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Cellulose Microcrystalline Beads As An Exfoliating Agent

Adiba Khan[1], Sudipa Bose[1], Urja Chopkar[1], Pritam Wath[1], Ahtesham Khan[1], Dr. Mitali Bodhankar[1]

[1]*Department of Pharmaceutics, Gurunanak College of Pharmacy, Maharashtra, India.*

Corresponding Author: Adiba Khan

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ABSTRACT: Powder exfoliants are incredibly gentle. When mixed with water, these finely-milled powders transform into a luxurious paste or lather that removes impurities and smooths skin - without scratching its surface. In addition to physical exfoliants like oat and rice flour, many also include naturally-derived Alpha hydoxy acids and Beta hydroxy acids.

Apricot and fruit kernels Scrub, has been used for decades by those hoping to reduce breakouts, slough off dead skin or to just get that after-scrub glow. But as consumers have become better educated about their skin, there has been increasing awareness of the risks of using products that contain such ingredients. Apricot Scrub caused harm to consumer's skin through over-abrasion while encouraging the onset of acne, wrinkles, inflammation and loss of moisture.

The present invention relates to cellulose particles with measurable exfoliation properties in a cosmetic composition, and uses thereof in the cosmetic field (1).

To overcome the onset of acne, wrinkles, inflammation and loss of moisture because of Apricot and fruit kernels we can use cellulose microcrystalline beads.

It also contains advantages like to exfoliate during cleansing of the skin or scalp of the body and to exfoliate part of body skin or scalp without rinsing out.

KEYWORDS: Cosmetics, Exfoliation, Inflammation, Microcrystalline

I. INTRODUCTION

Pharmaceutical Powders are intimate mixtures of dry, finely divided drugs and/or chemicals that may be intended for internal (Oral Powders) or external (topical or dusting powder) use. (2)

Powders represent one of the oldest dosage forms. It is a preparation in which a drug is blended with other powdered substances and used for internal or external purpose.

A good Powder formulation has a uniform particle size distribution.

Exfoliation is a cosmetic technique aimed at improving skin appearance by removing dead skin cells from the surface of the skin (3).

The skin of the human body self-renews continuously by eliminating the upper, external, layers and generating new internal layers from the basal layer. Desquamation normally occurs invisibly with shedding of dead cells resulting from desquamation. During natural desquamation process, the skin can shed spontaneously 30,000 to 40,000 dead cells per minute. However, disturbances in this process result in the accumulation on the skin surface of only partially detached cells with or without a concomitant thickening of the stratum corneum. Such cells and debris accumulation on the skin surface is generally combined with a feeling of roughness and dryness of the skin surface and may lead to flaky skin, less soft and smooth, non-uniform skin colour, etc.

Exfoliation of dead cells and debris from the epidermis is a well-known cosmetic process that generates abrasive tensions on skin surface, thereby removing dead cells and promoting regeneration of the epidermal tissue. Additional potential benefits to exfoliation are improved skin cleansing by helping to mechanically remove dirt and oil from the skin, reduction in bacteria on the skin and increased blood flow to the skin due to the mechanical stimulation. Exfoliation can be accomplished by the use of natural sponge or rag, or exfoliating compositions.

Exfoliating seems like a relatively self-explanatory process—you grab your scrub and facial brush and get to work (4).

Cellulose particles can be used as exfoliating agents. We can use this ingredient and can also sell this product in market. Because of its remarkable benefits, it can be great product in market.

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By conducting experiments and researches on cellulose particles, the inventors have discovered that particular particles may exhibit same exfoliating properties as fruit kernel particles without their associated drawbacks. Furthermore, the inventors have surprisingly found that these cellulose particles, or cellulose beads, get destroyed during skin application so that they naturally disappear from the body surface without any rinsing. These cellulose particles can be advantageously used in a body care composition, and notably for exfoliating composition (1).

Exfoliating agents can also be used in gel form which reveals a brighter, smoother complexion with this gentle facial exfoliating gel that eliminates surface impurities and unclogs pores while smoothing skin (5).

Effect of Cellulose Exfoliator in Face Scrub:

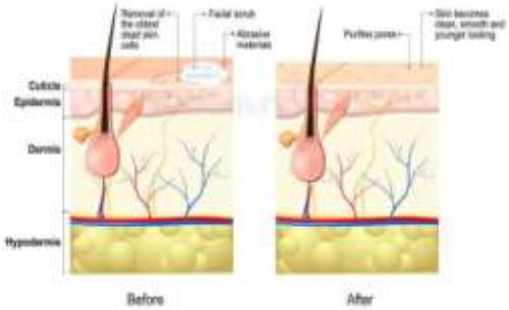

Fig.1:- Effect of Cellulose Exfoliator in Skin

Cellulose exfoliators, when contain in a cosmetic composition, are spreadable and disintegrate towards fine cellulose powder upon application on the skin. In face pack surprisingly shows effect that at least 80 %, preferably at least 90%, more preferably at least 95%, even more preferably at least 99% of the beads disintegrate under mechanical stress or during massage movements after an average time less than 3 minutes, when applied on human skin on application. (Fig.1)

Benefits of Exfoliation: - (6)

1) Exfoliating sloughs away old, dead skin cells which can make skin appear dull and dry. A buildup of dead skin cells can also lead to clogged pores which can encourage blemishes or acne.
2) Encourages cell renewal where healthy new cells replace old dead cells to give you a more radiant, brighter complexion. As we age, our skin is slower to shed these cells and exfoliating helps uncover fresh, new cells quickly.

Ideal properties of exfoliant: -(7)

1) It should be non-irritant.
2) It should be non-toxic.
3) It should have small gritty particles.
4) It should be non-sticky.
5) It should be mild abrasive.
6) It should remove dead skin.

Precautions to be taken while applying an exfoliant: - (8) (9)

1) An exfoliant is selected based on the skin type.
2) Excessive exfoliating and rubbing can damage the skin.
3) Do not exfoliate skin if any open wounds, cuts, and sunburns present.
4) Apply twice a week.
5) Apply with a rotating motion to face and neck for about 30secs. Thoroughly rinse with water.

II. MATERIAL AND METHODS

Microcrystalline cellulose (MCC) obtained from the softwood (pine) bleached sulphate pulp and thermo catalytic method from hardwood (birch, aspen) have been developed (10) (11). Each of these is a "natural" source.

Preparation of microcrystalline cellulose Powders: -(1)

Manufacturing of cellulose particles of the innovation

- 90% - 100% by wt. of cellulose,
- 0% - 5% by wt. of hydroxypropyl methyl-cellulose,
- 0%-5% by wt. of lipo-soluble active ingredients (e.g. D-Panthenyl triacetate, Vitamin E) and/or water soluble extract and/or pigment are thoroughly mixed in an industrial mixing machine.

After mixing 50% - 75% by wt. of water are added to the dry blend and the mass is mixed again to obtain a wet granulate.

The wet granulate is being dried in a fluid bed dryer at a temperature of 55 -75°C until the residual water content of the product reaches 3%. The final product is sieved in 3 size fractions: 0-200 µm, 200-400 µm and 400-900 µm.

Body care compositions:-

The body care composition of the innovation is for example, a cleansing body composition, in particular cosmetic composition, whitening and/or brightening composition, body and feet scrub compositions (1).

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The body care composition in a particular - shower gel composition can be formulated as a gel (1).

Cosmetic additives may be added to achieve a desired cosmetic result. Desired cosmetic results may be determined by one of ordinary skill in the art or the user of the disclosed compositions. Cosmetic additives may include, but are not limited to, carriers, excipients, vehicle ingredients, moisturizers, humectants, cosmetic salts, adjuvants, oils, emulsifiers, co-emulsifiers, gelling agents, absorbers, solvents, photo-protective agents, and inert bases (1).

The compositions for topical application may contain additional ingredients such as carrier, excipient, or vehicle ingredients such as, for example, water, acetone, ethanol, ethylene glycol, propylene glycol, butane- 1,3-diol, isopropyl myristate, isopropyl palmitate, mineral oil, and mixtures thereof to form lotions, tinctures, creams, emulsions, gels or ointments which are non-toxic and pharmaceutically or dermatologically acceptable. Additionally, moisturizers or humectants can be added to the present compositions if desired. (1).

The following are experimentations and examples provided solely to illustrate the present innovation and are not intended to limit the scope of the invention, as described herein.

Experimentations:-

1) Particle Size Distribution:-(12)

Avicel PH 105 microcrystalline cellulose was supplied by FMC (Food Machinery and Chemical Corporation) Corporation, Philadelphia, Pennsylvania, as a white powder. 15 g of microcrystalline cellulose were mixed with approximately 150mL of de-ionised water in a Waring blender for 2.5h. The thick slurry was then transferred to a 1L beaker to give a 1.5% (w/w) suspension of pH 5.04. The average particle size of microcrystalline cellulose, measured with light scattering, is 24.6µm
for the powder, and 21.6µm for the 1.5% suspension. The difference is caused by the Waring blender shearing effect (Fig.2)

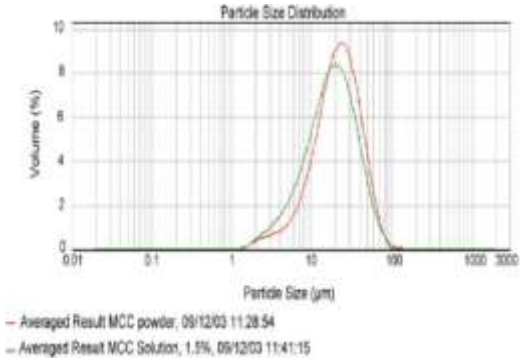

Fig.2: - Particle size distribution of microcrystalline cellulose (MCC) powder (24.6µm) and suspension (21.6 µm).

Scanning electron microscopy (SEM) showed this material to be irregular in shape
andpolydisperse (Fig.3). Microcrystalline is negatively charged (13), with surface ionic charge of −4.6 $meqkg^{-1}$ (dry basis) at pH 5.04, measured by a streaming potential titrator (M_W = 1, 07,000$gmol^{-1}$). Fourier transform infrared (FTIR) analysis showed that the MCC had no detectable carboxylic groups or were below the FTIR detection limit of about 1wt. %. Approximate calculations, assuming carboxylic groups are located on the external surface only.

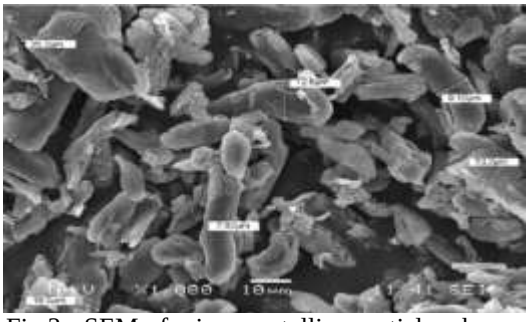

Fig.3:- SEM of microcrystalline particles shows that they are irregular in shape and polydisperse.

2) Angle of repose:- (14)(15)

The microcrystalline cellulose powder, weighed around ± 15, is carefully poured into the flow meter funnel. The end cover of the funnel is opened slowly so that the powder flows down slowly. The height and diameter formed are measured.

3) Flow rate:-(14)(15)

The microcrystalline powder, weighed around ± 25 g, is fully inserted into the flow meter. The flow meter is switched on, and then the time it

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takes until all of the powders flow down is recorded.

4) Evaluation parameters:- (1)

- **pH :- 5.0 - 7.5** (16)(17)
- **Consistency:** - It was found to be powder form.
- **Irritability:** - The small amount of powder with water was applied on skin and kept for few minutes and found to be non- irritated.
- **Washability:** - A little quantity of powder with water was applied on skin and was wash with water and it was easily washable.
- **Grittiness:** - Powder was found to have few gritty particles.
- **Spredability:** - The small amount of powder was spreaded on face and it is easily spreadable (7).

5) Exfoliation measure tests:-(1)

The use of microcrystalline cellulose as a feed additive is considered safe for the environment.

The exfoliation properties of the cellulose beads may be measured after one day in a cosmetic composition, whatever the composition is. In a particular patent, the measure of the exfoliation properties may be performed by using water. Advantageously, the measure is performed after 3 months in the composition at room temperature, preferably after 6 months in the composition at room temperature, more preferably after 12 months in the composition at room temperature, even more preferably after 30 months in the composition at room temperature.

One or more of the following tests can be used to characterize the exfoliation properties of the cellulose particles of the innovation and compare them to comparative exfoliating means or comparative cellulose particles. Convincing results may be obtained compared to cellulose particles of the prior art from the first day of storage in water or cosmetic composition, since the cellulose particles of the prior art lose their exfoliating properties when they are put in water or cosmetic composition.

III. OUTCOME OF THE STUDY

Cellulose is an organic compound with a polysaccharide consisting of a linear chain of several hundred to many thousands of β(1→4) linked D-glucose units. It is suitable as a cosmetic ingredient due to its smooth texture, hypoallergenicity on skin, and high air permeability. Cellulose particles having an average particle size less than or equal to 2 mm, wherein the cellulose particles provide measurable exfoliation after 1 day in a cosmetic composition, preferably after 3 months in a cosmetic composition, more preferably after 6 months in a cosmetic composition, even more preferably after 12 months in a cosmetic composition.

Various researches on cellulose show that it is possible to produce porous cellulose particles showing exfoliating properties in various formulations. These particles are obtained from a mixture of cellulose and water, with some pigments and aid materials like hydroxyl propyl-methyl cellulose, acrylates/ammonium methacrylate copolymer and triethylcitrate.

The cellulose particles that conventionally lost their exfoliating properties, it provides significant exfoliation after 1 day in their composition at room temperature and if possible 3,6,12 or 30 months in their composition at room temperature.

The cellulose beads have several advantages and applications in cosmetic.

Firstly, the beads are loaded with cosmetic/color agents who are meant to produce action at site of interest when they disintegrate. Any suitable cosmetic agents may be used like vitamins A or E, coenzymes, cooling agents, D-pantheyl triacetate, plant extracts, oils particularly hydrating oils, essential oils, natural oils(i.e. tea tree oil, jojoba oil, marula oil, argan oil), silicone oils, clay or metal or precious stone powders, pigments, etc. Preferably the cosmetic are lipid soluble so they do not diffuse in a cosmetic composition containing water. And more importantly the cellulose beads leave no residue when they disintegrate, so there is no need of rinsing out from skin to remove the particles.

Following experimentation is given below(1)**:**

Experimentation: Clinical investigation of the cellulose particles

To confirm the effectiveness of the cellulose particles of the invention as exfoliating particles a clinical investigation was performed with a gel containing them.

The efficacy parameters of exfoliation were assessed based on: skin softness and skin cleanness.

The tolerance parameters were the following: skin redness and skin irritation. These tolerance parameters were followed as the skin exfoliation process often impacts them.

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Material & Method Products used:

GEL FORM 1	Contains 5% apricot Powder
GEL FORM 2	Contains 5% cellulose particles of the invention with a particle size ranging between 200 and 400 µm

Panel and study conditions

A panel test was run on 29 people, 20 of them being women, to evaluate and compare GEL FORM 2 composition to GEL FORM 1 composition.

The study was simple blinded. Each tester used GEL FORM 2 composition on one side of their face and GEL FORM 1 composition on the other side of their face. The volunteers were asked to massage their faces with light circular movements then wash the products with water. The products were used for one week at the tester's convenience as many times as desired. The methods used to assess the efficacy of the products are described in detail in the following sections.

Efficacy assessment

Assessment of exfoliating properties (in use tests):

The following criteria were assessed by questionnaire (self-assessments):

1) **Skin softness sensation after washing**
2) **Skin cleaner sensation after washing**
3) **Product preference**

Safety assessment (Tolerance properties)

The tolerance properties of the exfoliating product were assessed during use tests by the following criteria (questionnaire):

1) **Sensation of skin aggression (feeling of scratches) by exfoliating particles**
2) **Skin redness and slight irritation (after intensive use)**

Efficacy Assessment:- 1) **Skin softness sensation after washing**

Table 1): Skin softness assessment (Questionnaire)

Type of product	Number of volunteers			% of volunteers		
	Very Soft	Soft	No differen-ce	Very soft	Soft	No differe-nce
GEL FORM 1	11	15	1	41	56	3
GEL FORM 2	12	17	0	42	58	0

Both products assessed are efficient skin exfoliators. The product GEL FORM 2 has shown the best efficacy in comparison to GEL FORM 1 product. 100% of the volunteers found their skins (soft or very soft) after the use of the product GEL FORM 2. 97 % of the volunteers found their skins soft or very soft after the use of the product GEL FORM 1.

Remark:- In the group GEL FORM 1, 2 volunteers were not able to answer because the product was too harsh for them.

Efficacy Assessment:- 2) **Skin cleaner sensation after washing**

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Table 2): Skin cleaner sensation assessment (Questionnaire)

Type of Product	Number of Volunteers	% of volunteers
GEL FORM 1	9	31
GEL FORM 2	11	38
No difference	9	31

Most volunteers (38%) found their skins cleaner with the product GEL FORM 2 in comparison to the product GEL FORM 1 (31%).

Efficacy Assessment: - 3) **Product preference**

Table 3): Skin cleaner sensation assessment (Questionnaire)

Type of Product	Number of volunteers	% of volunteers
GEL FORM 1	6	21
GEL FORM 2	23	79
No difference	0	0

The majority of the volunteers (79%) was satisfied by GEL FORM 2 product and preferred GEL FORM 2 product to GEL FORM 1 product. The volunteers found the GEL FORM 2 product very easy to apply and to use. They were satisfied because they had a new experience sensation. The product was less aggressive for their skins with a high efficacy.

Safety Assessment:- 1) **Sensation of skin aggression (feeling of scratches) by exfoliating particle**

Table 4): Assessment of skin sensation of aggression (Questionnaire)

Type of product	Number of volunteers	% of volunteers
GEL FORM 1	29	100
GEL FORM 2	0	0
No difference	0	0

All the volunteers (100%) felt scratching sensation of their skins with the GEL FORM 1 product. With the GEL FORM 2 product, any aggression was felt.

Safety Assessment:- 2) **Skin redness and/or slight irritation (after intensive use)**

Table 5): Assessment of skin redness and/or slight irritation (Questionnaire)

Type of product	Number of volunteers	% of volunteers
GEL FORM 1	21	84
GEL FORM 2	1	4
None	2	8
Both	1	4

84% of the volunteers showed skin irritation with the fruit kernel fragment particles, whereas only 4% mentioned skin irritation with the cellulose particles.

Remark: 4 volunteers didn't answer to the questionnaire.

Conclusion of above experimentation:-

The clinical investigation has shown that both products assessed were efficient exfoliators and confirms the efficacy of the composition of the invention seen during ex vivo experiments. The cream of the invention improved the following clinical parameters:

- Softness: Composition of the invention (100%) versus apricot exfoliator GEL FORM 1 (97%)
- Cleanness: Composition of the invention (38%) versus apricot exfoliator GEL FORM 1 (31%)
- Aggressiveness: Composition of the invention (0%) versus apricot exfoliator GEL FORM 1 (100%)

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- Redness or slight irritation: Composition of the invention (0%) versus apricot exfoliator GEL FORM 1 (84%)

Therefore cellulose particles can be used in cosmetics in replacement of fruit kernels.

IV. CONCLUSION:

The powders maybe intended for internal or external use. The exfoliation is the process of removing dead skin cells which accumulate on the topmost layer of the surface of skin. These dead cells from stratum corneum are removed or cleared away for the new layer of skin cells to come to the surface and grow by using a chemical, granular substance, or exfoliation tool.

It illustrate that the powder cleansers have powerful exfoliating properties. Only the powder is to be mixed with a bit of water. Preservatives are not needed in this type of formulation. Moreover as water is not present in powders, chances for bacteria and mould to grow are negligible

Generally, the powders in the cleansers are fine, smooth particles or plant based powders which result in exfoliation without harsh grit. Plastic micro beads and Apricot Scrubs used have their own disadvantages.

Apricot Scrub caused harm to consumer's skin

E.g. Guttikhal Apricot meal scrub and Ilana organic synergizing face scrub.

To overcome the harmful effects of apricot cellulose microcrystalline beads may be used instead by using specific composition and methodology. Innovation in this area of Cosmetic formulations is the need for consumers of the product. Cellulose microcrystalline beads seem to be the best choice for exfoliation to exfoliate during cleansing of the skin and to exfoliate part of body skin or scalp without rinsing out.

REFERENCES:-

[1]. Schweikert K, Egorova M, Juch R, Lefevre F, Westenfelder H. Exfoliating cellulose beads and cosmetic uses thereof. European; EP2907498A1, 2015.

[2]. Ali H, Suliman R, Elhaj B, Abdulgader R. Pharmaceutical Powder Dosage Forms: A Review. International Journal of Pharmaceutical and Clinical Research [Internet]. 2019 [cited 24 May 2021]; 11(1):20-22.

[3]. Farzaneh d. Exfoliating Agents: Selection and Formulation Tips [Internet]. Cosmetics.specialchem.com. 2021 [cited 24 May 2021]. Available from: https://cosmetics.specialchem.com/selection-guide/exfoliating-agents-selection.

[4]. Moorhouse V. How It Works: NUDE Detox Brightening Fizzy Powder Wash [Internet]. StyleCaster. 2021 [cited 24 May 2021]. Available from: https://stylecaster.com/beauty/how-to-use-a-dry-powder-exfoliator/

[5]. Julianne H. Gentle Exfoliating Gel [Internet]. www.aveneusa.com. 2021 [cited 24 May 2021]. Available from: https://www.aveneusa.com/gentle-exfoliating-gel

[6]. Dr. Joanne R. 5 Benefits of Exfoliating [Internet]. Kinvara Skin Care. 2021 [cited 24 May 2021]. Available from: https://www.kinvaraskincare.com/blogs/news/five-benefits-of-exfoliating

[7]. Ghadage P, Mahamuni S, Kachare D. Formulation and Evaluation of Herbal Scrub using Tamarind Peel. Research Journal of Topical and Cosmetic Sciences. 2021; 9:40-43.

[8]. Hiremath S. Textbook of Industrial Pharmacy, Drug Delivery Systems and Cosmetics and Herbal Drug Technology. Delhi: University Press (India) Ltd; 2008.

[9]. Dureja H, Kaushik D, Gupta M, Kumar V, Lather V. Cosmeceuticals: An Emerging Concept. Indian J Pharm; 2005.

[10]. Ollie M. Microcrystalline cellulose - Wikipedia [Internet]. En.wikipedia.org. 2021 [cited 24 May 2021]. Available from: https://en.wikipedia.org/wiki/Microcrystalline_cellulose

[11]. Marianna L, Svetlana C. Obtaining microcrystalline cellulose from softwood and hardwood pulp. 2007; 4.

[12]. Gaudreault R, van de Ven T, Whitehead M. Mechanisms of flocculation with poly (ethylene oxide) and novel cofactors. Colloids and Surfaces A: Physicochemical and Engineering Aspects [Internet]. 2005; 268(1-3):131-146. Available from: https://www.researchgate.net/publication/222335892_Mechanisms_of_flocculation

[13]. Luner P, Chou T. Colloidal Stability if Microcrystalline Cellulose in Aqueous Salt Solutions, Polymer Adsorption and Dispersion Stability. Washington, DC: American Chemical Society. 1983:377-392.

[14]. Altrista R, Kharismi Y, Sutriyo, Suryadi H. Preparation and Characterization of

Microcrystalline Cellulose. J Young Pharm [Internet]. 2018; 10(2):579-583. Available from: https://www.jyoungpharm.org/sites/default/files/JYoungPharm_10_2_s79.pdf

[15]. Lachman L, Herbert A, Joseph L. TeoridanpraktekfarmasiindustriJakarta. 1994; UniversitasIndonesis Press.

[16]. Bhaskar G, Arshia S, Priyadarshini S. Formulation and evaluation of polyherbalantiacne gels. Phcog Nag. 2009; 5.

[17]. Whitley, Alisha. Eminence Organics Skin Care [Internet]. Eminence Organic Skin Care. 2020. Available from: https://eminenceorganics.com/us