SCIENCE! monthly

COSMETICS & COSMECEUTICALS

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Koninklijke Nederlandse Pharmaceutische Studenten Vereniging (K.N.P.S.V.)

The Koninklijke Nederlandse Pharmaceutische Studenten Vereniging (K.N.P.S.V.), translated as the Royal Dutch Pharmaceutical Students Association, is a prominent organisation dedicated to uniting pharmacy students in the Netherlands. Established in 1925, the K.N.P.S.V. has played a pivotal role in fostering collaboration, knowledge-sharing, and professional development within the pharmaceutical community. The association operates on a national level, connecting students from various universities, including Utrecht, Groningen, and Leiden.

With a rich history spanning nearly a century, the K.N.P.S.V. has evolved to meet the changing needs of pharmacy education and practice. It serves as a platform for students to engage in academic discourse, participate in extracurricular activities, and network with professionals in the pharmaceutical field. The organisation hosts events, conferences, and workshops, providing members with opportunities to enhance their skills, broaden their perspectives, and prepare for successful careers in pharmacy.

At its core, the K.N.P.S.V. stands as a testament to the strength of unity among future pharmacists, emphasising the importance of continuous learning and collaboration in advancing the pharmaceutical sciences. As a vibrant and dynamic association, it remains committed to shaping the next generation of pharmacy professionals and contributing to the advancement of pharmaceutical knowledge and practice in the Netherlands.

Latvijas Farmācijas Studentu Asociācija

Latvian Pharmaceutical Students' Association (LPSA)

Latvian Pharmaceutical Students' Association (LPSA; LFSA – Latvijas Farmācijas Studentu Asociācija) is a non-profit organisation that unites and represents pharmaceutical undergraduate, graduate and postgraduate students from several educational institutions of Latvia. The main goals of the association are to unite and support pharmaceutical students, to ensure successful communication between students and organisations as well as to prompt personal and professional growth of young professionals. Throughout the academic year LPSA holds several educational and social activities, for instance, the Autumn Seminar where the tradition is to elect new board for the mandate. Also, LPSA members are welcomed to participate in the international events on local (e.g. Baltic Pharmaceutical Students' Seminar) and European level.

British Pharmaceutical Students' Association

British Pharmaceutical Students' Association (BPSA)

The British Pharmaceutical Students' Association is the official student body of the Royal Pharmaceutical Society (RPS). Founded in 1942, the BPSA is run *by* members *for the* members. The BPSA represents over 15,000 pharmacy students across the UK. We aim to protect student interests and promote welfare whilst also providing a plethora of opportunities for our members. These include but are not limited to: webinars, conferences, competitions, awards and international opportunities.

There is always a chance to network and by doing so, we strive to nurture the future generation of budding pharmacists and to inspire them through the opportunities they can partake in. The BPSA's work throughout the mandate also consists of 5 key campaigns which focus on: Black History month, Climate Change, Disability History month, Pride month and Mental Health Awareness. By advocating for these campaigns, we hope to spread and raise awareness whilst simultaneously educating our members on various topics. Additionally, the BPSA shows support for: World Pharmacists Day, Antimicrobial Awareness Week, World Patient Safety Day and much more.

As a student-led association, we make sure to have our members' best interests at heart and to support them throughout their pharmacy journey.

Students Association of the Faculty of Pharmacy, University Sarajevo (SAFF)

SAFF epitomises the student body of the preeminent and venerable Faculty of Pharmacy in Bosnia and Herzegovina. Presently, our representation encompasses 780 students. Every denizen of the faculty automatically assumes the mantle of membership in our Association, wielding the autonomy to elect the degree of their commitment to its pursuits. Despite our modest dimensions as an association hailing from a diminutive nation, we ardently endeavour to integrate and align ourselves with the eminent values prevalent in the global sphere of pharmacy.

We stand as one of the most dynamic entities within our university, orchestrating initiatives that span a spectrum of domains, including humanitarian endeavours, public health campaigns, athletic pursuits, international collaborations, cultural undertakings, advocacy for student rights, and an avid involvement in the realm of scientific exploration. As proud adherents of EPSA and IPSF, we had the privilege of hosting the EPSA Autumn Assembly in 2020 and have since actively partaken in the Twinnet initiative from 2021 onward. Our imprint was solidified further with our representative's presence at the General Assembly in Madrid this year, culminating in our attainment of Ordinary Membership status.

We revel in the resonance of our voice across borders, relishing the opportunity to forge connections with students traversing the expanse of Europe. Ever receptive to collaboration and forging new alliances, we extend an open invitation. At the core of our mission lies the commitment to articulate the aspirations and imperatives of pharmacy students within our academic enclave, ensuring an informed embrace of the myriad opportunities that unfold before them.

NAPSer
Nacionalna Asocijacija
Studenata Farmacije - Srbija

National Association of Pharmacy Students - Serbia (NAPSer)

The National Association of Pharmacy Students - Serbia (NAPSer) is a student organisation comprising all pharmacy and pharmacy-medical biochemistry students in Serbia. NAPSer has five local offices, founded at the Faculties of Pharmacy or Medicine in Belgrade, Novi Sad, Kragujevac, and Niš. When enrolling in pharmacy studies, every student becomes a member of student organisations and realises professional and personal improvement opportunities. Through various educations, soft-skills training and competitions, as well as student exchanges and foreign internships, and European and World congresses, NAPSer offers students the opportunity to expand their knowledge, improve their communication skills, get to know other cultures, and also to make good memories and friends for all life.

Association of Hacettepe University Pharmacy Students (AHUPS)

The Association of Hacettepe University Pharmacy Students (AHUPS Türkiye), also known as Farmasötik Gelişim Topluluğu in Turkish, was officially founded in 2014. As a dynamic student organisation, AHUPS Türkiye is dedicated to offering numerous opportunities for pharmacy students across Türkiye. We organise a diverse range of activities, including scientific, social, cultural, artistic, and sports events that revolve around the realm of health. Continuously expanding, we implement innovative projects to enhance pharmacy students' awareness and knowledge of various healthcare topics. Our initiatives include science excursions, fieldwork, surveys, public health campaigns, as well as seminars and webinars. We make sure to share our scientific and public health endeavours widely through our social media channels. Throughout the academic year, we focus on cultural development and foster social interaction through ice-breaker gatherings, English-speaking clubs, debate tournaments, sightseeing tours, museum trips, and discussion clubs centred around books and movies. Functioning as local representatives of pharmacy students, we host events that facilitate their engagement with professional organisations. Annually, we take pride in organising the groundbreaking congress, Farmasötik Gelişim Günleri (Pharmaceutical Development Days), promoting collaboration between academia and industry while facilitating information exchange among scientists, researchers, healthcare workers, and industry professionals.

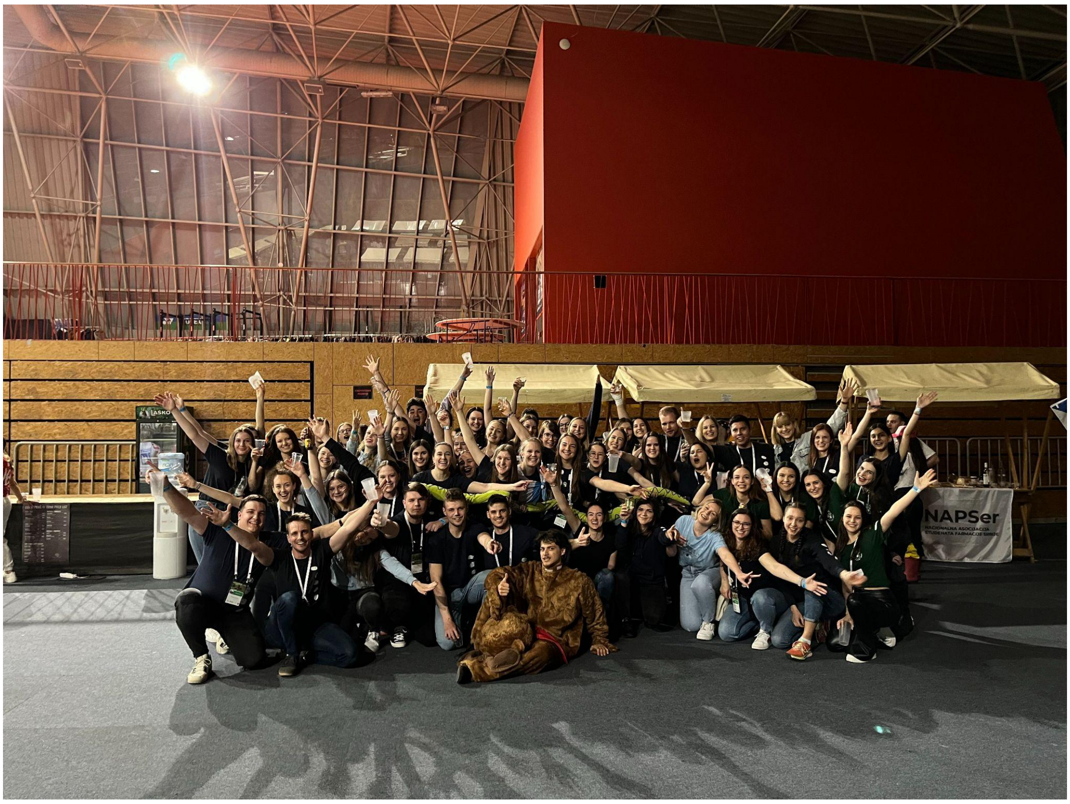
Istanbul University Pharmaceutical Students' Association International (IUPSAint)

Istanbul University Pharmaceutical Students' Association International (IUPSAint) is an independent, non-profit, non-political student organisation with a history of 24 years. IUPSAint is an Ordinary Member that represents more than 15000 pharmacy students from Turkey. IUPSAint works with its regulations which are configured by local executives.

IUPSA International was established to assist the interest and knowledge of pharmacies in Türkiye, to separate the international aspect of pharmacies, and to support communication and cooperation with pharmacies and companies around the world.

Within the scope of IUPSAint, public health events aim to inform and raise awareness about the issues that are on the agenda and attract the attention of pharmacy faculty students, social responsibility projects to instil social responsibility awareness and become exemplary pharmacists to the society, recognition of EPSA, of which we are the representative of our country, and IPSF, of which we are the regional representative. Projects such as Twinnet, SEP, EPSA Trainings and promotions are carried out in different faculties to increase the education and ensure that more students benefit from the opportunities offered. In addition, it organises national symposiums and congresses named SempoDermo and ECKON.

DŠFS



Slovenian Pharmaceutical Students' Association (DŠFS)

The Slovenian Pharmaceutical Students' Association (DŠFS) is a non-profit and non-political organisation established in 1997. Our aim is to organise projects and events that will improve the general competencies of our members. We represent over 900 students.

Our annual plan of action includes several notable projects, such as competitions (about patient counselling, clinical skills, compounding, and innovation), public health campaigns (from antibiotics, interactions, and skin cancer to herbal tea), and humanitarian activities (Christmas bazaar, volunteering in a Pro Bono clinic, collecting clothes and toys, school supplies, and even stuff for animal shelter). Our publication, Spatula, is very popular among students, and we recently started publishing another publication called Placebo. Some of you know us through our traditional International Pharmaceutical Summer Camp that we host annually. Of course, we are very active in IPSF and EPSA, too; we regularly participate in Twinnet and SEP exchanges, and we even hosted the Annual Congress this year. Besides that, we host a DŠFS Symposium each year, host many educational events, and collaborate with other organisations. Lastly, we don't forget to train our students on soft skills and organise sports and fun activities.

BEAUTY IS IN THE EYE OF THE BEHOLDER. AND THAT BEHOLDER MAY BE A COMPUTER!

Artificial Intelligence

AI has become a significant part of modern healthcare and beauty industry, as it may become a valuable assistant when it comes to identifying disease signs and symptoms, choosing treatment options, and improving the patient journey overall (1).

Augmented Reality

AR brings products closer to the customer through virtual consultations, skin complexion analysis, customized skin care routines, and make-up inspiration (2,3).

Cosmetic product formulation

While cosmetic formulation can be a tiresome process, there are a number of advantages to adopting software that can improve the process's accuracy, efficiency, and overall quality (4).

3D printing

3D-printed face masks allow personalization according to the needs of certain customers, as they assess the needs of the skin and suggest which ingredients will work best and where (5).

Beauty Is In The Eye Of The Beholder, And That Beholder May Be A Computer!

Whether it is paying bills at the click of a button, remote healthcare services, or CRISPR-Cas9 gene editing, technological advancements have been ingrained in every part of our lives. In the digital age that we live in, technology isn't just a mere convenience anymore. It shapes our daily routines, from setting alarms to choosing the fastest route to work and recommending the best restaurants in Paris. So, it comes as no surprise that technology has found its way into modern skincare, forming a complex symbiosis with beauty and self-care, which will be explored in this article.

The cosmetic industry has always made an effort to improve the customer experience by being innovative and using a customer-focused strategy. Because of this, the core ingredient of every cosmetic or cosmeceutical product is a formulation created to target particular skin issues, such as wrinkles, hyperpigmentation and acne scars. Many scientific advancements have made it possible to develop products that target such needs with the highest precision.

One such tool is artificial intelligence (AI), which has become a significant part of the modern healthcare and beauty industry, as it may become a valuable assistant when it comes to identifying disease signs and symptoms, choosing treatment options, and improving the patient journey overall[1]. When it comes to dermatology, AI has the potential to help recognise different skin conditions, such as acne, eczema, or vitiligo, improving the accuracy and efficiency of diagnosis[2]. On the other hand, it can also assist with skin type or skin colour evaluations, and detect aspects such as wrinkles, blemishes, and hyperpigmentation, which can further help consumers choose the appropriate cosmetic product for them[3]. By examining these traits, AI algorithms can provide insights into unique skin issues and offer tailored recommendations for skincare routines and cosmetic products that target individual concerns. What is more, numerous applications that use AI can be examined through mobile phones that are always at the tip of our fingers. A great example is the AI-enabled smart facial cleaning device, *LUNA Fofo*[4], developed by the Swedish beauty tech brand *FOREO*. This device can not only detect skin moisture levels in order to create a customised cleaning program but can also estimate true skin age[4]. Furthermore, AI can aid in the design of cosmetic products by doing ingredient research and analysis, simulating various situations, and predicting product performance[5]. However, one must pay attention that the use of AI has its limitations, such as the constant need for large databases that it draws information from in order to improve its accuracy[2].

The use of augmented reality (AR), which is an interactive experience that enhances the real environment with computer-generated information and content, is another great example of digital developments in the cosmetic industry[6]. Cosmetic companies can now offer their customers a more customised shopping experience and, as a result, higher customer satisfaction thanks to AR, which brings products closer to the customer through virtual consultations, skin complexion analysis, customised skin care routines, and make-up inspiration[7,8]. By cutting waste and expenses, AR solutions can also make a substantial contribution to a more sustainable cosmetics business. *Burberry Beauty Virtual Studio*[9] is one intriguing example of a company using augmented reality in its operations. *Burberry Beauty* has created a virtual studio experience using facial tracing technology, which enables them to create unique profiles for each customer and also helps them with product discovery and make-up tutorials[9].

Another interesting innovation is a 3D-printed mask developed by Neutrogena, *MaskiD*, that combines ingredients such as hyaluronic acid, niacinamide, feverfew, N-acetyl glucosamine, and vitamin C[10]. Furthermore, there are three ways in which this mask facilitates personalisation: the first is through the design of the mask itself. The user just needs to take a picture with their smartphone's 3D camera to get an exact, multi-dimensional map of their face that includes the precise dimensions and form of their nose, lips, and other physical features. The virtual counterpart of an experienced dermatologist is then created using the system's personalised data, which assesses the needs of the skin and suggests which ingredients will work best and where. Lastly, high-efficacy chemicals are printed onto the custom-fit hydrogel mask in the precise areas where they will have the biggest impact on that particular person using a patented 3D printing technique[11]. Other than that, 3D printing can also be used to create packaging, which was used by L'Oréal in 2019[12].

The product's formulation is a crucial component of the cosmetics industry. While cosmetic formulation can be a tiresome process, there are a number of advantages to adopting software that can improve the process's accuracy, efficiency, and overall quality. One such software is *Ilexsoftware*, which allows natural cosmetic product formulation by providing cosmetic chemists with a database that consists of information regarding INCIs, allergens, etc[13].

As we enter the era of the fourth industrial revolution, which has been marked by technological advancements, the cosmetic industry continues to evolve, driven by a commitment to innovation. As we navigate this exciting landscape, one thing is certain – the cosmetic industry's journey with technology is far from over, promising a future where beauty is as diverse and dynamic as the individuals who define it.

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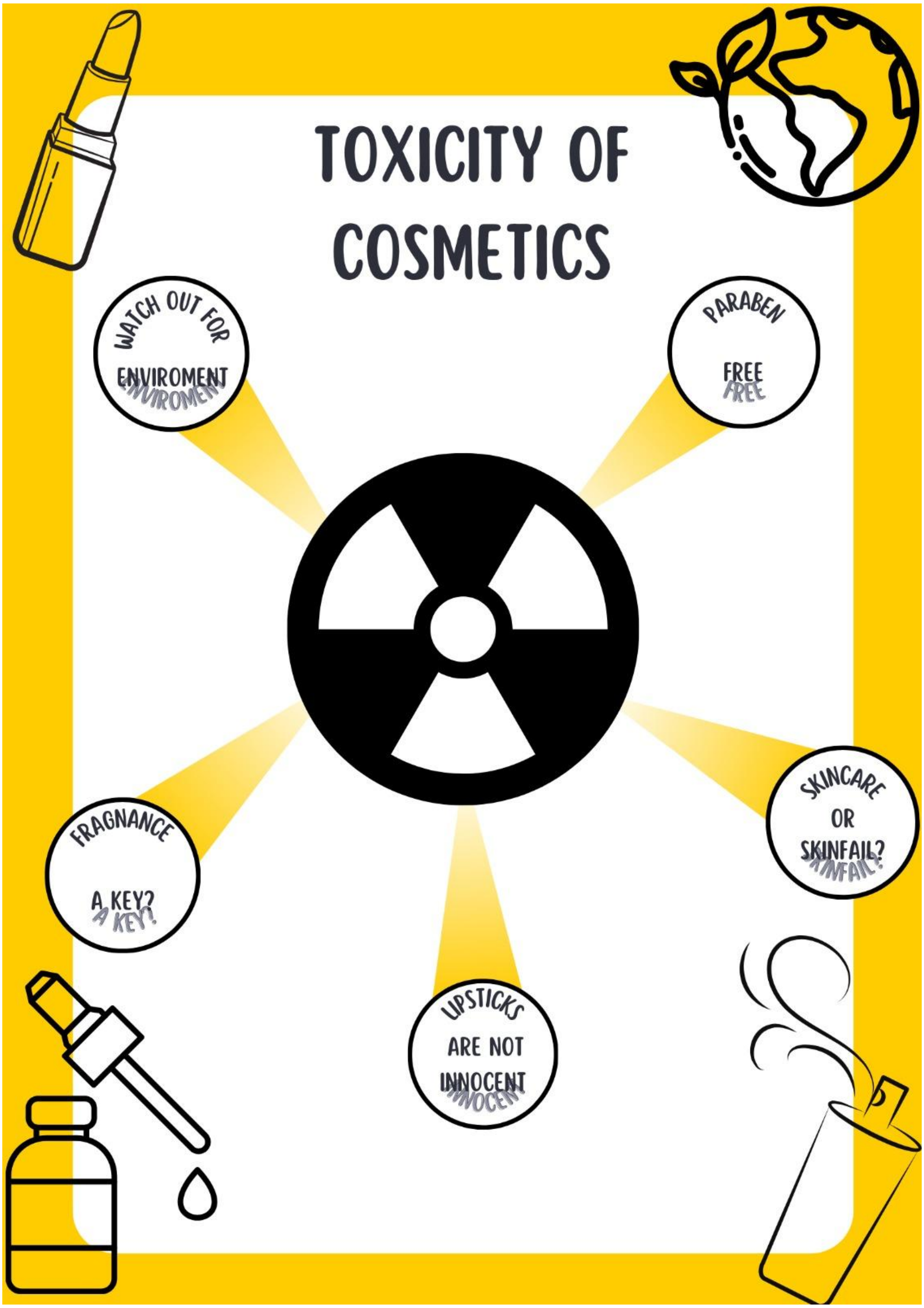
TOXICITY OF COSMETICS
WATCH OUT FOR ENVIROMENT
PARABEN FREE
FRAGNANCE A KEY?
SKINCARE OR SKINFAIL?
LIPSTICKS ARE NOT INNOCENT

Are Cosmetics Completely Safe to Use?

Introduction

The skin, the human body's largest organ, serves not only as a protective barrier against a range of microorganisms, chemical and physical agents but also plays a substantial role in the absorption of substances. Several factors can facilitate the penetration, for instance, a molecule's structure, weight, and skin temperature. At present, our skin is exposed to various cosmetic products for extended periods daily, thus different substances are absorbed and accumulated in the body[3].

Read the Labels - Ingredients in Cosmetic Products

According to European Law, all cosmetic products, approved for use have to be safe for their users. Despite the safety standards, almost all make-up and skin-care products are associated with undesirable consequences due to certain chemical ingredients[1].

Cosmetics Can Affect Not Only Their Users But Also the Environment

While it is cold outside, we miss summer, do not we? The warm period is the best time of the year to go out with friends and enjoy the weather. However, we must take precautions for our skin, therefore, we have to use sunscreens all over our body to avoid sunburns. The most important question is: can we use them with peace of mind? Unfortunately, the answer is no. Optimal sunscreen use prevents skin cancer, and that is great, but do you know they're harmful to our environment? Sunscreens might include chemicals like oxybenzone, avobenzone, octisalate, octocrylene, homosalate, and octinoxate. Among them, oxybenzone and octinoxate are known for their damaging effects on marine ecosystems. Next time we apply sunscreen on our skin, we have to think twice[1,2]!

Paraben Free

To ensure the preservation of cosmetics, some chemical substances from the parabens group are used to increase the shelf-life and stability of products. However, methylparaben, ethylparaben, and propylparaben are officially permitted across the EU, and their total amount in products is strictly regulated. The maximum content is 0.4% by weight of a single substance or 0.8% by weight of a mixture in cosmetic preparation. Reaching a bloodstream by penetrating through the skin, parabens can mimic estrogens and disrupt mechanisms in healthy cells, thus increasing the risk of the development of cancer[3].

Is Fragrance A Key?

Fragrances play a crucial role in modern everyday life in enhancing the attractiveness of cosmetic products. Pleasant scents significantly impact the overall evaluation of cosmetics by users, they increase comfortability and general effect. Among natural fragrances, essential oils are the most popular ones. There are 300 plant-based oils commercially available in the flavours and fragrances markets, however, predominantly for industrial purposes, the ones from orange, mint, citronella, lavender, eucalyptus, and lemon are used. Plant organs, used for getting derived products, and essential oils, can assimilate high amounts of heavy metals. No safety limits are defined by international law; however, recommendations are provided in European Pharmacopoeia. Comparing 34 essential oils obtained from various plants with different origins, the most contaminated plants come from India due to soil pollution with Mercury[4].

Lipsticks Are Not As Innocent As You Think They Are

Lipstick has been a beauty staple for women for thousands of years. To ensure certain qualities and appearance of lipsticks, various carcinogenic substances and trace metals are being added. For example, the metals that are used in lipsticks are chromium (Cr), manganese (Mn), cobalt (Co), nickel (Ni), copper (Cu), cadmium (Cd), antimony (Sb). These metals can reach the systemic circulation via lips. They can accumulate in various parts of the human body and cause undesired consequences on health. For instance, cadmium (Cd) could cause kidney and bone damage, whilst nickel (Ni) increases the chances of getting lung, nose, larynx, and prostate cancers. Up until now, there are no safety limits for the use of these metals that are globally approved, yet we better use them with reservation[5].

Skincare or Skin Fail?

Every single person in the modern world wants to feel as confident as possible about their skin. It is important to be able to shine and look glamorous, and that is why some skin-care products are used on a daily basis. However, these skin-care products may not be the safest option to commend our skin. Just like lipsticks, skin care products contain numerous heavy metals. They can be absorbed by the skin and affect the neurological and immune systems. Mercury (Hg) is a great example - the use of prolonged skin-care products (like facial cleansers, creams, and ointments) that contain Hg could cause neurological and immune system diseases and damage eyesight, hearing, and memory.

Have you ever had concerns about unpleasant body odour? Everyone experiences that occasionally. Consequently, underarm skincare products are used to prevent odour, but that doesn't necessarily mean they are safe to use. Investigations have indicated a correlation between the use of underarm skincare products, such as deodorants and antiperspirants containing aluminium (Al), and the increasing incidence of breast cancer cases[6-9].

What Can You Do?

In general, it is significant and necessary to keep in mind all health concerns related to the use of cosmetic products. In most cases, the amount of possible dangerous ingredients is too low to be associated with health issues at present, however, due to everyday exposure and accumulating effects, it is important to observe it long-term. There are various websites and mobile applications that can be helpful in the evaluation of the product – they allow you to see the list of ingredients as well as their safety standards. Several good examples are Yuka, EWG applications that allow you to see how dangerous and toxic specific ingredients in a skincare and make-up product can be. Last but not least, it is important not only to choose products wisely but also to take care of your skin by minimising the exposure periods, for example, removing decorative cosmetics before going to sleep.

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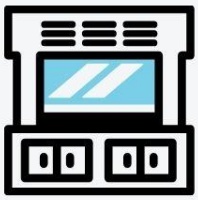
THE ROLES OF SOLID LIPID NANOPARTICLES AND NANOSTRUCTURED LIPID CARRIERS IN COSMECEUTICALS

MORPHOLOGY

- SLNs: solid lipid or solid lipid blend
- NLCs: solid and liquid lipid blends



PRODUCTION

- Hot or cold high-pressure homogenisation

APPLICATIONS

- Anti-wrinkle agents
- Sunscreens

ADVANTAGES

- Tolerability
- Physical stability
- Skin hydration

LIMITATIONS

- SLN recrystallisation
- Storage temperatures
- Aggregation

FUTURE PROSPECTS

- Additive manufacturing
- Multi-purposed lipid nanoparticles

The Roles of Solid Lipid Nanoparticles and Nanostructured Lipid Carriers in Cosmeceuticals

Cosmeceuticals combine cosmetic and pharmaceutical characteristics[1], using active pharmaceutical ingredients (APIs) to repair or improve skin[2]. The inclusion of lipid-based nanocarriers (LNs), particularly solid lipid nanoparticles (SLNs) and nanostructured lipid carriers (NLCs), has helped to target ageing and protect skin from ultraviolet (UV) rays[2].

Morphology

SLNs are particles produced by replacing the liquid lipid of an oil-in-water (o/w) emulsion with a solid lipid or solid lipid blend[3]. These include fatty acids, waxes, and triglycerides[4]. They have a low melting point and high surface activity for enhanced skin penetration[5]. 0.1%-30% weight per weight (w/w) of solid lipid is dispersed in an aqueous medium and stabilised with 0.5%-5% w/w surfactant[3]. APIs are incorporated[3]. The mean particle size of SLNs ranges from 40-1000 nm[3].

NLCs involve particles produced using solid and liquid lipid blends in a ratio between 70:30 and 99.9:0.1[3]. APIs are also incorporated[3]. NLC size ranges from 10-1000 nm[6].

Production

LN production can involve hot or cold high-pressure homogenisation[3]:

In hot homogenisation, the lipid melt containing the active compound is dispersed in a hot surfactant solution - 5-10℃ above the lipid's melting point - by high-speed stirring[3]. The pre-emulsion is passed through a high-pressure homogeniser adjusted to the same temperature[3]. Three cycles at 500 bar or two cycles at 800 bar are applied[3].

In cold homogenisation, the cooled mixture solidifies[3]. The mass is crushed and ground, creating lipid microparticles[3]. These are dispersed in a cold surfactant solution[3]. The pre-suspension is passed through a high-pressure homogeniser at room temperature, applying 5-10 cycles at 1500 bar[3].

Advantages

NLCs and SLNs consist of biodegradable, low-toxicity physiological lipids[3], giving them excellent tolerability for safe use on damaged or inflamed skin. Their small size ensures close adherence to the corneum skin layer, which improves transdermal absorption of the cosmeceutical active ingredients (CAIs)[3].

LNPs are physically stable in aqueous dispersions[7]. Mixing them with dermal formulations forms an adhesive film with an occlusive effect[7]. This occlusion further enhances CAI penetration into the skin[8-9], reducing water loss, which may improve skin elasticity[10-14].

The stratum corneum (SC) effectively impedes percutaneous absorption of exogenous substances[15]. Skin occlusion can increase SC hydration, influencing percutaneous absorption. In cosmetic products, the CAI should not be systemically absorbed. Still, some skin penetration is necessary for a cosmetic effect.

A study investigated skin hydration after repeated application of an SLN-containing o/w cream and a conventional o/w cream for 28 days[16]. The SLN cream increased skin hydration significantly more than the conventional cream[16]. An NLC-containing cream increased skin hydration significantly more than a conventional cream[17].

The occlusive, hydrating, and adherence effects on the skin make SLNs and NLCs suitable bases for cosmetic products[5]. Additionally, their submicron size and pearl-like properties make them aesthetically pleasing, improving compliance[5].

Anti-Wrinkle Agents

Adenosine-SLN was incorporated into elastic artificial skin[14]. The skin expresses the A_1 and A_{2A} adenosine receptors[18]. In the hypodermis, A_1 receptor expression of adenosine stimulates lipogenesis and adipogenesis[18]. In the dermis, A_{2A} receptor expression of adenosine stimulates collagen production[18]. Furthermore, adenosine increases new DNA synthesis and protein synthesis in dermal cells[18].

The adenosine release profile showed sustained release for 48 hours[14]. The amount of adenosine released from the elastic artificial skin and SLN was ten times higher than the adenosine solution alone[14]. These nanoparticles are a potential topical delivery system for anti-wrinkle treatment[14].

Sunscreen

Sunscreen helps to prevent skin damage[19]. Chemical UV filters, including zinc oxide, titanium dioxide, and octyl methoxycinnamate (OMC) are used in sunscreens - but may cause skin irritation or allergy[19]. Encapsulating these compounds in LNPs could reduce their side effects and minimise photodegradation[19].

A study incorporated zinc oxide as a physical blocker, and octocrylene as a chemical absorber, in SLNs to obtain UV-blocking potential in sunscreen[20]. The nanoparticles showed good stability for 360 days with pH values of 5.4-5.9 which could be buffered by the skin[20]. LNPs could enhance chemical UV filter activity.

The amount of molecular sunscreen can be reduced by 50% in an SLN formulation compared to a conventional emulsion[21]. SLNs can physically block UV rays and improve UV protection when combined with organic sunscreens - allowing reduced UV absorber concentration[22]. A sun protection factor (SPF) increase of up to about 50 was reported following titanium dioxide encapsulation into NLCs[23]. Inorganic sunscreen encapsulation into NLCs obtains well-tolerated sunscreens with high SPF.

Limitations

SLNs tend to recrystallise during storage due to the presence of solid lipid[4]. This causes uncontrolled expulsion of the entrapped drug[19], reducing the loading capacity of the active ingredients[24].

NLCs overcome certain SLN limitations. The NLC lipid blend forms an imperfect lipid matrix with more space for drug encapsulation, resulting in a higher drug loading capacity[25-26]. Drug leaching and oxidation during storage are prevented[27].

SLN and NLC stability relies on proper storage[27]. Their ambient storage temperature is 4℃[27]. No drug loss is found at 20℃, but particle size increases at 50℃[27]. At higher temperatures, particles may aggregate due to hydrogen bond breakages between the surfactant at the lipid/water interface[27].

Despite its wide use in SLN and NLC formulations, stearic acid's cytotoxic effects are not fully known[28]. SLNs and NLCs may form aggregates or experience structural changes, including surfactant desorption[28]. Evaluating core materials in the amounts and ratios in which they are used may help clarify their effects[28].

LNPs may increase the phototoxicity of UV radiation in dermal fibroblasts and form radical oxygen species (ROS) in mitochondria due to interrupting the respiratory cycle[28]. Five NLC types made of the most commonly used lipids and surfactants were formulated to examine their effect on ROS production - with and without UV radiation[29]. NLC cytotoxicity was exponentially enhanced in the UV-exposed cell lines, in some cases with a 468% increase in dead cells[29].

Future Prospects

While lipid nanosystems have great potential in dermal cosmeceuticals, they may require additive manufacturing for optimal treatment outcomes - including nanofibers, hydrogels, or microneedles[5].

More research is required to develop multi-purposed LNPs for wider cosmeceutical applications[19]. Formation of targeted LNPs with controlled CAI release could improve delivery to the target, minimising side effects[19].

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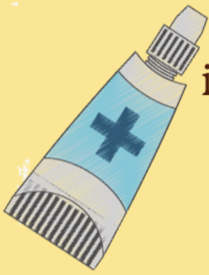
Atopic Dermatitis



Numerous anti-inflammatory, anti-mitotic, and immunosuppressive effects are associated with topical corticosteroids.

Topical corticosteroids can cause systemic side effects like Cushing disease, hypothalamic-pituitary-adrenal suppression, and type 2 diabetes.

Healthcare workers should learn one-to-two preparations from each potency category for steroid-sensitive conditions to minimize side effects and treat with a potent one for short periods..

Topical use of corticosteroids is safer than systemic use due to fewer side effects.

Atopic Dermatitis: The Effects of Corticosteroids

Comparison of the Topically Applied and Oral Corticosteroids

Atopic dermatitis, a skin disorder affecting 10% of adults in the US, is treated with topical steroids, unlike oral corticosteroids, which can be challenging to treat[1]. Topical corticosteroids are often considered safer for treating atopic dermatitis and psoriasis, but there's a lack of information on their effectiveness. Corticosteroid concentration can predict clinical effectiveness[2]. The well-known indications include vitiligo in some places, eczema, atopic dermatitis, psoriasis, and lupus erythematosus[3].

This activity provides information on topical corticosteroids, their indications, mechanism of action, adverse effects, contraindications, and monitoring, enabling providers to lead patient care effectively[4].

Topical corticosteroids have a wide range of anti-inflammatory, anti-mitotic, and immunosuppressive effects[5]. They inhibit phospholipase A2 production, constrict blood vessels, and indirectly prevent inflammatory transcription factors[6]. They also have a significant antimitotic effect in treating psoriasis[7], inhibiting humoral factors[8].

Topical corticosteroids are used topically; yet, their effective administration is contingent upon several factors, including a precise diagnosis, suitable medication selection, strength and vehicle selection, and application frequency[9].

The potency of topical corticosteroids is the amount of drug needed to produce a desired therapeutic effect. The gold standard for determining potency is the vasoconstrictor assay[10].

The dosage of steroids used is important for both therapy effectiveness and preventing side effects from abuse. 0.5 grams is one fingertip unit (FTU)[11].

Long-term use of topical corticosteroids may even lead to systemic side effects, such as Cushing disease, hypothalamic-pituitary-adrenal suppression, decreased growth rate, hyperglycemia, hypertension, and hypocalcemia [19]. They have even been associated with type 2 diabetes[20]. They can have a major impact on a person's life, sometimes even worse than the disease itself.

They are contraindicated for bacterial contaminations as their vasoconstrictive impact will veil the disease. Effective steroids ought to likewise be stayed away from impetigo, carbuncles, cellulitis, erysipelas, and erythrasma[12].

Oral corticosteroids should only be used as a last resort for short-term treatment of severe atopic diseases[13] due to potential severe side effects[14]. Long-term side effects are risky if the cumulative threshold is less than 2.5 g[15].

This survey aimed to determine the average corticosteroid exposure in eczema patients and its cumulative effects over time, despite the potential for significant exposure, due to the common use of corticosteroids[16].

Pharmaceutical Formulations To Reduce Side Effects

As topical corticosteroids are the preferred treatment for atopic dermatitis[17], it is important to know the different formulations and how they may decrease the severity of side effects associated with corticosteroids. The most important factor to assess is the potency of each preparation[18]. Furthermore, the choice of vehicle needs to be made based on the specific complaints, and they can affect patient comfort.

Topical steroids are categorised by potency, with seven classes ranging from super high to low potency. Medium- to high-potency steroids are commonly used for atopic dermatitis, while low-potency options are recommended for children, mild cases, and sensitive areas like the face[18].

Topical corticosteroids can be categorised into ointments, creams, lotions, gels, foams, oils, solutions, and shampoos[18]. Some of them are only used for specific parts of the body. Ointments are typically more powerful than creams but may exhibit a greasier appearance[21]. Ointments should not be used on open or oozing lesions and in skin folds prone to friction, as that may lead to aggravating the wounds and lesions, due to the increased absorption, as ointments are more occlusive[22]. Creams may include preservatives, that can trigger contact dermatitis[23]. Solutions and ointments usually have the least amount of allergens[23]. Lotions often lack the moisturising qualities essential for addressing atopic dermatitis, so they can't be used directly on dry skin[21]. Foams also show little to no skin hydration[24]. A new nanocarrier-mediated topical delivery method has been developed for the controlled and targeted release of corticosteroids, effectively inhibiting oedema and erythema in rats[24].

To minimise side effects, choose less potent corticosteroids and treat with a potent one for short periods. Healthcare workers should learn one-to-two preparations from each potency category for steroid-sensitive conditions[19].

What To Avoid While Under Corticosteroid Treatments

The most common methods used in the treatment of Atopic Dermatitis are topical and systemic use of corticosteroids. The side effects are usually known and afraid because, in the past many people who were treated with steroids experienced side effects. This is because steroid medications were often used for too long, too often, and in too high doses.

Topical Corticosteroids Use In AD

Topical use of corticosteroids is safer than systemic use due to fewer side effects. Common side effects include small pigmentation changes, temporary blisters, telangiectasia, and skin infections. To minimise side effects, choose a suitable steroid ointment or cream for the severity of AD and the affected skin area[25]. Ointments (water-in-oil emulsions) ensure optimal penetration of the active ingredient and are recommended for dry, sensitive skin. Creams (oil-in-water emulsions) are less greasy, easier to apply, and more tolerable. They can be painful during application and do not moisturise the skin as well as ointments. Lotions are used to treat large areas. They can cause stinging and dryness. Corticosteroid combinations are useful in treating itching that may occur with drug rash. For oily or hairy skin, gels (mixtures of water, alcohol or acetone) are used. Pastes (powder in ointment) are very useful for wet intertriginous areas. The powder absorbs moisture and the ointment acts on the skin more easily. Diaper creams are a good example of this[26].

Excessive or long-term use of corticosteroids also causes side effects. Some of these:

1. Acne and perioral dermatitis: Exacerbation of existing acne and onset of perioral dermatitis are the most common local side effects. Perioral dermatitis occurs due to the use of a stronger corticosteroid than needed to treat facial dermatitis. This situation can be prevented with regular checks and necessary warnings (such as patients with hand dermatitis should not touch their faces after drug application)[27].
2. Skin atrophy: It can occur with overuse, epidermal thinning, telangiectasia, striae and easy bruising. Because corticosteroids prevent both fibroblast collagen formation and epidermal cell division, causing the loss of supporting collagen around the vessels. In general, the induced changes are similar to those in normal ageing[27].

Apart from misuse, some points need to be taken into consideration. Immediately after using topical corticosteroids, the applied area should not be exposed to the sun.

One of the side effects of corticosteroids is drying the skin. Non-steroidal creams should be used to prevent relapse. Moisturising the skin daily will affect the treatment positively. Additionally, if a moisturiser is used daily, fewer corticosteroids will be needed.

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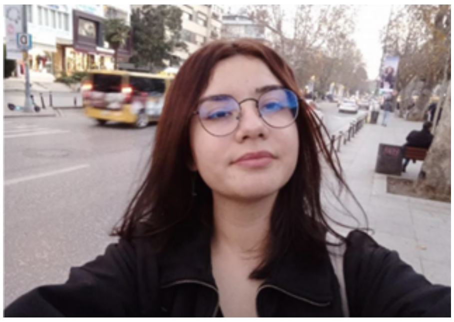

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The Green Revolution: Cannabinoids in Cosmetics and Cosmeceuticals

With the introduction of cannabinoid-infused cosmetics and cosmeceuticals, the convergence of beauty and wellness has reached a new peak. The Green Revolution has arrived in the skincare industry, ushering in a new era of innovation and intrigue. This article explores the enigmatic properties of *Cannabis sativa*. These compounds, known for their profound impact on the body's endocannabinoid system, hold promise in addressing a spectrum of dermatological conditions. Recent research into topical formulations suggests a compelling avenue for managing symptoms of conditions like multiple sclerosis, marking an exciting evolution in cannabinoid-based therapies. As exploration expands, considerations for safety and innovative delivery methods pave the way for novel medical applications.

Cannabis sativa **L.**

Cannabis sativa L. **(Figure 1.)** is classified as part of the *Cannabaceae* family. It is a perennial herb. The leaves develop on the stalk on opposite sides. Trichomes are epidermal protuberances that cover the plant's leaves, stems, and bracts. Trichomes are classified into two types: glandular and non-glandular. Non-glandular trichomes are found in the bracts, petioles, stipules, leaves, and stems and act as a defence against abiotic and biotic stress. Cannabinoids, secondary metabolites, and terpenes are synthesised in a viscous resin by glandular trichomes. When the days begin to shorten, the inflorescence is activated, and flower buds form. Male plants die after inflorescence, whilst females live till winter[1].

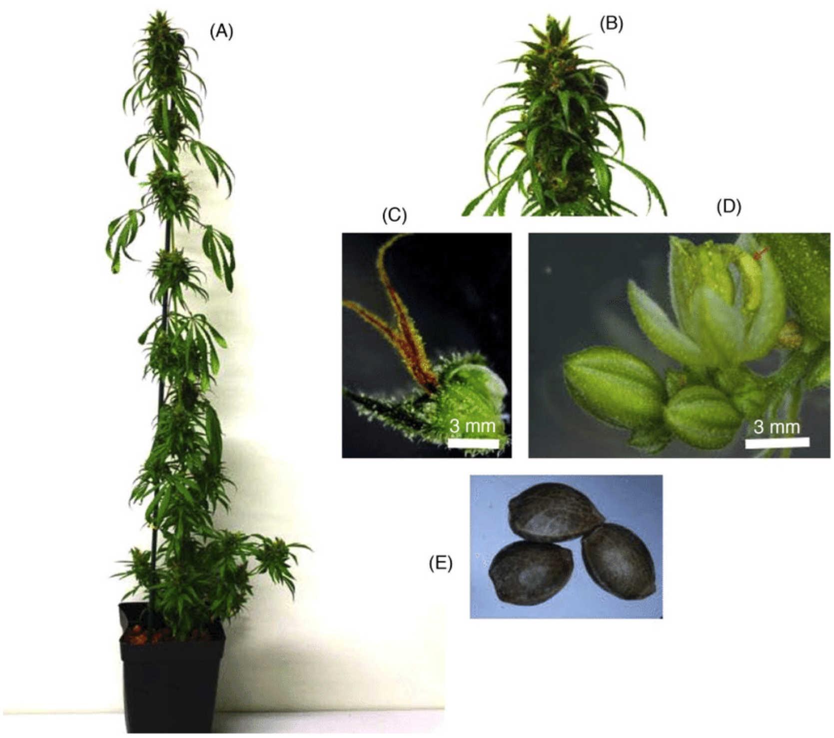

Figure 1. *Cannabis sativa* L. 1 (A) female *C. sativa*; (B) portion of the female flowers; (C) pistillate female flower (stigmas, style, perigonal bract, and stipule); (D)[15].

Cannabinoids & Skin

Cannabinoids (CBs) are classified into endo-, phyto-, and synthetic CBs based on their source[2,3]. Endocannabinoids are synthesised within mammalian bodies (including humans) and exert their effects via the cannabinoid type 1 (CB1) and type 2 (CB2) receptors located in the central nervous system and the immune system, respectively. They play important roles in memory, brain reward system, analgesia, drug addiction, sleep regulation, mood, appetite, and metabolic processes[2-5].

They have been shown to have antineoplastic properties[2] and have the potential to be used in the treatment of a variety of dermatological conditions such as acne vulgaris, atopic dermatitis (AD), allergic contact dermatitis (ACD), asteatotic dermatitis, Kaposi sarcoma, pruritus, skin cancer, psoriasis, hidradenitis suppurativa, and the cutaneous manifestations of systemic sclerosis[2,6].

The limits of conventional methods of administration highlighted the need to investigate other ways for more effective and prolonged therapeutic delivery of CBs. The skin is said to have promising medication delivery potential, with a number of advantages over conventional routes of administration. Pharmaceutical distribution through the skin is a more user-friendly approach that avoids the hepatic first-pass effect and inhibits pharmaceutical breakdown by enzymes in the gut. Furthermore, the ease of withdrawal in situations of toxicity and idiosyncratic reactions, as well as the promotion of adherence by reducing the need for regular drug consumption, make the idea of delivering CBs through the skin more appealing[2].

Cannabinoids Ligands

Some cannabinoids ligands significantly modulate the endocannabinoid system (ECS) response by activating various transient receptor potential ion channels (TRPV1, TRPV2, TRPV3, TRPV4, TRPA1, and TRPM8)[1,7], peroxisome proliferator-activated receptor alpha and gamma (PPAR-α; PPAR-γ) transcription factors, and serotonin receptors (particularly 5-HT1A, 5-HT2A, and 5-HT3 receptors). When activated by appropriate ligands, TRP ion channels allow various cations to pass through the cell. PPAR-α promotes the proliferation of peroxisomes, which regulate inflammatory response and lipid metabolism when activated by certain ligands[1,8,9].

The combination of these elements may produce either synergistic or antagonistic biological effects. As a result, it is critical to consider them when predicting the pharmacological or cosmetic activity of a cannabis ligand[1] **(Figure 2.)**.

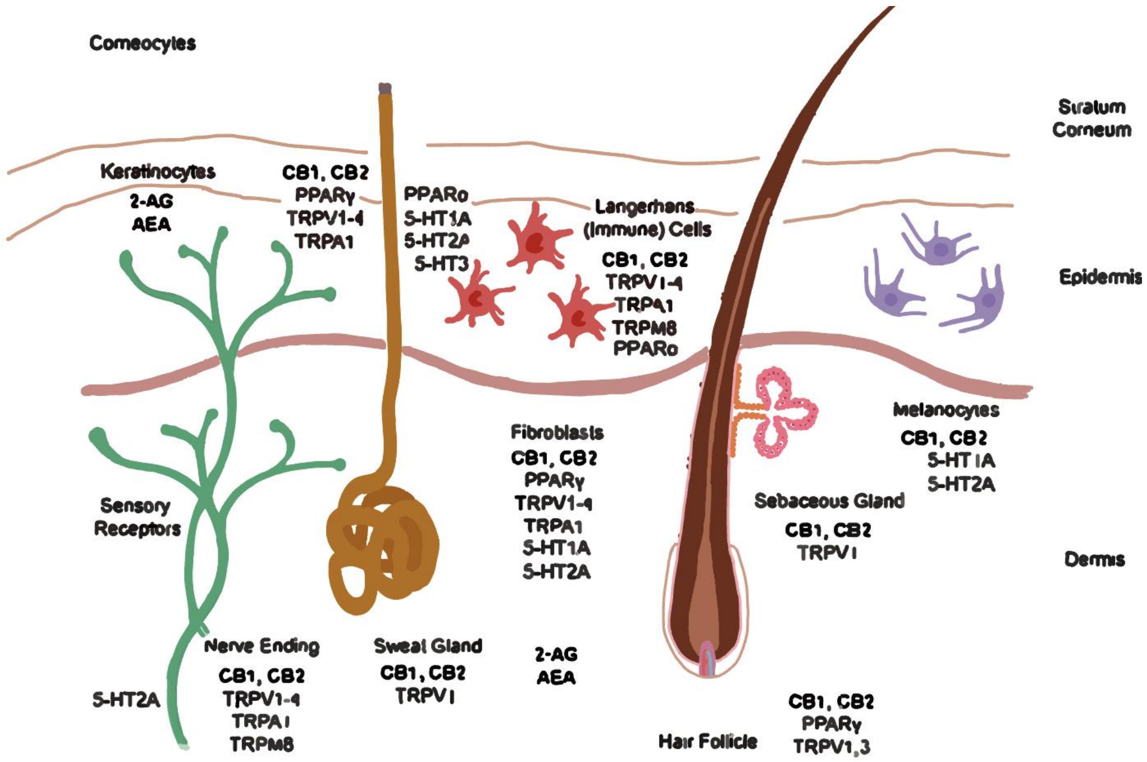

Figure 2. The repartition of CB1 and CB2, the TRPV1-4 channels, the TRPM8 channel, the PPARs transcription factors, and serotonin 5-HT1A, 5-HT2A, 5-HT3 receptors in skin cells[16].

A New Formulation of Cannabidiol In Cream Shows Therapeutic Effects

The goal of this study was to determine whether a novel topical formulation of pure cannabidiol (>98%), the primary non-psychotropic cannabinoid found in *Cannabis sativa*, would be effective against autoimmune encephalomyelitis (EAE), the most widely used model of multiple sclerosis (MS). In particular, the study assessed whether applying a topical 1% cannabidiol (CBD) cream at the onset of symptoms could influence the course of EAE and whether this treatment could also restore hindlimb paralysis, making topical CBD suitable for treating MS symptoms **(Figure 3.)**. All of these findings point to an intriguing new profile of CBD that may eventually be used, at least in conjunction with existing conventional therapy, in the clinical management of multiple sclerosis and its related symptoms[12-14].

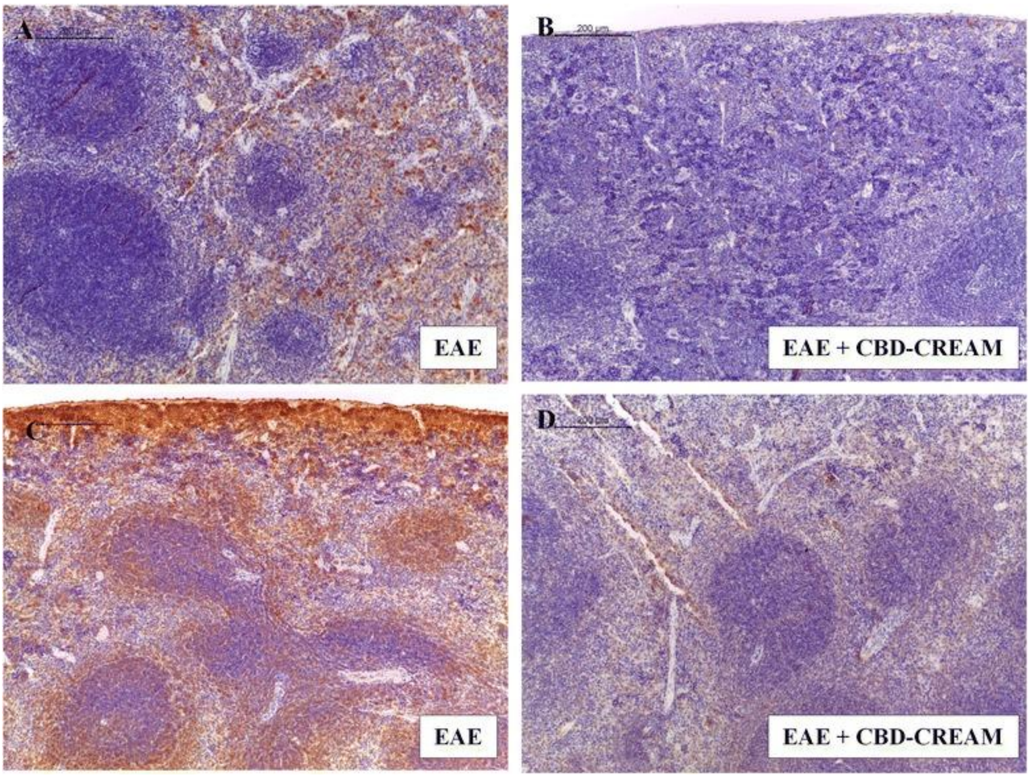

Figure 3. Immunohistochemical analysis for CD4 in spleen tissues from EAE mice (a:10x, A1 magnification:40x) and mice treated with 1% CBD-cream (b:10x, B1 magnification:40x). Immunohistochemical image for CD8α localisation of EAE mice (c:10x, C1 magnification:40x) compared to CBD topical treated mice (d:10x, D1 magnification:40x) in spleen tissues[17].

Future Analysis of the Topical Use of Cannabinoids

While most cannabinoid-related research focuses on the modification of brain processes, the topical administration of cannabis for local effects has recently received a lot of attention. Cannabidiol, a phytocannabinoid, is becoming more popular in the cosmetic sector, and they are usually branded as hemp-containing goods. However, the usage of phytocannabinoids may raise safety concerns due to impurities with psychoactivity or legal considerations in some countries. As a result, the use of endocannabinoid or endocannabinoid mimetics that directly modulate CBRs in skin, or the use of "entourage effects" (the capacity of two or more cannabinoids or non-cannabinoids to have a better combined synergistic effect than when taken separately) compounds that indirectly regulate endocannabinoid activity, could be a viable option[10,11].

Conclusion

In conclusion, *Cannabis sativa* L. is a complex plant with remarkable therapeutic potential, particularly in dermatology and autoimmune conditions. The complex interplay of cannabinoids and their receptors, combined with the promising delivery potential through the skin, points to a new direction for pharmaceutical research and formulation development. Recent research, such as the efficacy of a novel topical CBD cream in managing symptoms of multiple sclerosis, suggests that the landscape of cannabinoid-based therapies is changing. The horizon for medical applications of *Cannabis sativa* L. expands significantly as research delves deeper into harnessing the potential of cannabinoids, exploring formulations, entourage effects, and alternative administration routes.

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Friday, Dec 1, 3:52 PM

HOW ARE THEY USED?
Delivered

THE BENEFITS OF USING STEM CELLS?
Delivered

THE MECHANISMS BEHIND THEIR USE?
Delivered

POSSIBLE SIDE EFFECTS?
Delivered

NAVIGATING CHALLENGES AND INNOVATIONS: THE ROLE OF STEM CELLS IN COSMETOLOGY

REGENERATION

- anti inflammation
- immune modulation
- keratinocyte and fibroblast recruitment
- angiogenesis
- nerve regeneration

REJUVIATION

- immune modulation
- collagen synthesis
- elastin synthesis
- ROS reduction
- hair regeneration

Navigating Challenges and Innovations: The Role of Stem Cells in Anti-ageing Industry

You may have heard of one of the growing trends in the cosmetic field, stem cells, but be left wondering: how are they used in the beauty industry, and what are they, anyway[1]? In the pursuit of timeless beauty, the field of cosmetology has embraced a groundbreaking ally: stem cells. They are a promising pathway to achieving rejuvenating skin, surpassing the constraints of time, and reshaping our approach to ageing gracefully[1].

Get To Know Stem Cells

Within the body, stem cells are undifferentiated cells poised for replication. They possess the capacity to duplicate themselves or transform into specific cells required by various organs or tissues[1]. We can categorise them into three categories, depending on how many different types of cells they are able to differentiate[2]. Pluripotent stem cells, such as embryonic stem cells, have the ability to differentiate into any type of tissue. Multipotent stem cells, for example, mesenchymal stromal cells, are able to differentiate into a more limited number of related cells. Unipotent cells can meanwhile produce one cell type. Clinical research is leaning toward the use of mesenchymal stem cells as they have the capacity to differentiate into bone, cartilage, muscle, and fat. Compared to embryonic stem cells, they lack ethical concerns and are believed to be less potentially tumerogenic[2]. It is no surprise that adipose mesenchymal stem cells became the most popular source of stem cells in aesthetic medicine, as they are relatively easy and safe to harvest[2].

Thumb Through Skin Structure

As the body's largest organ, the skin has many different important physiological roles such as thermoregulation, protection and sensation of the outer world, but it is also a canvas for expressing ourselves and a mirror to our inner shape. It comprises three main layers - epidermis, dermis, and hypodermis - each with distinct structures and functions[3]. The epidermis, our skin's outermost layer, acts as a shield against damage and outer stress. It is mainly composed of keratinocytes that restrict water passage and chemical absorption. Melanocytes produce melanin, determining our skin colour and offering ultraviolet (UV) radiation protection. The dermis, essential for skin elasticity and compactness, encompasses a network of connective tissue that produces collagen and elastin[4]. The hypodermis is rich in well-vasculated adipose tissue that offers insulation and protection as well as contributes to the overall shaping of face[3].

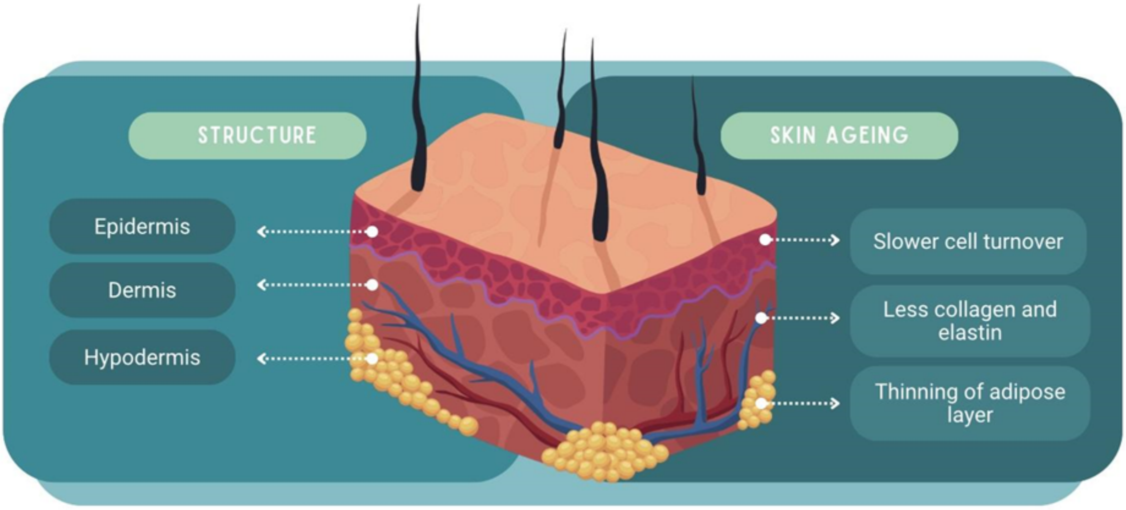

Figure 1. Schematic representation of the human skin structure and skin ageing[10].

Signs of Ageing Under the Microscope

Fine lines, wrinkles, hyperpigmentation and sagging - these are the signs of approaching a more mature stage of life. In the pursuit of ageing as gracefully as possible, the field of cosmetology and aesthetic medicine developed numerous treatments and therapies to address the issue. To treat the signs of ageing, we must first understand the process of skin ageing itself. The epidermis, a tissue undergoing continuous cell renewal, ideally every 27 days, relies on epidermal stem cells and their secretions for repairing any skin damage. As we age, the number and activity of the skin's stem cells decrease, leading to a slower turnover of skin cells, an uneven skin tone, thinning of the epidermis, and a devitalised appearance. Sagging of skin is the result of weaker collagen and elastin presence in the dermis. Decreased collagen production diminishes skin firmness, while worn-out elastin contributes to reduced elasticity, causing sagging and wrinkles. The decline in these proteins is a key contributor to visible signs of ageing, along with the volume loss from thinning of the adipose layer in hypodermis[1]. Collectively, changes throughout all three layers of skin manifest as sagging skin, fine lines, and wrinkles[3].

The Use of Stem Cells in Practice and Potential Use

In the past two decades, the manipulation of stem cells has become a standard procedure in restorative medicine and its research scope for diverse applications, including scar healing, burns treatment, cartilage reconstruction, skin grafting, and more[5]. While it may not be realistic to anticipate a straightforward application of stem cells for in-vivo tissue regeneration, they do present various indirect benefits[2]. Derby and colleagues have demonstrated that the administration of Adipose-Derived Stem Cells (ADSC) intracutaneously to damaged skin results in their migration into the dermis, where they exhibit the capacity to secrete cytokines and various growth factors, thus promoting angiogenesis and executing immunoregulatory activities[5]. The secretory and signalling capabilities of ADSC play a significant role in augmenting wound healing and mitigating the extent of scarring[2].

Concepts behind the utilisation of stem cells within the domain of restorative medicine can also be applied in aesthetic medicine to achieve a desired rejuvenating appearance. The most notable stem cell therapy for facial rejuvenation is Cell Assisted Lipotransfer (CAL)[6]. CAL represents a novel approach to autologous fat grafting, a technique commonplace in aesthetic surgery that was initially documented nearly a century ago. The process of fat grafting involves harvesting fat grafts from a region rich in adipose cells and subsequently injecting them into a secondary site. While traditional fat grafting successfully addresses volume loss in ageing skin with fewer safety concerns compared to other fillers, such as hyaluronic acid, the outcome and patients' satisfaction rates vary due to the unpredictable survival of injected adipose cells. The process of fat grafting was improved by incorporating stem cells that are proven to promote angiogenesis which leads to an increased survival rate of transplanted adipose cells[6]. CAL thus emerges as a promising and advanced approach to rejuvenating skin appearance[7].

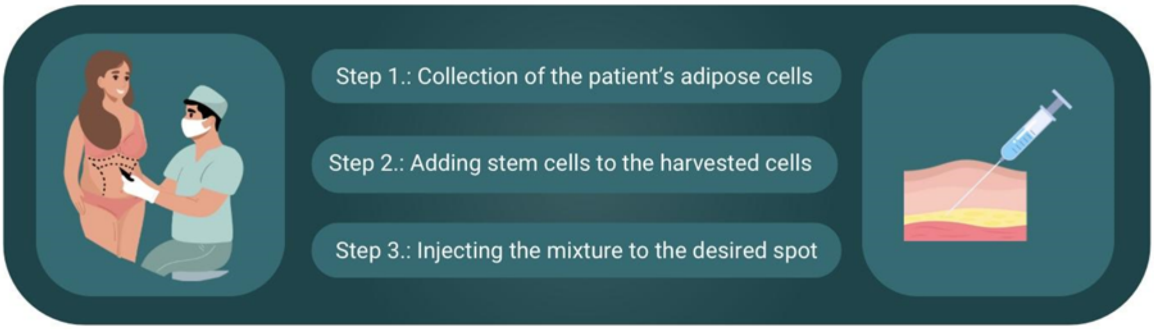

Figure 2. CAL, presented in simple steps[2].

Stem cells also showed success in treating hair density loss, a common problem in the mature population, by promoting the angiogenesis of hair follicles and secretion of growth factors. Stem cell technology may be applied through various methods, such as injecting stem cells or their derivatives directly into the scalp, using stem cell-containing products like serums or creams, or even employing techniques like microneedling to enhance the absorption of stem cell-based treatments[8].

Navigating Stem Cells Challenges and Innovations

While researchers acknowledge the positive impact of stem cells, concerns about their long-term safety persist due to potential tumorigenic effects observed in vitro as well as in experiments with mice[2]. While there are research reports that challenge such conclusions, more research needs to be conducted to determine long-term safety of incorporating stem cells into anti-ageing treatments. The concerns should always be presented to the patients so that they can make a fully informed decision. Recognising these limitations, researchers' attention started to shift to cell-free treatments using stem cell secretions like cytokines and exosomes. These innovations, incorporated into established treatments like CO_2 laser therapy, mesotherapy and microneedling, demonstrate success in promoting collagen production for a more rejuvenated appearance[9].

The allure of stem cell efficacy extends to plant cell cultures, offering unique and renewable cosmetic ingredients. Certain plant cultures are clinically proven to enhance epidermal gene functions, nurturing the body's innate stem cell functionality[1]. However, a notable revelation unveils the undisclosed use of plant stem cell extracts in commercial products, sparking doubts about the consistency of benefits. Exploring the complexities of cosmetic labels, where "stem cell" often refers to plant extracts, adds an intriguing layer to the ever-evolving narrative of skincare innovation[10].

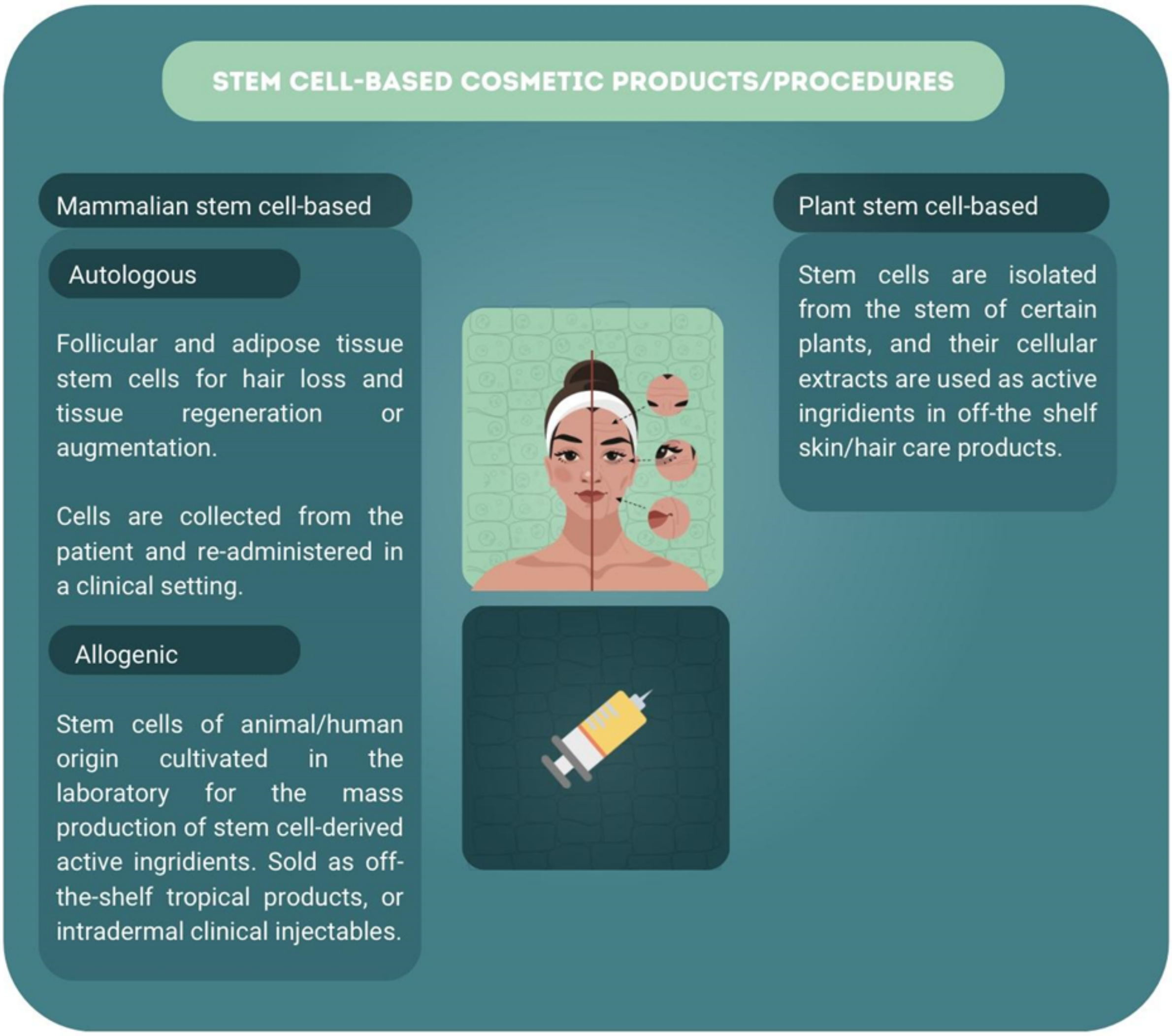

Figure 3. Categorisation of currently available stem cell-based cosmetic products/procedures available[3].

Conclusion

As we age, our skin goes through several changes that on the outside result in fine lines, wrinkles and overall volume loss. In the pursuit of graceful ageing, the world of cosmetology and aesthetics medicine never lacks novelties. Borrowed from the field of restorative medicine, stem cells proved to be a useful tool to upgrade the efficiency of existing anti-age treatments, such as fat grafting and ground to develop new ones, such as stem cell injections for promoting hair growth. But as with any other innovation, some of the treatments entering the marketplace lack proof of their efficiency. Despite the successful outcomes of some of the novelty treatments, more research needs to be conducted about long-term safety of stem cell therapies as they could potentially carry a risk of being tumourigenic.

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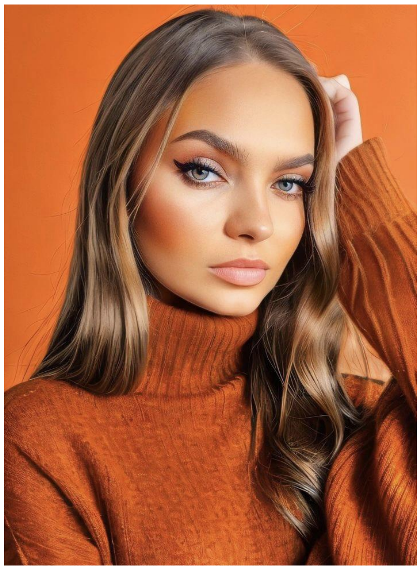

3D PRINTING IN THE COSMETICS INDUSTRY

AREAS OF USE

- CUSTOMIZED FACE MASKS
- TAILORED LIPSTICK APPLICATORS
- MASCARA BRUSHES

ADDITIVE MANUFACTURING GROUPS

- SINTERED LAYER SINTERING (SLS)
- FUSED DEPOSITION MODELING (FDM)
- STEREOLITHOGRAPHY (SLA)

MATERIALS

- FORMLAB RESIN
- POLYLACTIC ACID
- NYLON
- FLEXIBLE FILAMENTS

BENEFITS

- PERSONALIZATION
- COST-EFFECTIVE PROTOTYPING
- HIGH SPEED AND ACCURACY

The Fusion of Beauty and Technology: 3D Printing is Revolutionizing Cosmetics

In the dynamic landscape of beauty and personal care, the cosmetics industry stands as a thriving hub of innovation and revenue[1]. A recent groundbreaking development in this sphere is the integration of 3D (three-dimensional) printing into cosmetic production processes, directing the industry into a new era of customisation and precision-driven solutions[2]. It is evident that 3D printing is not merely a manufacturing method but a catalyst for redefining the very essence of cosmetic craftsmanship.

Additive manufacturing has different groups; nowadays, Fused deposition modelling (FDM) and Stereolithography technology (SLA) are the two most used processes in the cosmetics industry[3]. FDM is a 3D printing technology that involves the layer-by-layer deposition of thermoplastic materials to create three-dimensional objects[4]. In the case of SLA, an ultraviolet (UV) laser selectively solidifies layers of liquid resin to create a three-dimensional object[5].

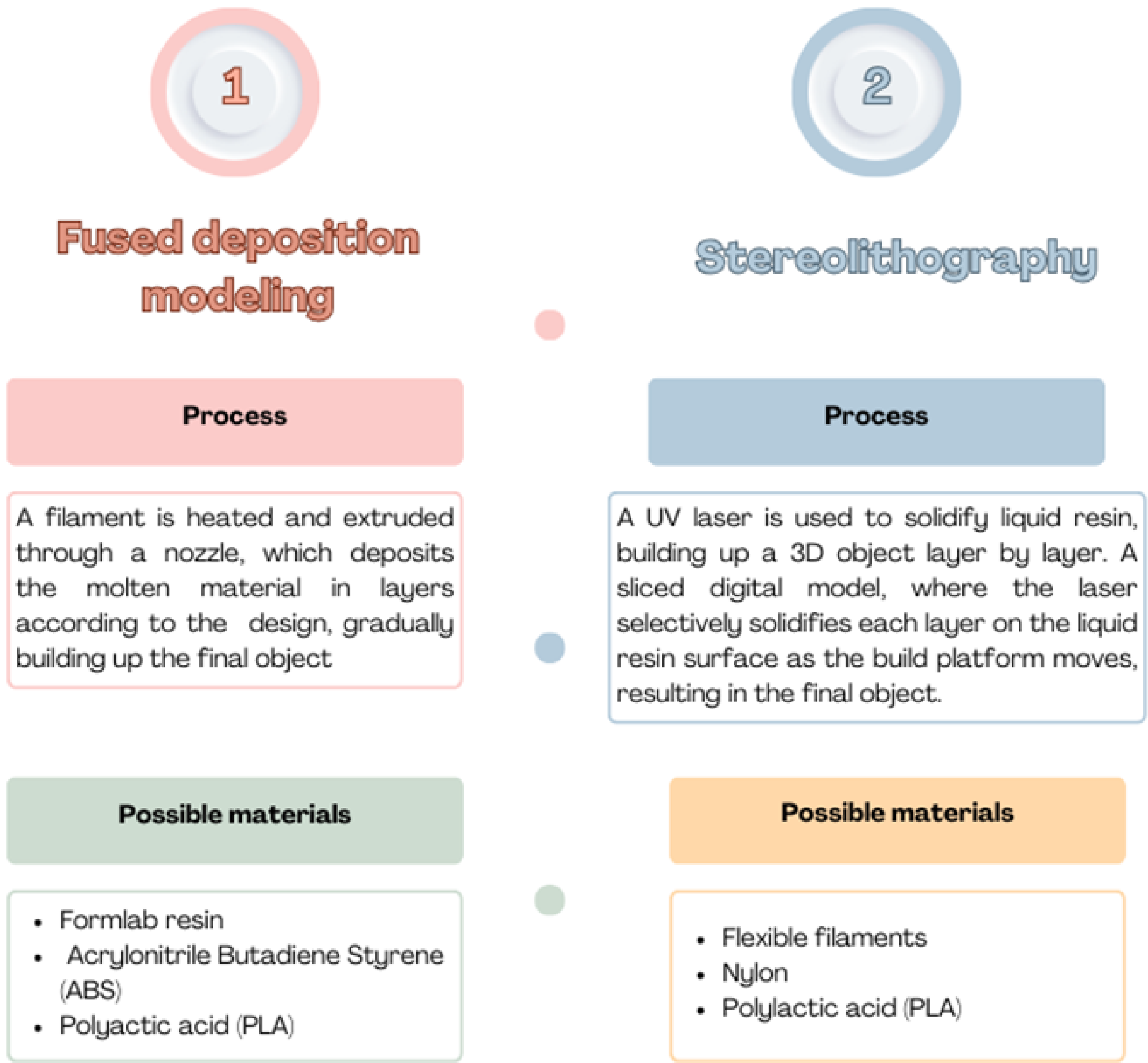

Figure 1. Additive manufacturing technologies[4,5].

The incorporation of 3D printing technology in the cosmetics industry is a relatively new concept. Yet, several cosmetic giants have already embraced its transformative capabilities: Neutrogena and Amorepacific have emerged as pioneers, leveraging cutting-edge 3D printing technology to revolutionise the beauty industry[6,7].

Neutrogena, with its innovative MaskiD™, showcases precision and personalisation. This transformative process begins with a high-tech 3D selfie, capturing intricate details to create a topographic map of the face[8]. The Neutrogena Skin360 tool then intelligently divides this data into six unique skincare zones, enabling the crafting of a sheet mask tailored to individual needs[6]. The advantages of Neutrogena's MaskiD™ are numerous, including precise measurement of facial dimensions, unparalleled personalisation, seamless technology integration, hydrogel material for optimal ingredient absorption, and a diverse array of high-efficacy ingredients targeting specific skincare concerns[8].

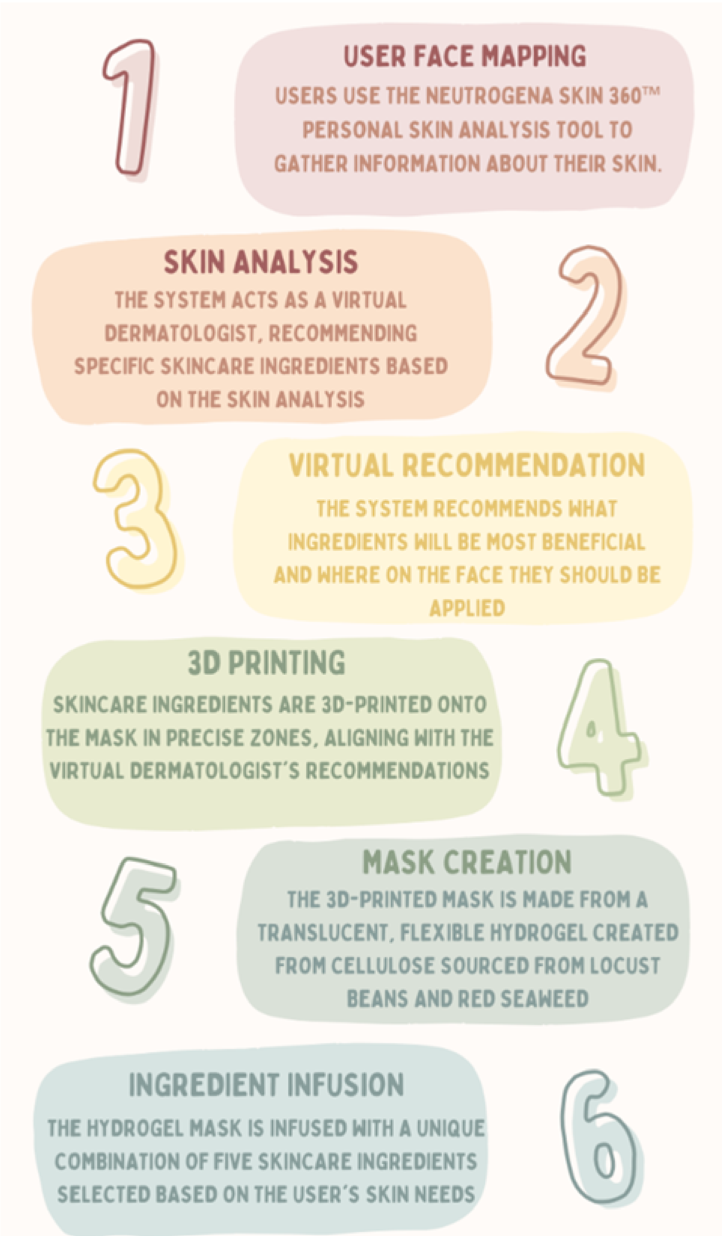

Figure 2. The steps of 3D mask processing[8].

Another great example of an innovative approach to 3D face mask printing is presented by Amorepacific. Developed in collaboration with Lincsolution, this system employs a smartphone app to instantly measure facial dimensions, creating a personalized hydrogel mask[9]. Recognised as a CES 2020 Innovation Award Honoree, Amorepacific's technology allows for tailored services through its lab-based skincare brand IOPE[10]. The advantages of Amorepacific's system include the speed and accuracy achieved through continual improvement, as seen in the pilot project at the IOPE Lab[9].

Both Neutrogena and Amorepacific exemplify the transformative potential of 3D printing in the beauty industry. Neutrogena emphasises precision and continuous monitoring, ensuring that each skincare solution is tailored to an individual's unique needs[6]. Amorepacific, on the other hand, showcases the integration of technology and a steadfast commitment to customization[10]. These advancements underscore a new era in skincare, where technology and personalisation converge to redefine the beauty routine.

Moving beyond skincare, the application of 3D printing extends to the manufacturing of cosmetic applicators, as highlighted by a recent study[11]. The research aimed to explore the potential of 3D printing technology in creating a novel cosmetic product — a personalised lipstick applicator. Utilising 3D scanning to capture digital data of an individual's lips, researchers employed SLA and FDM to fabricate lipstick applicator elements using materials such as clear Formlab resin, acrylonitrile butadiene styrene (ABS), and polylactic acid (PLA)[11]. Formlab resin, known for its high precision and smooth surface finish, enables the creation of intricate and detailed cosmetic prototypes and products[12]. ABS, a thermoplastic polymer, is recognised for its durability and impact resistance. Additionally, ABS can be easily moulded and coloured, offering versatility in design[13]. PLA, a bio-based and biodegradable material, presents an environmentally friendly option for cosmetic mould production, aligning with the growing demand for sustainable practices in the industry[14].

The advantages of the newly created applicator lie in its personalised design, tailored to the unique contours of an individual's lips. The FDM technique, particularly with PLA material, demonstrated effectiveness in consistently producing the personalised lipstick applicator[11]. This bespoke product offers a convenient application process, eliminating the need for a mirror, as users can press the sculpted lipstick surface directly to their lips, ensuring a uniform coating.

However, potential disadvantages may arise from the choice of materials and printing techniques. While PLA and ABS showed promise, the clear resin applicator faced challenges in consistently detaching the lipstick from the mould[11]. Additionally, the study does not extensively address the longevity and durability of the 3D-printed applicator, leaving room for further investigation into the wear and tear over extended usage.

The use of 3D printing in cosmetics is a promising and innovative approach, introducing a new dimension to beauty that holds immense potential. As this captivating journey is still in its early chapters, demanding rigorous testing and exploration of various factors, the evolving landscape of 3D printing in cosmetic artistry is set to redefine beauty standards in uncharted ways. Long-term effects, durability, and potential side effects remain unexplored territory, leaving room for continued advancements and a deeper understanding of this exciting intersection of technology and cosmetic artistry. As the curtain falls on this cosmetic spectacle, the promise is clear – while 3D printing adds a thrilling dimension to beauty, there's much more to uncover and understand.

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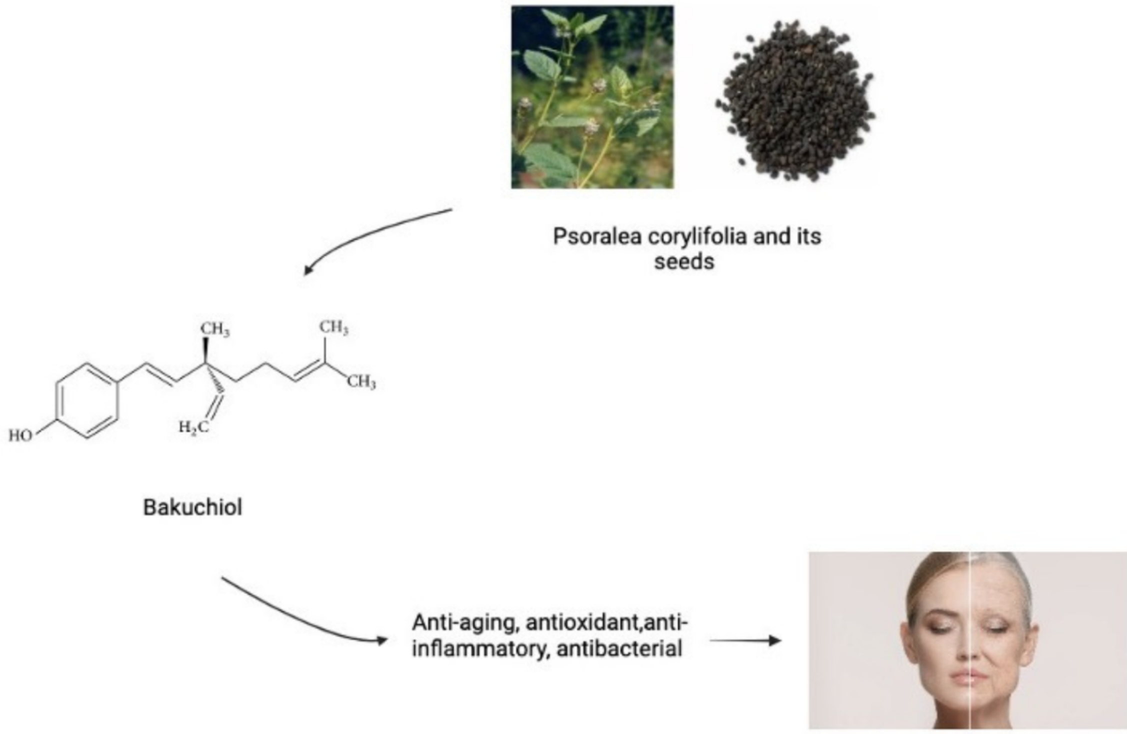

Bakuchiol – biological activity, use in cosmetology and its main source

Fresh Ginseng
↓
Steaming
↓
Drying
↓
Red ginseng root
↓
Extraction

water soluble extract

solvent extraction for oil

supercritical fluid extraction

ginseng cream


ginseng oil

Ginseng - general methods of extraction

Natural Ingredients in Anti-ageing Products

Introduction

Aged skin is characterised by wrinkles, uneven pigmentation, loss of skin tone, severe atrophy, roughness, dryness, sallowness, laxity, deep furrows and leathery appearance[1]. These clinical manifestations result from structural and metabolic changes induced by processes of intrinsic and extrinsic ageing. Intrinsic ageing has been attributed to factors including telomere shortening, chronic inflammation, mitochondrial DNA single mutations and free radicals, and oxidative stress[2]. Furthermore, due to the biological ageing process, the rate of cell proliferation decreases, leading to a loss of skin structure and function. Extrinsic ageing is primarily triggered by UV radiation and environmental influences[3]. These effects cause skin damage that accelerates cutaneous ageing[3]. Scientists have been working for a long time to reduce the signs of skin ageing. Many anti-ageing products are used to prevent ageing and eliminate its signs. Natural anti-ageing products have become very popular in recent years.

Psoralea corylifolia (Leguminosae) is an erect annual herb that usually grows in India, Pakistan, China and Southern Africa[4]. It has been widely used as a therapeutic agent in many local medicine systems, mostly in Ayurveda and traditional Chinese medicine (TCM), where it is known as babchi or buguchi[4]. *Psoralea corylifolia* has been used both internally and externally for various ailments such as leprosy, leukoderma, psoriasis, eczema, alopecia, and inflammation[5]. Many bioactive compounds have been isolated from *P. corylifolia* so far, and the most important compounds identified belong to the coumarin, flavonoid, and meroterpene groups[6]. Among them is bakuchiol, a meroterpene phenol first isolated from the plant's seeds in 1966[7]. Bakuchiol shows a wide range of pharmacological activities, including anti-ageing, anti-acne, antioxidant, anti-inflammatory, anti-cancer, and antimicrobial properties[8].

The use of ginseng as a herbal traditional medicine dates back about 5000 years ago in the Far East, namely China and Korea, with written records and prescriptions about 2000 years ago[9]. However, the first-ever Ginseng-based cosmetics product was much later manufactured in 1966 by a luxury Korean cosmeceutical company[10]. Among 13 named species in Asia, America, and Europe, *Panax ginseng* C.A. Meyer (Korean ginseng) is the most popular distributed species[9]. Nowadays, ginseng skincare formulations range from face masks, creams, and serums to balancing emulsions. According to the National Institute of Health, ginseng products are currently imported by more than 35 different countries, with the top largest markets naming South Korea, China, Canada, and the United States[11]. Moreover, ongoing studies have been conducted to prove their effects in delaying skin ageing and increasing skin elasticity, hence further propelling the sales of ginseng cosmetics and personal care products worldwide[12].

The Importance of Bakuchiol in Anti-Ageing

The topical use of bakuchiol is a promising cosmeceutical agent, gaining value in the skin care industry as an anti-ageing compound and natural alternative to topical retinol[13]. Bakuchiol, like retinol, has significant anti-ageing effects, but unlike retinol, it is considered to cause less irritation and has a more favourable safety profile[14]. Chaudhuri and Bojanowski conducted a study that shows bakuchiol has retinol-like functionality, although it is structurally different from retinol[14]. Both bakuchiol and retinol have upregulated several genes important for the integrity of the extracellular matrix and the dermo-epidermal junction, such as E-cadherin, laminin, aquaporin 3 (AQP3), and several types of collagen[13]. The study suggested that bakuchiol used in combination with retinol may reduce retinoic acid-induced toxicity. Also, bakuchiol was further evaluated in a clinical trial in this study, assessing female subjects aged 40-65 years old. Results were notable: significant reduction in wrinkle depth and improved skin roughness[14]. Dhaliwal et al. found that bakuchiol had a higher reduction in hyperpigmentation than retinol[15]. Subjects had significant improvements in pigment intensity, pigment surface area, and wrinkle surface[15]. Another study found that bakuchiol was well-tolerated in individuals who have sensitive skin, and the study showed highly statistically significant improvement in all parameters of visual smoothness, tactile smoothness, clarity, radiance, skin moisture content, overall appearance, and anti-ageing[16].

Combinations of antioxidants result in synergism and enhance the antioxidant effects of the compounds, which can be used in anti-ageing. Some studies investigated the effects of bakuchiol combinations using bakuchiol, vitamin C, melatonin, or bakuchiol and vanilla tahitensis extract combination. Both studies showed significantly increased skin firmness, improvement in skin texture and radiance, reduced wrinkle lines, uneven pigmentation, and photo-damage[17-19].

Ginseng: Methods of Extraction and Anti-ageing Mechanism of Action

Ginseng products are processed at different stages: fresh, white, red, and black, all derived from the raw root of ginseng after 4 to 6 years of cultivation[20]. Red ginseng is the stage when the root is steamed and then dried until the moisture content is less than 15%[21]. This article would provide deeper insights into red ginseng, as it is the most common form of ingredient in beauty products. The first step of preparing red ginseng extract is to dilute it with purified water at a high temperature[22]. Then, it is either through conventional solvent extraction, hydro distillation or steam distillation, or supercritical CO_2 fluid extraction method[23].

A diverse range of potent components present in all parts of a ginseng plant have been identified, including ginsenosides (the major active metabolite), alkaloids, phenolics, carbohydrates, ginseng oils, amino acids, vitamins (such as B_1, B_2, B_3, B_5, B_{12}, Choline), minerals (trace elements such as zinc, copper, magnesium), and enzymes[20]. In **Figure 1**, ginsenosides have complex conversion mechanisms, similar to steroid hormones[23].

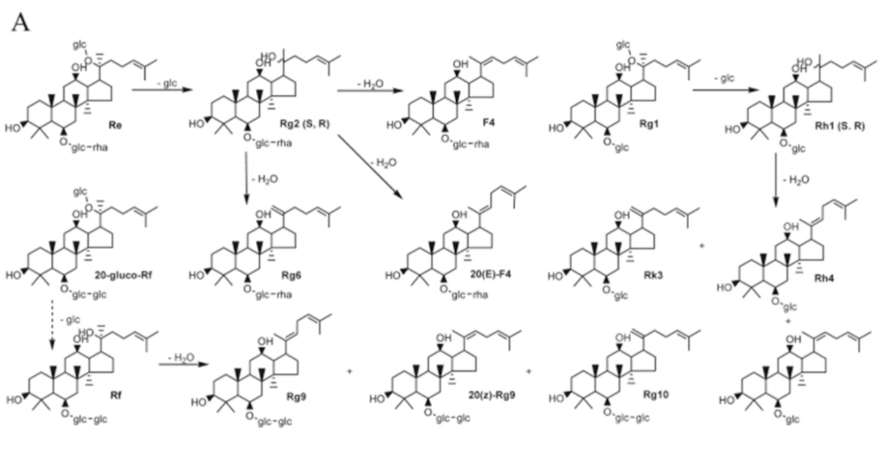

Figure 1. Conversion mechanism of ginsenosides in processing a red ginseng product[23].

A bibliometric analysis analysed the main active ingredients that contribute to the anti-ageing effects of ginseng on the skin[24]. For example, from 18 articles, the red ginseng natural gel has been proven to reduce UV-induced levels of matrix metalloproteinases in human fibroblasts and increase type I collagen for the skin[24]. Additionally, ginsenoside Rb1 and Rg1 promoted cell metabolism, accelerated the synthesis of nucleic acid and protein in ageing skin cells, and reduced lipid peroxidation metabolites, hence rejuvenating human skins[24]. Another research also showed that red ginseng natural gel decreased the formation of wrinkles by enhancing the levels of Col-I and prevented rehydration by promoting the expression of SPT, CERS3, and FLG enzymes[25].

Conclusion

Topical bakuchiol shows efficacy in preventing and treating ageing and photo-damage thanks to its retinol-like functionality and antioxidant properties. Bakuchiol demonstrates clinically significant similarity to topical retinol in efficacy and superiority in terms of tolerability and safety. Bakuchiol offers the added benefit of being suitable for daytime use owing to its impressive photostability, and its ease of formulation is attributed to its excellent miscibility. When looking for formulas containing bakuchiol, products containing other antioxidants may be most beneficial due to a synergistic effect in photoprotection. Since it has an activity enhancing and stabilising effect on retinol, it can also be used as a complementary product with topical retinol. In conclusion, bakuchiol can be an alternative to retinol and may be the key ingredient in anti-ageing skincare products.

Ginseng's mechanisms specific to several skin cell types are still limited to research. The solvent extraction stage requires various appropriate solvents to make red ginseng concentrated due to the complexity of its compositions. However, it is undeniable that substantial evidence of its regulatory role in human skin cells, accompanied by safety studies, has asserted the great potential of red ginseng as a cosmeceutical.

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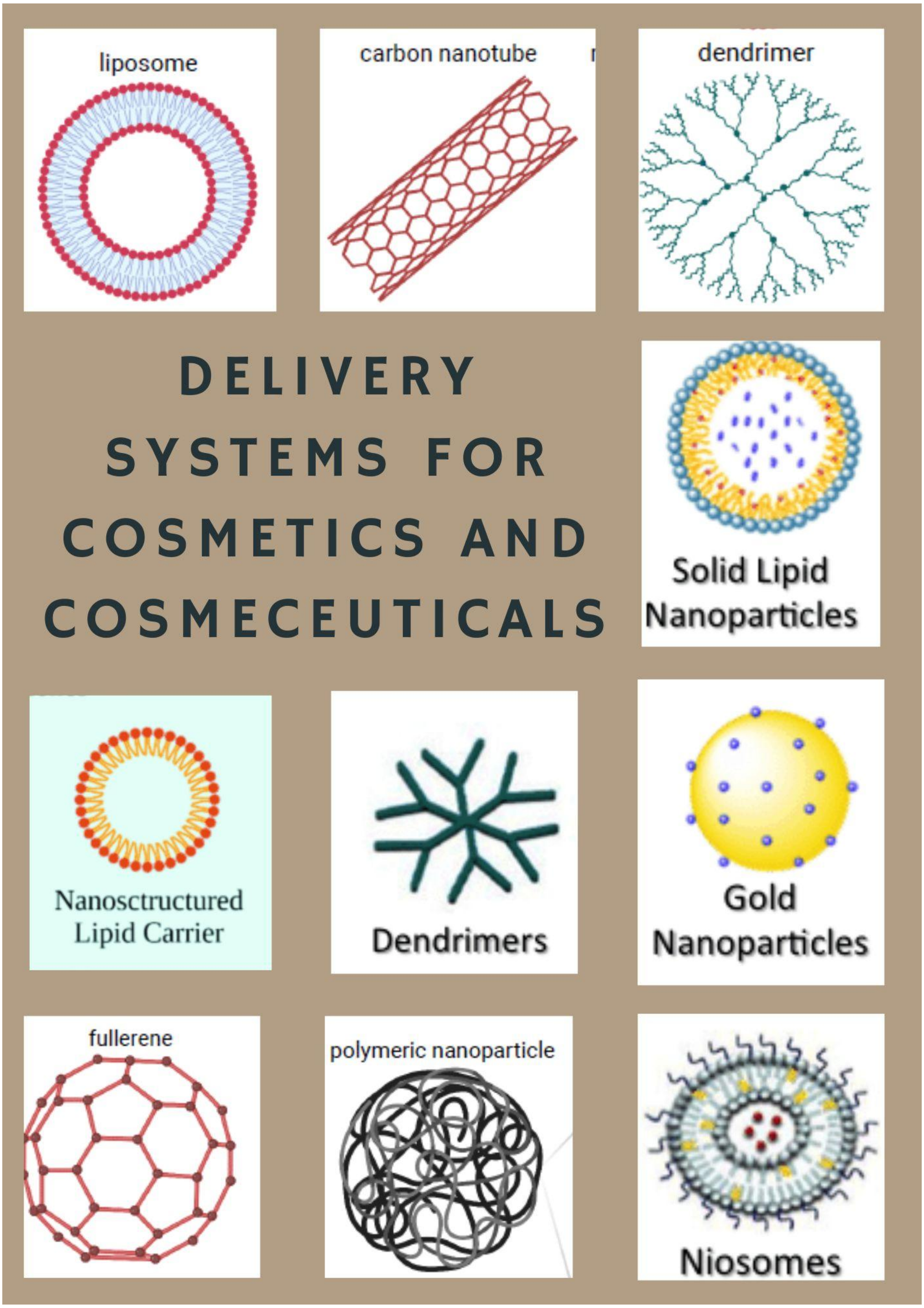
liposome
carbon nanotube
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DELIVERY SYSTEMS FOR COSMETICS AND COSMECEUTICALS
Solid Lipid Nanoparticles
Nanosctructured Lipid Carrier
Dendrimers
Gold Nanoparticles
fullerene
polymeric nanoparticle
Niosomes

Delivery Systems for Cosmetics and Cosmeceuticals

It is in our nature to strive to look better, feel better, and be better. One of the ways we accomplish that, at least the first two, is through the use of cosmetics and cosmeceuticals. FDA defines cosmetics as "articles intended to be rubbed, poured, sprinkled, or sprayed on, introduced into, or otherwise applied to the human body...for cleansing, beautifying, promoting attractiveness, or altering the appearance"[1]. The term „cosmeceutical" is not recognised as a separate category, but it describes a product that has characteristics of both a drug and a cosmetic. For example, a shampoo is considered a cosmetic, but an anti-dandruff shampoo is considered a cosmeceutical[2]. Now, in developing any of those products, the goal is to achieve the highest possible efficiency, the lowest possible toxicity and side effects, and to make the final product affordable. Those goals make the delivery system of a product an important choice, as the delivery system will impact the properties of the cosmetic/cosmeceutical. This article will cover some of the common nano-delivery systems. Nanomaterials generally offer many benefits. They can improve absorption and availability, prolong the effects of a product, and improve the organoleptic experience[2–4].

Nanoliposomes

Nanoliposome is a nanometric version of liposomes, vesicles consisting of a fluid core surrounded by bilayers of phospholipids, imitating the structure of the epidermis, which makes them efficient in dermal application[2,5]. Their structure allows them to transport hydrophilic substances placed in the centre of a liposome, as well as hydrophobic components placed in the walls **(Figure 1)**[5] Their use is in deodorants, body wash, and lipsticks as a fragrance carrier. Liposomes can be found in skincare, for example, as carriers of glycolic acid in moisturizers or salicylic acid in acne treatments[5]. Reasons for their versatile use are reduced systemic absorption, biocompatibility, and improved stability of the product due to encapsulation and protection of active ingredients. Negatives are high production costs and the possibility of degradation and leakage of the cosmetic components[2,5].

Niosomes

Niosomes are laminar or multilaminar vesicles consisting of nonionic surfactants, with or without lipids and cholesterol[2]. **(Figure 1)** Niosomes are 100 nm to 2 mm in diameter. Compared to liposomes, they are more stable, affordable, and adaptable[2,5]. Some issues are hydrolysation in aqueous suspensions and their weak drug load capacity. An example of their use is the encapsulation of essential oils, like *Lippia citriadora* essential oil. They are also in anti-ageing treatments[2,5].

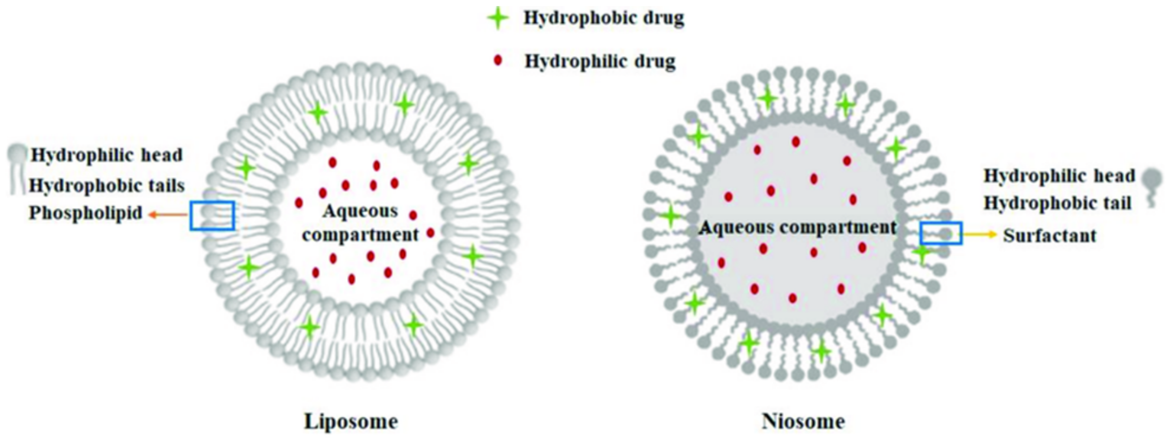

Figure 1. Structures of liposome and niosome[6,7].

Dendrimers

Dendrimers are macromolecules with many branches, which give them a tree-like structure, used to encapsulate and deliver mainly lipophilic active components[2,5]. **(Figure 2)** They consist of a core and layers around it. One of their main traits is intrinsic viscosity, meaning they reach a maximum of viscosity, but it then decreases as molecular weight increases. The advantages of this delivery system are improved skin permeability, controlled release, and prolonged shelf life. Among other applications, Dendrimers are used to encapsulate salicylic acid in acne treatments. Their disadvantages are potential cytotoxicity, high cost, and incompatibility with hydrophilic drugs [2,5,8].

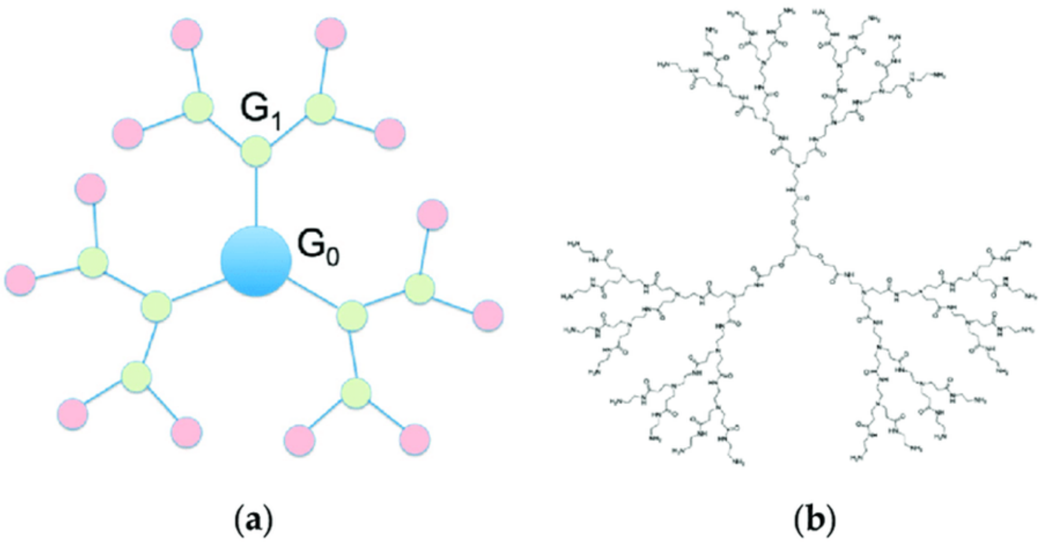

Figure 2. structure of a dendrimer[13].

Inorganic Nanoparticles

This category includes metals, metal oxides, and carbon-based nanomaterials. The most common metals and metal oxides in use are silver, gold, titanium oxide, zinc, zinc oxide, and silica[2,9]. Zinc and titanium oxides are widely used in sunscreens, as they offer protection from

UVA and UVB light. Gold nanoparticles are used in deodorants and are often present in anti-ageing creams, as they can help with skin damage and improve skin flexibility and surface. Silver nanoparticles are considered to have antifungal and antimicrobial effects, and research suggests they can be used as a preservative. Silica NPs improve the texture of cosmetics and can prolong their usability[2,5,10]. Carbon-based are nanotubes used in hair staining products and fullerenes are used in anti-ageing treatments[2]. Inorganic particles are typically safer, more biocompatible, and more stable than natural ones. However, most of the mentioned materials carry risks of some type of toxicity. For example, zinc and titanium oxides, silica, as well as silver and gold materials can contribute to the development of pulmonary toxicity. At high doses, silver and gold materials can also cause DNA damage[5,9].

Nanoemulsions

They are colloidal, water-in-oil, or oil-in-water solutions. **(Figure 3)** They are of lower viscosity, better solubilisation ability, and increased stability than some traditional options. [5]Nanoemulsions are typically transparent and used as vehicles in body lotions, creams, and sunscreens. They are appropriate delivery systems for lipophilic components, such as essential oils, fatty acids, flavours, and colours[5,11]. Nanoemulsions are also characterised by strong skin permeability, large load capacity, and unlike microemulsions, they are considered thermodynamically unstable systems[3].

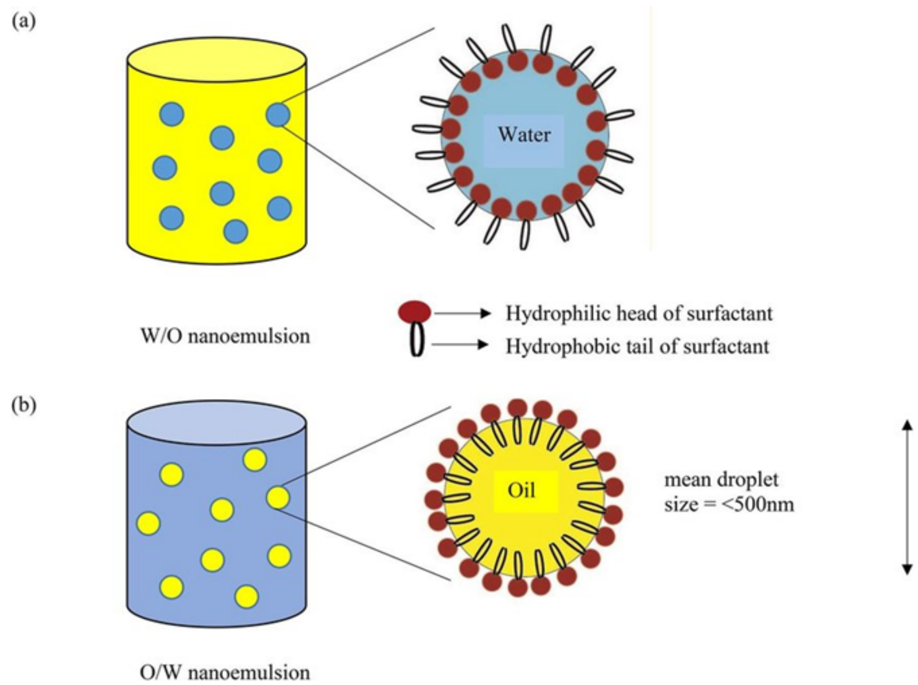

Figure 3. Water-in-oil and oil-in-water nanoemulsions[14].

Nanocrystals

They are aggregates of hundreds to thousands of atoms, stabilized by surfactants and without lipid or polymeric matrix[2]. Nanocrystals positively affect dermal absorption of cosmetics, especially those with lutein, coenzyme Q10, and flavonoids[2]. Flavonoids, for example, can be used in treating rosacea[2]. Nanocrystals improve solubility and promote diffusion of drug molecules into the skin.[3]

Solid Lipid Nanoparticles (SLNs) and Nanostructured Lipid Carriers (NLCs)

Solid lipid nanoparticles contain solid lipids, like waxes **(Figure 4)**[2]. They are used for slow delivery of poorly water-soluble substances which they protect[2]. SLNs consist of one layer with a lipid nucleus, they are characterised by low toxicity, easy access to the stratum corneum of skin, high load capacity, and stability[2]. They also increase the duration of action, are easy to produce, bioavailable, and biodegradable, but they have a short shelf life[2,5,12]. Unlike SLNs, NLCs also contain liquid lipids, and they offer higher load capacity and penetrate deeper into the stratum corneum **(Figure 4)**. They trap the drug in their core and release it in two phases. First in an outburst, then at a constant rate. NLCs prolong shelf life but decrease the duration of action[5]. These systems are used in perfumes and creams, as well as for delivery of macromolecules, like proteins[5,12].

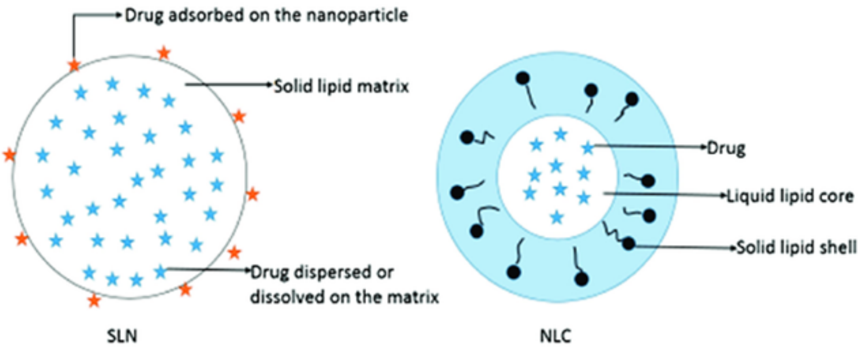

Figure 4. Comparison between solid lipid nanoparticle and nanostructured lipid carrier[15].

Health Risks

While nano-delivery systems are promising, there are some health concerns. Firstly, one of the reasons many of these systems are useful is their ability to penetrate the skin layers and improve the bioavailability of active substances[3,13]. That advantage can turn into a disadvantage if these nanoparticles are absorbed into the bloodstream and carried to the tissues, where they can cause cell damage or death[5]. Another reason these delivery systems and cosmetics/cosmeceuticals need a lot of research, is that nano-sized particles have significantly different properties, and different pharmacokinetics and pharmacodynamics[3]. In case these carriers reach other tissues, they can cause oxidative stress, inflammation, and damage to DNA. Their size also allows them to enter the placenta, and cause placental damage, fetal deformities, and neurotoxicity in infants[5].

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Beauty Is In The Eye Of The Beholder, And That Beholder May Be A Computer!

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Are Cosmetics Completely Safe to Use?

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The Roles of Solid Lipid Nanoparticles and Nanostructured Lipid Carriers in Cosmeceuticals

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Atopic Dermatitis: The Effects of Corticosteroids

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The Green Revolution: Cannabinoids in Cosmetics and Cosmeceuticals

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Navigating Challenges and Innovations: The Role of Stem Cells in Anti-ageing Industry

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The Fusion of Beauty and Technology: 3D Printing is Revolutionizing Cosmetics

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Natural Ingredients in Anti-ageing Products

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Delivery Systems for Cosmetics and Cosmeceuticals

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