूल ऑफ बायोकेमिकल अभियांत्रिकी स्कूल
School of Biochemical Engg
भारतीय प्रौद्योगिकी संस्थान
Indian Institute of Technology
(का.हि.वि.वि.) वाराणसी-221005
(B.H.U.) Varanasi-221005

Signature:

Name: Prof. Vikash Kumar Dubey
Designation: Dean (R&D), IIT (BHU)

भारतीय प्रौद्योगिकी संस्थान (का.हि.वि.)
Indian Institute of Technology(B.H.U.)
वाराणसी/Varanasi-221005

Annexure A

Project proposal

On

Biochemical transformation of natural products into functional bioactive cosmetics

Submitted to

Chhatisgarh State Minor Forest Produce (Trading and Development) Co-operative Federation Ltd.

by
Dr. Sumit Kumar Singh, Ph.D. (PI)/ Dr. Pranjal Chandra (Co-PI)

School of Biochemical Engineering, IIT BHU

&

Dr. Preeti Chouhan (Co-PI)

Institute of Medical Sciences, BHU

Background: Hair is an important component of the body with great physiological importance for both men and women. The spurt in several cosmetic alterations of hair, like coloring and straightening, bears testimony to their importance across cultures and fashion. However, these cosmetic activities utilize harsh chemical processes that often damage the normal structure of the hair shaft. For example, the bleaching process utilizes strong oxidizing agents that destroy the disulfide bonds of keratin (80% of human hair is made up of keratin and is responsible for the hair strength, flexibility, durability, and functionality), resulting in significantly altering hair mechanical and surface properties. Thus, there is a huge demand for the development of new hair protective products, and currently, the hair cosmetic Industry is focused on alternative solutions like proteins and protein-based materials that could be eventually developed into topical applications.

Benefits of natural science-backed formulations: Proteins can create a suitable environment for healthy hair because of their amphoteric and buffering properties that enable them to bind water with the horny skin and its annexes.

Proposed Products:

i) Anti-greying upcycled hair product:

The coloration of hair results from a complex interplay within the hair follicle involving melanocytes, matrix keratinocytes, and dermal papilla fibroblasts. This pigmentation process occurs specifically during the anagen phase, the active growth phase of hair. Melanins, the pigments responsible for hair color, are produced within melanocytes in organelles known as melanosomes. These melanins, including the dark brown to black eumelanin and the reddish-yellow pheomelanin, are then transferred to keratinocytes, ultimately determining the color of the hair shaft.

Eumelanin synthesis, crucial for determining hair darkness, is initiated by activating the melanocortin 1 receptor (MC1R), often stimulated by the hormone α-MSH. Tyrosine, an amino acid, serves as the building block for eumelanin synthesis. This process is tightly regulated by various proteins and enzymes, including tyrosinase (TYR) and dopachrome tautomerase (DCT), ensuring precise control over melanin production and hair coloration.

Our proposal:

To counteract hair greying, we propose to develop a new cosmetic active ingredient, which is based on an aqueous **Kaunch seeds** sourced from CGMFP. For this active ingredient this unique kaunch seed extract will be supplemented with acetyl tyrosine, which is the amino acid that acts as a substrate for the melanin synthesis in the melanocytes and thus also supports the product efficacy. Acetyl tyrosine will be extracted from the **Malkagani seeds**. Further, imgridents of the proposed product will include **mahua seed extract** (moisuturizing properties), **mahua flower** (conditioning effect) **and amla extract** (as a natural preservative with antimicrobial properties).

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Mouse Preclinical testing:

The efficacy of these formulations will be tested for stimulation of melanogenesis on mouse B16 melanoma and skin cells eiterh alone or in synergestic combination with α-MSH analogue.

Gene expression analysis of human melanocytes:

The research involves treating human melanocytes with various compositions of the aqueous extract from the proposed formulation. Gene expression analysis will then be conducted to unravel the underlying mechanisms. Specifically, the study will focus on examining the expression of key genes, including the DCT gene responsible for encoding the dopachrome tautomerase enzyme crucial for converting dopachrome into 5,6-dihydroxyindole-2-carboxylate—a fundamental step in eumelanin production. Additionally, the evaluation will extend to analyzing the gene expression changes of MKI-67, serving as a marker for cell proliferation and indicative of melanocyte proliferation status. Furthermore, the study will assess the expression of two genes (HMOX1 and TXN) encoding enzymes involved in defense mechanisms against oxidative stress.

Protection against stress induced malfunction of melanocytes

While genetics primarily determine hair greying, other factors such as stress have been associated with premature greying. Scientific research has shown that the hormone noradrenaline, released during stress, plays a role in stress-induced greying. Interestingly, stress-induced greying can be reversed. Melanocytes treated with 100 μM noradrenaline for 24 hours exhibited altered gene expression profiles, indicating stress-induced dysfunction. Key genes involved in melanocyte function and melanin production, such as HMOX1 (encoding heme oxygenase 1), MC1R (encoding melanocortin 1 receptor), and CCN3 (encoding cellular communication network factor 3), were significantly downregulated. The downregulation of CCN3 can lead to decreased cell adhesion and melanocyte detachment from the basal membrane, resulting in reduced melanin production. Further tests will be conducted to determine if the formulation can reverse the gene expression changes induced by stress and consequently reverse the greying process.

Clinical study of Anti-greying effect

If the invitro results turn out to be encouraging, the efficacy of the proposed product will be analyzed in a placebo-controlled clinical study involving both male and female volunteers with grey hair.

ii) Anti-Hairloss product

The human hair follicle is a sophisticated structure comprising various components, including the outer and inner root sheaths, the hair shaft, the bulge, and the sebaceous gland. At the base of the follicle lies the hair bulb, where highly active matrix keratinocytes produce the keratinized hair shaft. Surrounding this bulb is the ectodermal matrix housing mesenchymal cells known as the dermal papilla, which nourishes the hair bulb and regulates the hair growth cycle through nutrient transfer.

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Following their formation during embryonic development, hair follicles undergo cyclical growth characterized by three phases: anagen, catagen, and telogen. Anagen, the growth phase, lasts approximately three to five years, succeeded by catagen, the involution phase, lasting several weeks. The cycle concludes with telogen, a resting period lasting up to four months. Dermal papilla cells orchestrate signals that govern keratinocyte activity within the follicular matrix, with keratinocytes ceasing proliferation at anagen's end and undergoing apoptosis during catagen. The commencement of a new growth phase, signaling the length of anagen, is prompted by growth factors released from dermal papilla cells, stimulating nearby quiescent keratinocyte progenitor cells to proliferate and initiate a new hair follicle.

Hair follicles cycle independently, resulting in continuous growth, rest, and shedding of hair simultaneously. Scalp hair density and total count remain constant, with telogen hair typically comprising 10% to 15% of the total. Diffuse hair loss, characterized by a uniform reduction in hair density, can result from triggers such as physiological or emotional stress, hormonal imbalances, or nutritional deficiencies. Telogen effluvium, a form of diffuse hair loss associated with stress, entails the premature transition of follicles into catagen and telogen phases and early termination of anagen follicles. Trichogram analysis of telogen effluvium reveals a notable reduction in the anagen-to-telogen ratio, with over 25% of hair in the telogen phase.

Proposed Product:

In the proposed work, we aim to develop an anagen phase promoting formulation using Bhelwa seed extract (Aqueous). The seed extract is known to contain isoflavounes- a type of phytoestrogen compounds that are commonly found in various plant-based foods. These isoflavounes are known to extend the hair growth cycle in the anagen phase.

Analytical Characterization of the proposed formulation

1. **Identification and Quantification of Isoflavones Forms by LC-DAD-FLD**

Isoflavones forms will be analyzed using LC-DAD-FLD. A quaternary pump chromatographic system will be utilized, with a C18-5 µm Kromasil® column maintained at 40 °C. The mobile phase will consist of milli-Q water and acetonitrile (added with 0.3% formic acid) at a flow rate of 1.0 mL/min.

The column will be equilibrated with a mixture of eluent A and B (85%:15%), and then the eluent mixture will be modified during the 30-minute assay. Injection intervals of 25 minutes will be used for re-equilibration. Quantification will be done using external standardization, with isoflavones quantified by DAD peak area at 250 nm. The contents of malonyl glycosides and acetyl glycosides will be determined from the calibration curve of the corresponding β-glycoside isoflavone. The results will be expressed as mg of compound per 100 g of dry weight of the extract (dwb), and quantification will be performed using a calibration curve (0.1–10.0 ppm) with standards at a minimum of five concentration levels.

Invitro/mouse preclinical testing

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The cytotoxicity of bhelwa aqueous extract will be assessed through in vitro assays on healthy and tumoral cells. Bone marrow cells will be harvested from BALB/c mice aged 8–10 weeks, following approval by the Institutional Ethics Committee for Animal Research/ IIT(BHU) Varanasi.

One hundred microliters containing healthy mouse bone marrow (BM) cells (5.0 × 105 cells/mL) or fibroblast (1.5 × 105 cells/mL) L929 or human glioblastoma U-87 MG cells will be cultured in 96-well microplates for 24 hours at 37 °C in a 5% CO2 humidified atmosphere. Subsequently, 100 µL of Bhelwa aqueous extract at concentrations ranging from 125 to 0.97 mg/mL will be added to the wells. After a 24-hour incubation period, cell viability will be assessed by introducing 20 µL of resazurin (2.5 µg/mL) (Sigma-Aldrich Co), with cells further incubated in its presence for an additional 6 hours. The fluorescence intensity will be measured using a Victor™ X microplate reader at excitation and emission wavelengths of 530 nm and 590 nm, respectively.

Clinical Studies

The clinical efficacy testing will be done following approval by the Institutional Ethics Committee / IMS BHU.

Gene expression analysis in plucked hairs will be conducted with human volunteers of appropriate age. The study will involve participants using scalp products with bhelwa aqeous exteract. The extract will be formulated at approapraite % into a neutral scalp product. Treatment with the products and extraction of hair bulbs will be carried out on two test sites at the back of the head. The products will be applied twice a day for 2 weeks.

Before the initial product application, 10 hairs will be plucked from each test site and pooled together. At the conclusion of the study, 20 hairs will be plucked from each test site. The extracted hair bulbs will be trimmed to around 1 cm in length and stored at -80°C. The expression of selected markers will be analyzed using the RT-qPCR method on mRNA extracted from the different hair pools. Gene expression analysis will be performed in duplicates using a dedicated PCR array containing 32 target genes (including 2 housekeeping genes) selected for their significance in hair physiology.

At the end of the study, the volunteers will be asked to evaluate the efficacy of the treatment in a questionnaire.

iii) Hair-densifying product

Hair loss, also known as alopecia, is a common concern affecting individuals worldwide, leading to various degrees of distress and impacting one's self-esteem. While several factors contribute to hair thinning and loss, compromised mitochondrial function in hair follicles has emerged as a critical aspect in the pathogenesis of this condition. Mitochondria play a vital role in providing energy for cellular activities, including hair growth and maintenance.

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Recent research indicates that aging, environmental stressors, and genetic predispositions can lead to mitochondrial dysfunction in hair follicles, resulting in decreased hair growth, miniaturization of follicles, and ultimately hair loss. Therefore, targeting the revival of mitochondrial function within the hair follicles presents a promising approach for developing innovative hair densifying products that can promote healthy hair growth and combat hair loss effectively.

By focusing on enhancing mitochondrial function, it is possible to improve the energy production within hair follicles, potentially enhancing follicular activity, prolonging the hair growth phase, and increasing hair thickness and density. Innovations in hair care formulations that incorporate ingredients known to support mitochondrial health and function hold significant potential for revitalizing hair follicles and promoting overall hair density.

This proposal aims to develop a novel hair densifying product that targets the revival of mitochondrial function in hair follicles. Through advanced research, formulation development, and clinical testing, the objective is to create a scientifically-backed and effective solution that addresses the root cause of hair loss by promoting optimal mitochondrial activity and ensuring healthy hair growth.

Proposal :

Our innovative solution to combat hair loss and promote healthy hair growth involves the development of a potent formulation harnessing the power of natural ingredients known for their beneficial effects on hair health and, more importantly, mitochondrial function. Through meticulous research and formulation design, we propose to curate a blend of aqueous extracts from **Harra Sabut, Amla, Kutki, Satavari root, Mahua flower, and honey** to create a comprehensive and effective hair care product.

At the core of this formulation lies **Harra Sabut**, a key ingredient renowned for its remarkable ability to enhance mitochondrial function within hair follicles. This potent ingredient serves as the powerhouse that revitalizes and energizes the mitochondria, promoting optimal cellular activity essential for robust hair growth and follicular health.

Combined with the nourishing properties of Amla, the detoxifying effects of Kutki, the balancing benefits of Satavari root, the rejuvenating properties of Mahua flower, and the humectant and antioxidant properties of honey, this unique blend offers a holistic approach to address hair thinning and promote hair densification.

By leveraging the combined strengths of these natural extracts, our formulation aims to rejuvenate and fortify hair follicles, stimulate hair growth, increase hair density, and enhance overall scalp health. This synergistic blend will be meticulously crafted to deliver a potent and effective solution that targets the root cause of hair loss by supporting mitochondrial function and promoting optimal conditions for healthy hair growth.

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Analytical Characterization:

The hair densifying formulation will undergo thorough analytical characterization to assess its physical, chemical, and biological properties. This will involve analyzing the content of active ingredients, pH levels, viscosity, stability, and microbial contamination using techniques such as high-performance liquid chromatography (HPLC) and microscopy to ensure consistent quality.

In Vitro Testing:

In vitro studies will be conducted to investigate the efficacy of the hair densifying formulation at a cellular level. Cell culture experiments with human hair follicle cells or skin models will be utilized to evaluate its impact on mitochondrial function, cellular proliferation, and gene expression related to hair growth. These studies will also assess antioxidant, anti-inflammatory, and nourishing properties of the formulation.

Preclinical Testing:

Before advancing to human tests, preclinical studies will be carried out to evaluate the safety and efficacy of the hair densifying product in animal models. Acute and subchronic toxicity assessments will be performed to determine the safety profile of the formulation. Animal models with hair loss conditions will be employed to examine effects on hair growth, follicle morphology, and scalp health.

Clinical Tests:

Clinical tests will be a key component for validating the efficacy and safety of the hair densifying formulation in human subjects. Controlled studies with defined participant populations and rigorous protocols will be conducted to assess efficacy and safety. Measurements of changes in hair density, diameter, growth rate, and participant-reported evaluations on hair quality will be included.

Moreover, the safety profile of the product will be evaluated through dermatological assessments, skin irritation tests, and monitoring for allergic reactions. All clinical tests will adhere to regulatory guidelines and ethical standards to ensure participant well-being and the reliability of results.

By integrating analytical characterization, in vitro studies, preclinical testing, and clinical tests, a comprehensive approach will be applied to evaluate the efficacy and safety of the hair densifying formulation. This approach will support the successful development and commercialization of the product as an advanced solution for promoting hair health and revitalization.

iv) Skin refining (Acne) Product

Skin impurities resulting from the overproduction of sebum are not merely a teenage concern but also affect many adults, leading to self-confidence issues and emotional distress. The excessive

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sebum production by sebocytes in the sebaceous glands within hair follicles contributes to an oily skin appearance and enlarged pores, creating an environment conducive to impurities like comedones and inflammation.

One of the primary factors triggering increased sebum production is the hormone dihydrotestosterone (DHT), a byproduct of testosterone conversion catalyzed by the enzyme 5-alpha-reductase. Among the three isoforms of 5-alpha-reductase, type I plays a pivotal role in sebum production and is predominantly expressed in skin cells, particularly in sebocytes. DHT binds more strongly to androgen receptors than testosterone, leading to enhanced sebocyte differentiation and sebum secretion.

Inhibiting 5-alpha-reductase type I to impede DHT generation has shown promise in reducing sebum production and mitigating skin impurities. By targeting the key regulator of sebum formation, this approach offers a potential solution for individuals struggling with greasy skin, comedones, and large pores. The modulation of sebum production through 5-alpha-reductase inhibition represents a promising strategy for promoting clearer, healthier skin and addressing the underlying causes of skin impurities.

Our Proposal

To address the challenges associated with excessive sebum production and skin impurities caused by the hormonal effects of DHT, we propose a novel solution in the form of a lysosomal preparation enriched with a unique blend of natural extracts. This innovative formulation incorporates the therapeutic benefits of **lac resin, kusum seed, bael pulp, mahua flower, and mahul leaf** to combat sebum overproduction and promote clearer, healthier skin.

At the heart of this formulation is lac resin, a key ingredient known for its potent sebum-regulating properties. By harnessing the capabilities of lac resin, our lysosomal preparation targets the inhibition of 5-alpha-reductase type I activity, thereby limiting the conversion of testosterone to DHT and reducing the excessive sebum production that contributes to skin impurities. Lac is primarily an oleoresin- which is a mixture of essential oils and resin. Oleoresins typically contain volatile essential oils along with non-volatile resinous components. In the case of lac, it consists of a blend of essential oils and resin, with the resin component primarily composed of triterpenes. The essential oils in oleoresins are often made up of monoterpenes, while the resin portion, as in the case of lac, comprises triterpenes. These constituents contribute to the unique properties and potential therapeutic benefits of lac resin.

Combined with the nourishing and revitalizing properties of kusum seed, bael pulp, mahua flower, and mahul leaf, this synergistic blend works harmoniously to restore balance to sebaceous gland activity, minimize pore enlargement, and alleviate issues such as comedones and inflammation. The formulation aims to provide a comprehensive solution that not only addresses the root cause of oily skin and impurities but also supports skin health and clarity.

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By leveraging the natural potency of these botanical extracts, our lysosomal preparation offers a gentle yet effective approach to sebum regulation and skin purification. Through the incorporation of lac resin as a key component, we strive to deliver a product that promotes sebum normalization, enhances skin appearance, and boosts self-confidence for individuals struggling with oily and impure skin conditions.

In Vitro Assessment of 5-alpha-Reductase Type I Inhibition:

A cell-free assay system will be utilized to assess the direct inhibitory effect of lac liposomes on 5-alpha-reductase type I using cell extracts from HEK293 cells expressing the enzyme. Liquid chromatography combined with mass spectrometry will be employed to detect the conversion of androstenedione to 5-alpha-androstenedione. The impact of varying concentrations of lac liposomes on inhibiting 5-alpha-reductase type I activity will be investigated, with emphasis on determining the IC50 value in vitro.

Clinical Assessment of Pore Size Reduction:

A double-blind clinical trial will be conducted with appropriate number of healthy volunteers exhibiting enlarged pores on their cheeks to evaluate the effect of lac liposomes on pore size reduction. Participants will be instructed to apply a placebo cream on one side and a cream containing lac liposomes on the other side of the face twice daily for 28 days. Silicon imprints will be obtained from the test areas at specified intervals and analyzed using Primos 5.7 high-resolution imaging. Pore refinement will be assessed based on changes in skin roughness and total pore area, with a focus on observing trends in pore size reduction over the study duration.

Clinical Assessment of Shininess Reduction and Imperfections:

In a second double-blind clinical study, the impact of mastic on comedo formation and shininess reduction in the skin will be investigated. Female volunteers with oily skin and visible comedones will be divided into two groups, with one group using a placebo cream and the other applying a cream containing lac liposomes twice daily on their faces for a period of 28 days.

Macrophotographs will be taken before and after the treatment to assess the anti-comedogenic and mattifying effects of mastic. The number of blackheads and microcysts will be counted in different facial zones, and the shininess of the skin will be evaluated by a clinician.

The study aims to observe reductions in blackheads and microcysts, as well as improvements in skin shininess, for participants using mastic liposomes. Self-evaluation and macrophotographs will be used to confirm the mattifying effect of mastic liposomes and the perceived reduction in skin imperfections.

v) Anti-Wrinkle Product

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Glycation is a natural process that contributes to the formation of wrinkles and other visible signs of skin aging. Inhibition of glycation can play a vital role in preventing the structural and functional changes that lead to skin aging. The development of skincare products that target glycation can offer a promising solution to effectively combat wrinkle formation and promote skin youthfulness.

Our Proposal:

This project aims to develop an innovative skincare product formulated as liposomes to prevent wrinkle formation by inhibiting glycation. The product composition will include a synergistic blend of natural ingredients known for their anti-glycation properties. Key ingredients such as **Kusum seeds, Bhuineem, Mahua flower, Bael pulp, Mahua seed, and Giloy extract** will be carefully selected for their ability to target the glycation process and maintain skin health.

The formulation will be encapsulated in liposomes to enhance the delivery and efficacy of the active ingredients. Liposomes, with their unique lipid bilayer structure, can facilitate the penetration of bioactive compounds into the skin, ensuring optimal absorption and bioavailability.

Through a systematic approach encompassing ingredient selection, formulation development, and efficacy testing, this project aims to create a high-performance skincare product that addresses glycation-induced wrinkle formation. By harnessing the synergistic effects of these natural ingredients in liposomal form, the product seeks to provide a comprehensive solution for combating skin aging at its core.

By leveraging the anti-glycation properties of **Kusum seeds, Bhuineem, Mahua flower, Bael pulp, Mahua seed, and Giloy extract** in a liposomal formulation, this project aspires to offer a cutting-edge skincare solution that promotes skin youthfulness, elasticity, and overall radiance. The development of this innovative product holds the potential to revolutionize the skincare industry by providing effective anti-aging benefits and supporting healthy, resilient skin.

Preclinical Testing:

1. **In vitro Glycation Inhibition Assay**: Evaluate the ability of the formulation to inhibit glycation by conducting cell-based assays using skin cell models and measuring the formation of advanced glycation end products (AGEs).

2. **Skin Permeation Studies**: Assess the skin permeation and absorption of the liposomal formulation using Franz diffusion cells with human or animal skin samples.

3. **Cytotoxicity and Skin Irritation Testing**: Conduct cytotoxicity assays and skin irritation tests to evaluate the safety profile of the formulation using skin cell lines and skin irritation models.

Analytical Characterization:

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1. Liposome Characterization: Analyze the size distribution, morphology, stability, and encapsulation efficiency of the liposomes using techniques such as dynamic light scattering, electron microscopy, and spectrophotometry.

2. Active Ingredient Quantification: Determine the concentration of bioactive compounds such as Kusum seeds, Bhuineem, Mahua flower, Bael pulp, Mahua seed, and Giloy extract within the formulation through validated analytical methods like high-performance liquid chromatography (HPLC).

Clinical Tests:

1. Skin Compatibility Study: Perform patch testing on human volunteers to assess the skin compatibility and potential sensitization reactions to the liposomal formulation.

2. Efficacy Assessment: Conduct randomized, double-blind clinical tests on a target population of participants to evaluate the efficacy of the formulation in preventing wrinkle formation and improving skin elasticity and firmness.

a) **Timelines**

Milestone	**R & D, Characterization, and preclinical tests**			**Clinical Tests**		
	2	**4**	**6**	**8**	**10**	**12**
Development of Anti-greying upcycled hair product						
Development of anti-hair loss product						
Development of hair-densifying product						
Development of skin-refining product						
Development of anti-wrinkle product						

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b) Budget:

S.No	Items	Funds Requested
1.	**Development of Anti-greying upcycled hair product:** • **R & D** • **Product characterization** • **In vitro tests** • **Preclinical Tests** • **Clinical Tests**	25L
2.	Development of anti-hair loss product • **R & D** • **Product characterization** • **In vitro tests** • **Preclinical Tests** • **Clinical Tests**	25L
3.	Development of hair-densifying product • **R & D** • **Product characterization** • **In vitro tests** • **Preclinical Tests** • **Clinical Tests**	25L
4.	Development of skin refining product • **R & D** • **Product characterization** • **In vitro tests** • **Preclinical Tests** • **Clinical Tests**	25L
5.	**Development of anti-wrinkle product** • **R & D** • **Product characterization** • **In vitro tests** • **Preclinical Tests** • **Clinical Tests**	**25L**
	Total	**1.25Cr**
	Overhead Charges (@25%)	**0.3125 Cr**
	Net Total	**1.5625Cr**

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Annexure B

CHHATTISGARH STATE MINOR FOREST PRODUCE
CO-OPERATIVE FEDERATION, LTD.
"Van Dhan Bhawan" Sector 24, Atal Nagar, Nawa Raipur (C.G.)
E-mail: mfpfed.cg@nic.in Website: www.cgmfpfed.org

No./MFP/PROS/RD/PROD-TECH/23-480/2024/ 3494 Raipur, Date: 11/03/2024

To,

Dr. Sumit kumar singh (PI),
Assistant Professor
School of Biochemical Engineering
IIT (BHU) Varanasi U.P.
E-mail Id: sumit.bce@iitbhu.ac.in

Sub: Sanction Of Research Project Proposal Titled Biochemical Transformation Of Natural Products Into Functional Bioactive Cosmetics - Reg.

Ref: Letter From IIT (BHU) Dated 29.02.2024.

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The CGMFP Federation is glad to give its consent for undertaking R&D proposal on "Biochemical transformation of natural products into functional bioactive cosmetics" reference to the above. Accordingly an agreement can be signed between the MFP Federation and IIT (BHU) at mutually agreed conditions of agreement condition. Project outlay can be as proposed by you and will be paid as below :-

- **Project Cost**

S.NO.	Item	Cost (Lakhs)
1	Development of Anti Greying Upcycled Hair Product	25.00
2	Development of Anti Hair Loss Product	25.00
3	Development of Hair Densifying Product	25.00
4	Development of Skin Refining Product	25.00
5	Development of Anti Wrinkle Product	25.00
Total		**125.00**

An Overhead amount of Rs. 5.00 Lakh can be charged from the total sanction cost of the project. No other cost will be sanctioned other then the sanction project cost. Project duration shall be one year and effective from date of signing of MoU . The payment will paid as per agreement conditions. **All the terms & Conditions are applicable as per agreement.**

Hence you are requested to proceed with R&D activity immediately duly sending signed MoU on Rupees 100/- stamp paper for taking further action.

With Regards

(B. Ananda Babu)
Additional Managing Director (D)
CGMFP Federation, Raipur

End. No./MFP/PROS/RD/PROD-TECH/23-480/2024/3495 Raipur, Date: 11 /03/2024

Copy to for necessary action:-

1. **Dr. Pranjal Chandra (Co-PI),** Associate Professor School of Biochemical Engineering IIT (BHU) Varanasi U.P.
2. **Dr. Preeti Chauhan (Co-PI),** Institute of Medical Science (BHU) Varanasi U.P.

Additional Managing Director (D)
CGMFP Federation, Raipur

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