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Augmentation of the bioactive potency of natural ingredients by fermentation yielding added benefits of prebiotics and post biotics to maintain the skin microbiome balance

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Introduction:

Beauty habits have changed considerably over the years, with many consumers swapping their customary cosmetics for a simpler and more holistic regime aiming to safeguard the skin from environmental factors giving it the opportunity to restore and strengthen. The industry is witnessing the boom in skin microbiome-friendly ingredients and the interest in fermented ingredients is expanding. The fermentation process improved the quality of the active phytochemicals and also facilitates their easy absorption by the human system. Recently, several research groups are working on the cosmeceutical importance of fermented plant extracts, particularly on the anti-aging, anti-wrinkle, and whitening properties [1-2].

Imbalances in the skin microbiota composition (dysbiosis) are associated with several skin conditions, either pathological such as eczema acne, allergies, or dandruff, or non-pathological such as sensitive skin, irritated skin, or dry skin [3]. Therefore, the development of approaches that preserve or restore the natural, individual balance of the microbiota represents a novel target not only for dermatologists but also for skin care applications

Biotics are the newest ingredients in skincare based on normalizing the microbiome to achieve skin health. There are numerous studies providing evidence of the benefits of specific probiotic strains for skin health [4-6]. In addition, the mechanisms of anti-aging suggest strains can help to regulate pH, reduce oxidative stress, protect from photoaging, and improve the skin barrier function [7].

Fermentation is used to improve the bioavailability of minerals that could be further utilized to enhance the level of micronutrients in plant-based extracts. The ferment filtrates better known as 'Bioferments' are augmented extracts with improved bioactive delivery, oxygen uptake, moisturization, and reduced skin irritation. The process of fermentation can phenomenally increase the potency and bioavailability of the original bio substrates. The study portfolio includes *Lactobacillus*/Carrot root ferment filtrate, *Lactobacillus*/Radish root ferment filtrate, *Bacillus*/Soybean ferment filtrate, *Bacillus*/ Rice ferment filtrate, *Saccharomyces*/Coconut oil/Onion bulb ferment filtrate which are branded as Kopcarotol, Kopraditol, Kopsoyatol, Kopryza, and Kopalleum respectively. The research facts and figures substantiate the augmentation of the bioactive content by the process of fermentation

Materials & Methods:

Fermentation

The solid substrates were grated sliced or soaked before sterilization to facilitate maximum surface area for the microorganisms to act upon. An optimized size of inoculum was then transferred to the sterile substrates and was fermented in solid state for 15-20 days. Further, the fermentation mixture was subject to filtration separating the spent biomass.

DPPH radical scavenging assay

The free radical scavenging ability of the extracts was tested by DPPH radical scavenging assay as described by Blois [8] and Desmarchelier et al. [9]. The hydrogen atom donating ability of the test samples was determined by the decolorization of methanol solution of 2,2-diphenyl-1-picrylhydrazyl (DPPH). DPPH produces violet/ purple color in methanol solution and fades to shades of yellow color in the presence of antioxidants.

Determination of total phenolics

Total phenolic contents in the extracts were determined by the modified Folin-Ciocalteu method described by Wolfe et al. [10]. An aliquot of the extract was mixed with 2 mL Folin-Ciocalteu reagent (previously diluted with water 1:10 v/v) and 2 mL (75 g/L) of sodium carbonate. Salicylic acid was used as the reference standard.

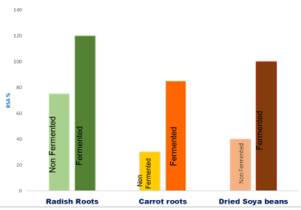
Skin Moisturisation

The moisturization measurements were carried out by Corneometer CM 825. The measurements were based on **capacitance measurement** of a dielectric medium, here the stratum corneum, the uppermost layer of the skin. With increasing hydration, its dielectric properties change. The measurement was with respect to the fact that water has a higher dielectric constant (81) than most other substances (mainly < 7).

Results & Discussion:

All the substrates in the portfolio were subject to the radical scavenging activity assay with and without fermentation to evaluate the enhancement in the bioactive content. The carrot roots, radish roots, and soybeans were fermented with *Lactobacilli* and *Bacilli* and the radical scavenging assay results are as below:

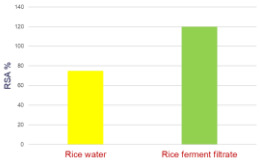
The enhancement is almost two-fold in the case of carrot roots and soybeans whereas it is 30% in the case of radish roots. The mobilization of the hardcore active contents released during fermentation is because of the action of a variety of enzymes produced during fermentation.



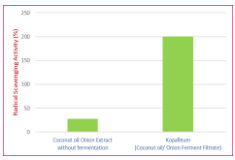
The nonfermented extracts of carrots and soybeans in the market were also compared to the fermented filtrates for the antioxidant content estimated as Ascorbic acid equivalents which are tabulated as below:

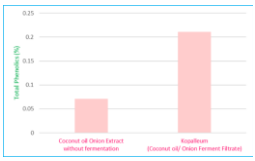
No.	Extracts	Ascorbic acid equivalents (µg/ml)
1	*Daucus carota*, Carrot liquid extract	79.2
2	*Daucus carota*, Carrot liquid extract Glycerin Base	35.2
3	*Daucus carota*, Carrot liquid extract[100% PG]	122.0
4	Soya liquid extract	38.0
5	Soya liquid extract Glycerin Base	88.0
6	Soya liquid extract [100% PG]	71.2
7	Radish liquid extract	60.0
8	Carrot liquid extract	36.8
9	Carrot ferment filtrate	376.8
10	Soybean ferment filtrate	473.3

Rice water also was compared between the fermented and the nonfermented as represented in the figure below. The black Kavuni rice, a rare variety of rice in South India was chosen for fermentation. Controlled fermentation with specific bacteria improved the potency of rice water as substantiated where a 40% improvement in the radicle scavenging activity has been demonstrated.



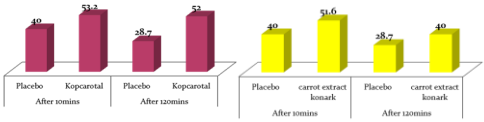
Red onions are a good substrate for fermentation augmentation but the high sulfur content generates a very pungent smell. To minimize the odor coconut oil was used as the medium for fermentation using *Saccharomyces* and the results obtained is as below. The results are outstanding achieving almost 88% augmentation in fermentation. In addition, the total phenolics post-fermentation was found to be increased by 75% .





There is an interesting relationship between the skin and the fermentation of lactic acid bacteria . Supernatants of these bacteria contain lactate and amino acids, which contribute to the hydration of the skin.

The skin hydration readings of ferment filtrates in comparison with the nonfermented extracts are represented in the graphs below



Active fermentation is an indication that the prebiotics and postbiotics have also been added to the soup during the process. Skin acts as a physical, chemical, immunological, radiation, and free radical barrier and is inhabited by billions of resident commensal microorganisms which constitute the skin microbiome. Therefore, the development of approaches that preserve or restore the natural, individual balance of the microbiota represents a novel target not only for dermatologists but also for skin care applications. The increased bioactive content and the pre and postbiotics in the filtrate make Bioferments a superpower extract compared to the convention extracts in the market.

Conclusions:

The cosmetic industry is always very dynamic and vibrant with novel ingredients and formulations continuously being introduced to reciprocate the changing consumer interests and demands. Modern consumers are pickier of their cosmetic stuff and are eager about the ingredients in them to secure them from the harmful and the toxic. So, cosmetic scientists worldwide are in an urge to screen more and more natural ingredients with potent and proven benefits. It has been scientifically proved that the fermentation process improves the phytochemical content and its effective absorption has been authenticated. Thus, Bioferments, the ferment filtrates of natural substrates are most likely to fuel a mega trend in the cosmetic arena and could be the possible hope for the sustainable development of cosmetic products for skin microbiome and eco-conscious consumers.

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