

Formulation & Evaluation of Herbal Anti-Aging Cream

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ABSTRACT: This research work aims to formulate and evaluate an anti-aging face cream, focusing on antioxidant activity, texture, stability and spreadability. Majority of existing cosmetic products including face creams have several side effects such as hypersensitivity, irritation, redness, etc. as they are based on synthetic formulations. In contrast to this, plant based cosmetic products usually do not have such side effects due to naturally derived ingredients. Cosmetic products that have herbal ingredients are more advantageous and safe to use as compared to any other synthetic or chemical based cosmetic cream. The purpose of this research was to prepare and assess the poly-herbal cosmetic cream comprising extracts of natural compounds from soya beans, spinach, peanut, blue pea leaves and blue pea flowers. All the parameters like; spreadability, pH test, inflammation test, antimicrobial studies, anti-aging properties were analyzed. From rigorous analysis and procured results it might be concluded that it's possible to formulate a poly-herbal anti-aging face cream from these plant extracts. These formulations have anti-oxidant properties and can be further used as a foundation to produce cosmetic creams that act as skin barrier against various pollutants, anti-inflammatory formulations and moisturizing properties that can treat skin diseases like eczema, to some extent.

Key words: Skin, anti-aging, treatment, soya beans, peanut, blue pea, spinach, cream, herbal, formulation, evaluation

I. INTRODUCTION:

An adult's human skin is a multi-layer structure that weighs about 8-15 pounds and renews in every 28 days. The pH of skin lies between 4.7-5.75. Human skin hosts more than thousands of normal flora species.[1] Human skin acts as a physical and chemical barrier that serves a variety of functions. It plays protective roles in different environmental conditions. It also contributes in homeostasis, insulation, Vitamin D secretion and act as first line of defence. [2] Both

external and internal factors are responsible for a healthy skin. The skin health primarily depends on the hereditary. Aging and lifestyle habits also have a serious impact on the human skin. Pollutants like particulate matter, nitrogen dioxide, soot, etc. enter the skin layers through pores and lead to degradation of collagen. Excessive exposure to sunlight results in photo-aging that involves formation of abnormal elastin and fastens the breakdown of collagen. Skin damaged by sun loses its flexibility.[3] Such factors contribute to skin deterioration that may lead to pigmentation, wrinkles and even cancer. Therefore, in order to develop an anti-aging strategy, it is important to understand the structure and functioning of skin. [4] Skin disorders like psoriasis, vitiligo, acne, eczema, etc. also affect physical appearance. Most of the skin diseases arise due to dryness, itchiness, scale formation; some may involve thinning of skin layers and lack of collagen protein (aging). [5]

Skin aging is characterized by complex cellular activities that are dependent on genetic and environmental conditions. Skin's reduced elasticity and low collagen production lead to wrinkles (fine lines & sagging) – a natural outcome of aging. Preventive methods include: protection from sun damage, healthy skin care routine, cleaning, moisturizing, adequate amount of water intake, balanced diet, avoiding toxic habits. It is important to understand the mechanism behind aging as well as its effect to formulate anti-aging interventions.[6,7] Impact of aging on skin may include; imbalance in the distribution of natural moisturizing agents, reduced amounts of lipids (mainly ceramides), oxidation of intracellular lipids leading to dryness, reduced collagen synthesis, low hyaluronic acid, disrupted elastin fibres, etc. Reduced activity of fibroblasts highly contributes to skin aging as these are the cells that synthesize collagen fibres. Resistance to stretching and reduced skin resilience with inadequate moisture marks skin-aging. [8]

Some available anti-aging treatment options are - anti-aging creams, laser skin

resurfacing, medicines, fillers, facelift, etc. Any artificial treatment has potential to cause adverse side effects; also some complications may arise so it's better to consult a dermatologist before starting a treatment. Side effects may involve swelling, redness, allergic reactions, acne, pigmentation, pain, etc.[9] There are two product categories that can be used for treating skin aging are often

discussed – cosmetic and skin care. Although both of them are targeted to improve appearance, there is difference between the two. Both have different but complementary roles in a beauty routine. In order to maximize the use of beauty products, it is important to understand the difference between cosmetic and skin care products because they differ in functions and ways of working. [10]

Table 1: Cosmetic and Skin care Products

Cosmetic products	Skin care products
<ul style="list-style-type: none"> • Instantly enhance the appearance • Work on surface of skin • Improve visual appearance • Lipstick, blush, eyeshadow, foundation, etc. 	<ul style="list-style-type: none"> • Long-term effect • Work at cellular level • Repair and protect the skin • Serum, face wash, moisturizer, cleanser, lotion, etc.

A simple cosmetic or skin care formulation is an emulsion containing aqueous phase, an oil phase and an emulsifying agent. The two categories of emulsions on the basis of quantity of two phases are: oil-in-water (O/W) and water-in-oil (W/O). O/W emulsions have oil drops immersed in aqueous phase while W/O emulsions are formed of water drops immersed in oil phase. O/W emulsions are the most commonly used as they are suitable to create creams and body lotions for all types of skin. On the other hand, W/O emulsions are formed to target dryness related skin issues. Also O/W emulsions are readily absorbed as compared to W/O type.[11] Creams are semi-solid in texture and used as topical applications. They can be either O/W or W/O. As mentioned above, O/W emulsions are lighter to absorb. Creams are used as topical application to treat various skin disorders, dryness, inflammation, beautifying, etc. Lotions are generally less viscous than creams. It is due to high amount of aqueous phase. They are easily absorbed. These are lighter version of moisturizing creams. [12]

Skin care products contain emulsifiers (e.g. polysorbates), perfumes and preservatives (like parabens) for stability and consumer appeal. But these chemical compounds are toxic in nature. Paraben - a preservative agent has potential to cause hormonal imbalance, redness, irritation, etc. Phthalate another compound is found to be linked with developmental and reproductive issues in

humans. Such toxic substances present in personal care product have reportedly been found to cause serious skin issues including cancer. Apart from affecting human health, these are also polluting the environment. The unorganized cosmetic disposal is raising environmental concerns regarding pollution and harmful effects on nature. Aquatic ecosystem is being reportedly affected by nanoparticles, squalene, triclosan, and other toxic compounds. The chemical compounds being used in the sunscreen may accumulate in the aquatic organisms and affect their ability to absorb adequate sunlight in order to survive. The bioaccumulation of such toxic compounds in the environment will result in long-term problems, even in the distant regions. To determine the real extent to which the disposal from cosmetic industries is contaminating the ecosystem, further studies are needed. [13,14]

Plants contain a variety of bioactive chemical compounds called phyto-chemicals that can be obtained through different processes and incorporated in the manufacturing steps of different products to make them risk-free for humans as well as for environment, paving a path for sustainable development. [15] The use of plants by ancient civilization has paved the way to produce more innovative and effective products that are non-toxic. Existing as well as newly discovered plants are being used in natural products. In order to minimize the incorporation of chemistry in the formulation of cosmetic products, plant based

ingredients are being rediscovered. [16] Here is a list of some phytochemicals along with their

properties.

Table 2: Phytochemicals and their properties

S.No.	Phytochemicals	Plant parts	Properties
1.	Saponins	Leaves, roots and stem	Anticancer, anti-inflammatory, anti-viral, anti-microbial
2.	Flavonoids (polyphenol)	Leaves and fruits	Anti-oxidant, anti-tumor, anti-bacterial
3.	Tannins	Bark, roots and leaves	Anti-carcinogenic, anti-inflammatory, antimicrobial
4.	Terpenoids	Flowers, fruits, leaves and stem	Anti-cancer, anti-inflammatory, antioxidant
5.	Alkaloids	Leaves, roots and stem	Analgesic, anti-microbial anti-inflammatory, antimicrobial

The demand of natural products has been raised, driven by concerns over damage caused by chemical based cosmetics. Herbal cosmetics offer additional benefits of antioxidant and antimicrobial properties along with fulfilling consumer preferences for natural skincare alternatives.[17] Here are some plant resources that can be used as potent ingredient to formulate an effective and eco-friendly skin care products-

A. Spinach (*Spinacia oleracea*): It belongs to Chenopodiaceae family. Spinach is popular for its skin conditioning properties that have been discovered recently. It is rich in minerals, antioxidants and vitamins (A, C, E and K). It contains iron, calcium and folate. These components are responsible for its nourishing and rejuvenating effects on the skin. It can be a potent ingredient for a skin care product that may help in skin softening,hydrating, even complexion and texture improvement. Generally, it is used as a safe topical application in cosmetics but there can be some side effects too that must be considered before using it. [18]

B. Peanut (*Arachis hypogaea*): It is also known as groundnut and belongs to legumes family. Peanut is used as a good source of protein in diet. It also contains vitamin E and healthy fats that are beneficial for skin. Peanut oil is a potent ingredient in cosmetic industries. It readily absorbs in the skin layers leaving them hydrated. Also the skin of peanuts has antioxidant properties that make it more valuable in beauty industry. It is rich in niacin (vitamin B) too. Effects of peanut oil on the skin could be hydration, anti-inflammation,

elasticity enhancement and antioxidant properties. As it is known that nuts are allergic too, peanuts can also show some side effects. [19]

C. Soya beans (*Glycine soja*): It is a leguminous plant that contains bioactive components like phenolic acids, flavonoids, isoflavonoids and tannins. Soja oil is rich in fatty acids like oleic acid, palmitic acid, linoleic acid, stearic acid, etc. It is a cost-effective ingredient offering notable results/outcomes. It can be used for collagen stimulation, skin barrier, anti-inflammatory, photoprotective, soothing and soothing agent. Although, soya bean extract is non-toxic, its effect may vary from skin type to skin type. [20]

D. Blue pea(*Clitoria ternatea*): It is a vibrant blue flower plant. It is getting popular in skin care industries due to its exceptional anti-aging properties. It is rich in antioxidant, flavonoids, peptides, etc. It is also used in a variety of cocktails and teas. It has numerous skin care benefits like prevents premature aging, skin brightening, hydration, moisture retention, etc. [21]

II. MATERIALS AND METHODOLOGY:

Requirements: Soya beans, peanuts, spinach, blue pea flowers and leaves, autoclaved water, nutrient agar, agar agar, carboxy-methyl cellulose (CMC), chloroform, ethanol, span- tween (1:1),vitamin E capsules, glycerin, preservative, sodium chloride,30% hydrogen peroxide (H₂O₂), vitamin C source (lemon), potassium dihydrogen phosphate (KH₂PO₄), Sodium hydroxide (NaOH), beakers,

flasks, test tubes, petri plates, spatula, micro-pipette, mortar and pestle, measuring cylinders, filter paper, funnel, strainer, eppendorfs, pH paper, stop watch, glass slides, scale, marker, weighing balance, autoclave, water bath, magnetic stirrer, centrifuge, Hot air oven, Laminar air flow, incubator, cytometer, refrigerator, and spectrophotometer.

Sample collection: The samples were collected from different sources. The soya beans and peanuts were bought from a grocery shop. Blue pea flowers and leaves were plucked from home grown plants. Spinach was purchased from nearby vendor.

Preparation: Plants extracts were prepared by using maceration method. [22] Oil was separated from roasted peanut kernel paste by using hydrophobic (chloroform) and hydrophilic (water) solvents followed by purification through centrifugation. [23] The solid part remained after preparing soya extract was dried and grinded in

order to obtain ceramide and lecithin powder. [24, 25]

Formulation: The two phases – oil phase and aqueous phase were prepared. In aqueous phase autoclaved water and plant extracts were mixed by using a magnetic stirrer. Oil phase was prepared using peanut oil, agar agar or carboxymethyl cellulose (CMC), spinach ethanol extract, soya peptides, lecithin, and ceramide powder. Usually oil phase is prepared by stirring at temperature 50 – 60°C in order to facilitate proper mixing of small solid ingredients. Since the two phases are immiscible, an emulsifying agent (span-tween) was used to mix prepared aqueous phase and oil phase. Also lecithin was used as a natural stabilizer that prevents separation of the two phases after emulsification. [26] Different batches were prepared by mixing different ingredients in varying proportions as shown in the table 3.

Table 3: Formulations

S. No.	Ingredients	Batch 1 (B1)	Batch 2 (B2)	Batch 3 (B3)	Batch 3A (B3A)	Batch 3B (B3B)	Batch 4 (B4)	Batch 5 (B5)
1.	Autoclaved water (ml)	2.00	2.00	2.00	1.00	1.00	2.00	5.00
2.	Soya water extract (ml)	5.00	5.00	12.00	6.00	6.00	6.00	15.00
3.	Spinach water extract (ml)	1.00	1.00	-	-	-	1.00	2.50
4.	Peanut water extract (ml)	-	1.00	-	-	-	1.00	2.50
5.	Blue pea flowers water extract (ml)	1.00	-	1.00	0.50	0.50	1.00	2.50
6.	Blue pea leaves extract (ml)	1.00	-	-	-	-	-	-
7.	Peanut oil (ml)	1.50	2.00	2.00	1.00	1.00	2.00	5.00
8.	Spinach ethanol extract (ml)	0.02	1.00	2.00	0.50	0.50	2.00	3.00
9.	Soya peptides (ml)	-	1.00	-	-	-	1.00	2.50
10.	Vitamin E (capsules)	-	1	-	-	-	-	2
11.	Glycerine	-	-	-	-	-	1.00	2.50

	(ml)							
12.	Agar agar(gm)	0.02	0.20	0.20	-	0.15	0.30	1.00
13.	CMC (gm)	-	-	-	0.15	-	-	-
14.	Ceramide and lecithin powder (gm)	0.10	0.20	0.40	0.20	0.20	0.40	1.00
15.	Span- tween (ml)	-	1.00	1.00	1.00	1.00	2.00	5.00
16.	Preservative (gm)	0.02	0.02	0.02	0.10	0.10	0.02	0.05

Evaluation: All the prepared batches were evaluated against different parameters like physical appearance, pH, stability, spreadability, washability, irritancy[27], CFU count [28], anti-oxidant tests as represented in the table.

Spreadability: Spreadability was calculated after recording the time in which the slides get separated and the length covered by the sample was measured using a cm scale. The spreadability is calculated by the formula:

$$S = \frac{w \times l}{t}$$

Where, S = spreadability, W = weight kept over the slides, l = length covered by the sample after slide removal and t = time taken in the slide separation.[27]

Antioxidant test: The antioxidant test was performed by analyzing hydrogen peroxide scavenging activity. Standard solution was prepared at different concentrations as depicted in the table 5 and absorbance at 230nm was recorded

by using a spectrophotometer. Test tube marked as 0 was used as blank. A graph was plotted for the different values of absorbance against varying concentrations of lime solution and an equation was obtained. A solution containing 1ml phosphate buffer and 5ml H₂O₂ was used as control. Sample solutions were prepared by diluting all five formulations (10ul each) in 990ml of phosphate buffer in separate test tubes and 5ml 40mM H₂O₂ was added. All the samples solutions were further diluted by mixing 500ul of those solutions into 2ml phosphate buffer in separate test tubes. After an incubation period of 10mins the absorbance of all sample solutions was recorded. [29]

Stability test: The finalized batches were analyzed for their stability. The prepared batches were maintained under an ambient condition for a month and different tests were performed in every 15 days. The batches were tested for CFU count, pH, spreadability, colour, odor, antioxidant property and washability. [30]

III. RESULTS:

Primarily five batches were prepared – B1, B2, B3, B4 and B5.

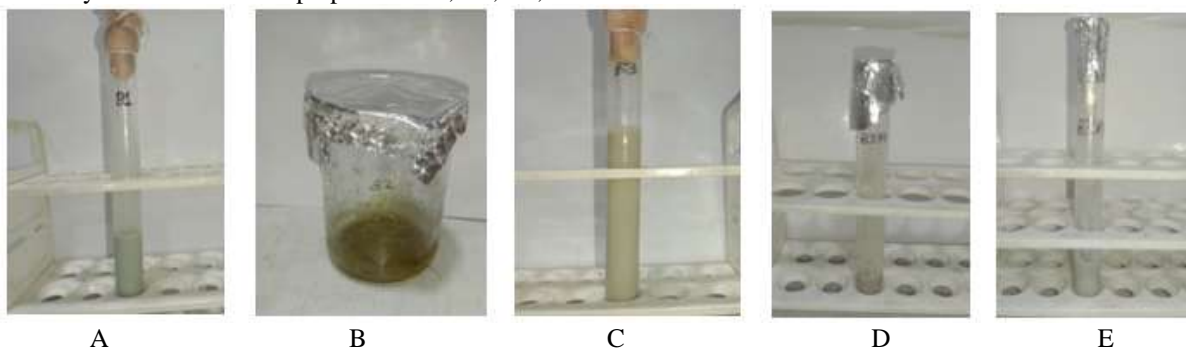


Fig.1(A-E): Prepared Batches

All the batches were evaluated against different parameters as depicted in the table 4.

Table 4: Evaluation

S. No.	Parameters	B1	B2	B3	B3(A)	B3(B)	B4	B5
1.	State	Liquid	Semi-solid	Liquid	Gel	Semi-solid	Liquid	Liquid
2.	Color	Greenish blue	Dark green	Light green	Light green	Light green	Dark green	Dark green
3.	Odor	Peanut like	No smell	Peanut like	No smell	No smell	Spinach like	Spinach like
4.	Texture	Smooth	Smooth	Smooth	Smooth	Smooth	-	-
5.	Homogeneity	Completely homogenize	Partially homogenize	Completely homogenize	Completely homogenize	Completely homogenize	Not homogenized	Not homogenized
6.	Spreadability (gcm/sec)	18.09	16.26	27.86	17.83	15.57	-	-
7.	Washability	Easily washable	Easily washable	Easily washable	Easily washable	Easily washable	Easily washable	Easily washable
8.	Irritancy	No irritancy observed	No irritancy observed	No irritancy observed	No irritancy observed	No irritancy observed	No irritancy observed	No irritancy observed
9.	pH	5.5	6.0	6.5	7.0	6.0	6.2	6.8
10.	CFU (10^1)	1080	-	-	135	145	54	60
11.	CFU (10^2)	630	805	110	15	20	32	30

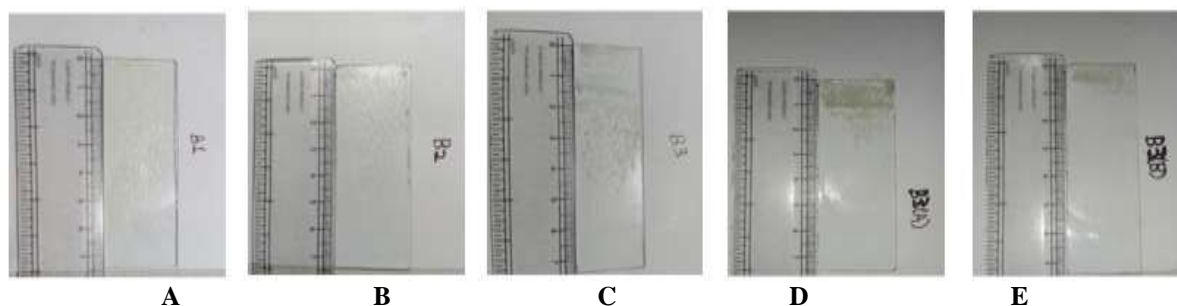


Fig.2 (A-E): Spreadability test

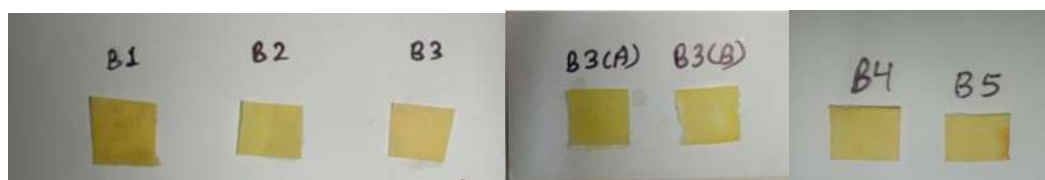


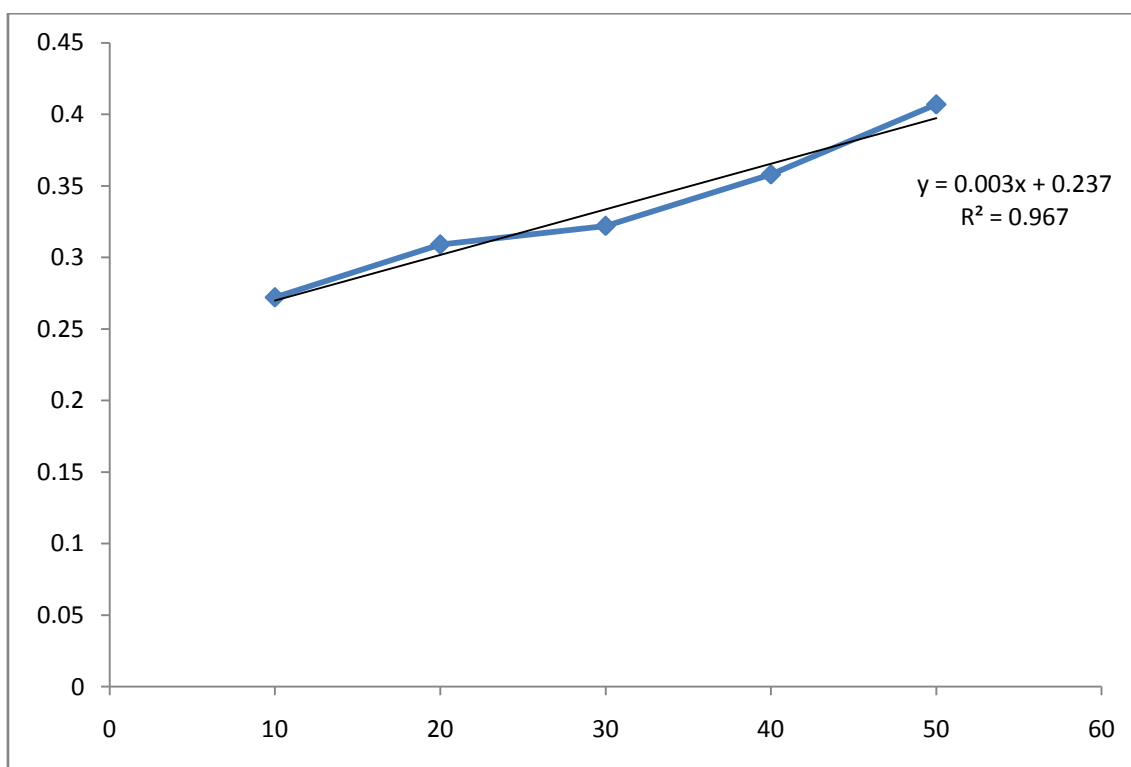
Fig.3: pH test

Among the five batches B2, B4 and B5 did not homogenized properly that's why these were not consider for improvement. According to Sasidharan, et al., the acceptable range of pH of a dermo-cosmetic product should lie between pH 4

and pH 6. B1 and B2 showed the acceptable range of pH[31]. Among B1 and B3, the maximum spreadability was observed in B3. The CFU count, which represents the microbial growth, of the B3 formulation was lesser than other batches.

Table 5: Varying concentration of standard solution preparation

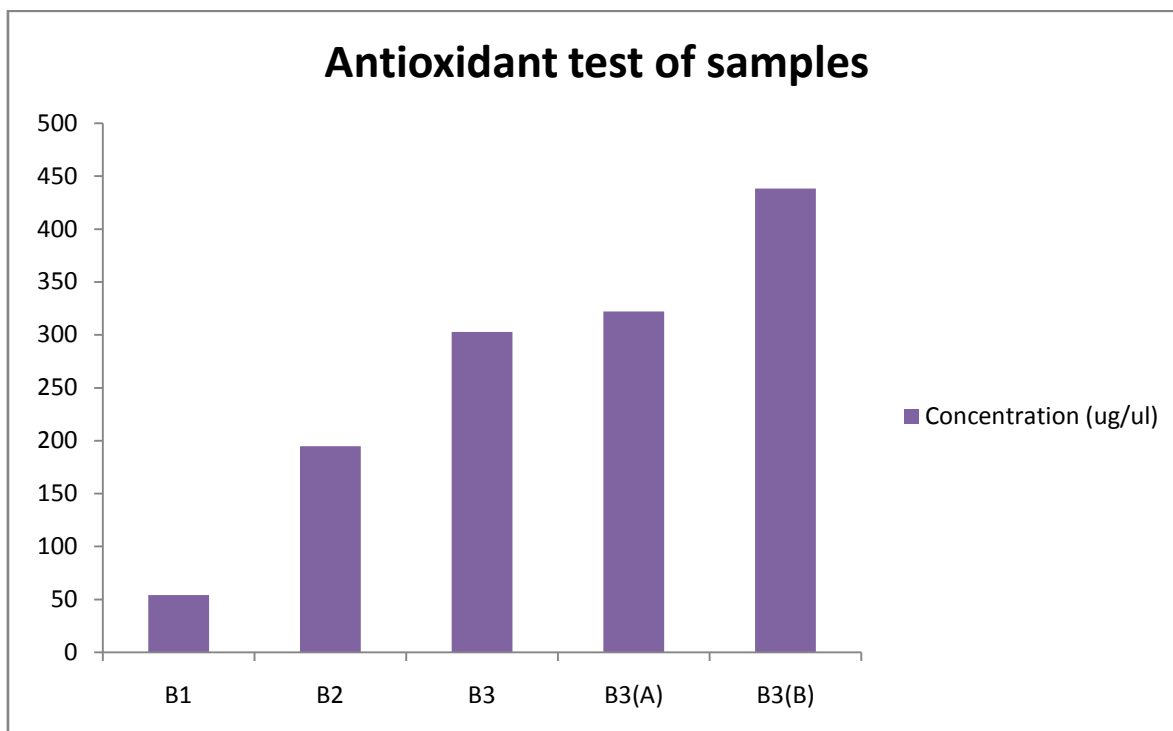
S. No.	Phosphate buffer (ul)	Standard Solution (ul)	Lime	40mM H ₂ O ₂ (ml)	Mix well and incubate for 10mins.	Absorbance at 230nm
0	1000	0		5		0.00
1	990	10		5		0.272
2	980	20		5		0.309
3	970	30		5		0.322
4	960	40		5		0.358
5	950	50		5		0.407



Graph 1: Standard graph for antioxidant test

By using the equation obtained from the standard graph of antioxidant test, the concentration of the samples were calculated against the recorded absorbance values. The antioxidant test of the

prepared batches gave the following (graph 2) results that represents their ability to scavenge the H₂O₂ in terms of concentration.



Graph 2: Antioxidant test of samples

The antioxidant activity of B3 was also highest among all. Thus, B3 was found to be the most appropriate among all five batches. Still B3 batch was needed to be improved in terms of consistency and pH, for which two variants of B3 were prepared with two different gelling agent i.e. CMC (B3A) and agar agar (B3B), and were further evaluated. It was found that B3A was better than B3B in case of spreadability and CFU but its pH

was not appropriate and consistency was not that appealing. These two batches were further studied for stability as given below in the table 5.

Stability study: It was observed that pH of B3A decreased as the time passes while that of B3B increased. Due to added preservative the CFU count was in control. Spreadability of both the batches increased but the antioxidant activity decreased.

Table 5: Stability studies

Batches Tests	B3A			B3B		
	Day 1	Day 15	Day 30	Day 1	Day 15	Day 30
pH	7	6.5	6.8	6.0	6.2	6.8
CFU (10 ⁻¹)	135	55	43	145	48	52
CFU (10 ⁻²)	15	25	38	20	24	30
Spreadability	17.83	30.03	26.44	15.57	26.54	26.54
Antioxidant activity	1.203	1.872	0.386	1.55	2.37	0.448

IV. CONCLUSION AND FUTURE PERSPECTIVE:

The aim of the study was to formulate and evaluate the herbal anti-aging cream with soya beans, peanuts, spinach and blue pea. The extracts of the ingredients were prepared successfully. At first, five batches were prepared among which last two batches were failed as they did not homogenize. The evaluation tests results of five batches have shown that Batch 3 is best among all three, though the consistency of B3 was needed to be improved. Both B3A and B3B were found to be improvised forms of B3 formulation. But it was found that B3B was the best among all the prepared batches. Still there is a scope of improvement in consistency of B3B and the stability is also needed to be evaluated more strictly to consider it as final product. After improvement further analysis is needed to check the stability and effectiveness of the final product.

The safety profile of the cream has been evaluated by conducting patch tests. Stability studies have also been performed at lab level to confirm that the prepared formulation remains effective and safe for use over time under varying storage conditions. The results of these testing have shown that the prepared batches are not that stable for storage; therefore more strict analysis and evaluation is required to enhance the stability of the prepared product.

The efficacy and safety of the formulated anti-aging cream need to be evaluated through both in vitro and clinical trials. In vitro testing, such as collagen synthesis assays, and irritation tests, should be conducted to determine the biological activity of the cream's components. Clinical trials, including dermatological patch testing, must be assessed to test the effectiveness of cream on human skin, particularly in terms of wrinkle reduction, skin hydration, and overall skin texture improvement.

The formulation of herbal anti-aging cream by combining soya beans, blue pea, peanut oil and spinach holds promising potential for addressing the multi-factorial nature of skin aging. By leveraging the natural properties of these ingredients, the cream offers a viable alternative to conventional anti-aging products, with the added benefit of being safer and more sustainable. The synergistic effects of these herbal ingredients, with their antioxidant, anti-inflammatory, and collagen-stimulating properties, may provide an effective solution for improving skin health and appearance,

reducing the visible signs of aging, and promoting a youthful, radiant complexion.

The future of anti-aging skincare lies in the continued exploration of natural, bioactive compounds, and this study contributes to that body of knowledge, emphasizing the role of plant-based ingredients in achieving healthier and more youthful skin

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