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Efficacy of Bee Pollen, Aloe Vera, and Commercial Ointment in Reducing Freckles: A Comparative Study

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Abstract

The freckles are hyper-pigmented patches of the skin lesions, and they are a typical cosmetic issue related to beauty and self-esteem of an individual. Some of the known products for use that treat freckle can be purchased in the market but because they are chemical in nature, they have some negative effects to the skin. Bee pollen and Aloe Vera have been utilized as moderate antioxidants since the span of centuries. In this study, the hypothesis is that bee pollen and Aloe vera are ameliorative and they can assist in being rid of these skin lesions. In order to put this hypothesis to test, this study was established to design and formulate Aloe Vera gel and bee pollen to find out the ameliorative effect of these on freckles. Bee pollen samples were taken out of the University of Sindh apiary and aloe Vera was taken out of a local garden. The Vaseline base (paraffin), 2 percent Aloe vera gel, 1 percent pollen grain tincture, and vitamin E (as the preservative) were used to make an ointment of bee pollen and Aloe Vera. In total four varying formulations A1, A2, A3 and A4 were prepared by varying concentration of pollen grains, aloe vera gel and Vaseline base. Patients (30 female) were selected

and randomly assigned into 2 groups; in Group A, ointment prepared was used, in Group B commercial ointment was used of formula magnesium ascorbyl phosphate 5%. Each group had five percent of the patients as the controls and were only applied with a cream base. Herbal ointments have physical descriptions like color, smell, smoothness and grit that was noted down. It was found that herbal ointment was in compliance to the parameter of acceptable ointment. A4 formulation still gave significantly ($p<0.05$) higher results as compared to the standard drug and there is a significant reduction in dark spots as compared to the standard drug. In addition, the formulations did not exhibit allergic reaction, itching or redness of the skin of the patients. These results indicate the possibility of utilizing bee pollen and Aloe Vera as an effective and secure way of freckle treatment.

Introduction

The skin is the body's largest and primary protective organ, covering its entire external surface and serving as a first-order physical barrier against the environment. Its functions include temperature regulation and protection against ultraviolet (UV) light, trauma, pathogens, microorganisms, and toxins. The skin also plays a role in immunologic surveillance, sensory perception, control of insensible fluid loss, and homeostasis in general. The skin is also highly adaptive with different thicknesses and specialized functions in different body sites. This article will discuss the anatomy of the skin, including its structure, function, embryology, blood, lymphatic, and nerve supply, surgical, and clinical significance (Maranduca et al., 2019).

Embryologically, the epidermis originates from the surface ectoderm. It is infiltrated with pigment-producing cells known as melanocytes, which originate from the neural crest (Vandamme & Berx, 2019). Other cell types normally present in the epidermis include keratinocytes, antigen processing Langerhans cells, and Merkel cells (tactile receptors that sense pressure changes at the bottom of the epidermis). The dermis is embryologically derived from the mesoderm and contains connective tissue macromolecular components and cells, including elastic fibers, collagen, nerves, blood vessels, adipocytes, and fibroblasts (Someya & Amagai, 2019).

Skin conditions are common all around the and makeup approximately 34% of occupational illnesses. All age groups are impacted, from young children to elderly adults. Skin illnesses have very low death rates, but they have a substantial impact on quality of life, are frequently persistent, and are challenging to cure. It has been discovered that traditional medicinal plant resources are essential for treating skin conditions. In many nations around the world, where they greatly contribute to the primary healthcare of the populace, they have been used by individuals of different ethnic backgrounds to cure skin conditions. The largest organ in the human body is the skin, which covers the exterior of the body. It serves as the initial line of defense as well (Balaha & Hassan, 2023).

Numerous specialized cells and structures can be found in the skin. The epidermis, dermis, and hypodermis are its three primary layers. Every layer contributes differently to the skin's overall functionality. The thickness of the epidermis, the skin's outermost layer, varies depending on the body part. It is thickest on the palms and soles (1.5 mm) and thinnest on the eyelids (0.05 mm) (Yousef, Alhajj, & Sharma, 2017). The location of the skin affects the thickness of the dermis as well. The measurements are 3.0 mm on the back of the torso and 0.3 mm on the eyelid. The subcutaneous connective tissue, or hypodermis, is connected to the dermis. Larger blood arteries and nerves are housed in the subcutaneous tissue, which is a layer of fat and connective tissue. This layer is crucial for controlling the body's and the skin's internal temperature. This layer is different in size in different parts of

the body and different people. The primary skin appendages are sebaceous glands, sweat glands, and hair follicles (Lopez-Ojeda, Pandey, Alhajj, & Oakley, 2022).

Herbal medicines can reduce the adverse effects of allopathic treatment for skin problems. The expense of treatment, skin reaction, injection site pain, diarrhea, skin irritation, and allergy are among the side effects of allopathic medications. Immunosuppressant can weaken the immune system, induce skin malignancies, and cause an appetite loss (Ahuja, Gupta, & Gupta, 2021).

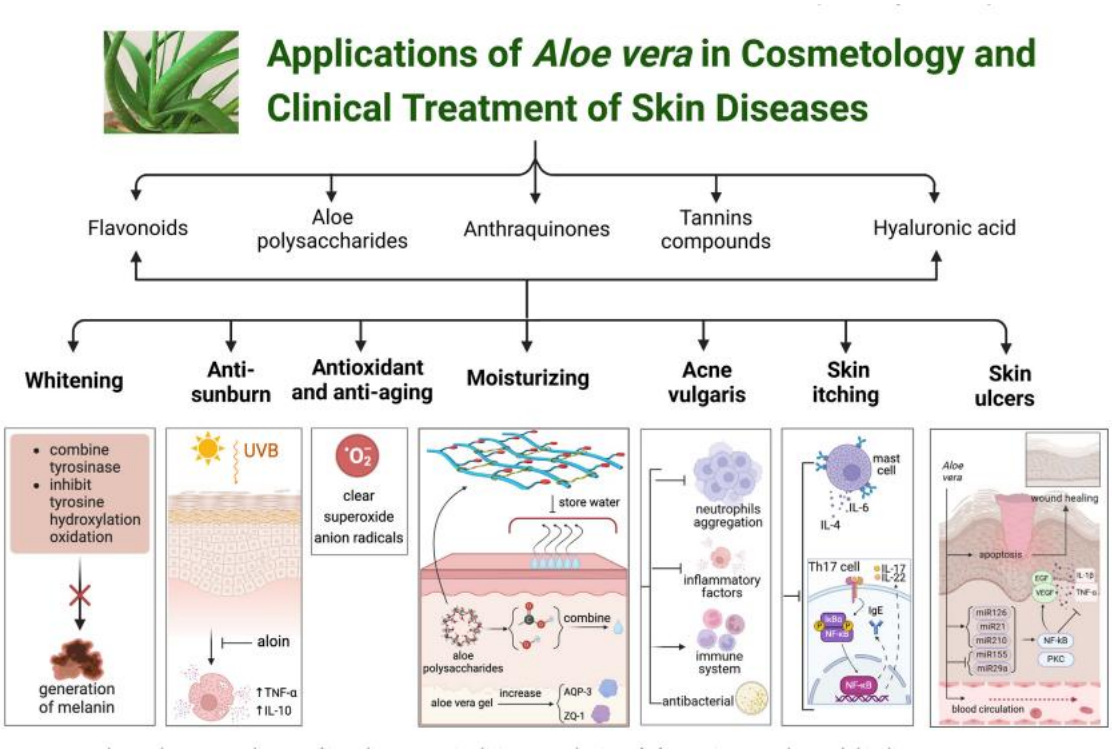
Natural remedies are used and produced in the herbal industries to screen newer medicines that promote human health because they are effective against a variety of infectious disorders, including fungal infections, skin infections, cancers, respiratory tract infections, and cardiovascular diseases.

Aloe vera Aloe vera (A. vera) is a native of India and a member of the Liliaceae family. One of the richest and oldest herbs in the world, aloe vera is utilized in traditional medical systems all over the world as a powerful skin healer for wounds, cuts, sunburns, bug bites, infections, and swelling. In addition to functioning as a herbal gel, it is a skin purifier and detoxifier that delays the ageing process, minimizes wrinkles, and restores damaged skin cells. Vera gel has significant herbal potential for treating eczema in cases of dry skin. This herbal treatment possesses laxative, chemo protective, ulcer-preventive, antioxidant, and cardio protective properties. It is a powerful skin protector that can be combined with sap to apply moisturizer, sunscreen lotion, and herbal shampoos to the skin to prevent dandruff and scabies (Rajeswari et al., 2012). Herbal extract works wonders as an emollient, repairing minor cuts and wounds, sunburns, and skin disorders with strong antibacterial, antiseptic, and anti-cancerous properties. The key function of the herbal extract is to reduce wrinkles, cure acne, lessen pimples, and promote a glowing complexion. This makes it an excellent source for extensive research into the many aspects of herbal formulations of A. vera for a range of health issues by extending life expectancy. According to a different characterization, the effective use of A. vera for burn and wound healing speeds up the rate at which the skin's surface heals because of cell multiplication (Kulawik-Pióro & Goździcka, 2022).

Figure. 1: Aloe Vera



Figure. 2. The summary diagram of ingredients-cosmetic/clinic uses-mechanism of Aloe vera in cosmetology and skin diseases treatment.



Review of Literature

According to Zhu Zheng et al.,2024, The medicinal value of Aloe Vera (AV) has been continuously explored and utilized in recent years, becoming a research hotspot. Some basic studies have found that AV had cosmetic effects such as whitening, sun protection, antioxidant, anti-aging, and moisturizing. Some clinical trials have found that AV had medical effects such as antibacterial, anti-damage, and promoting wound healing. In this work, we summarized the indications and therapeutic efficacy of AV in cosmetology and clinical treatment of dermatosis, in order to provide certain inspiration for the development of new AV-based skincare products and new medicines for skin diseases (Zhu, Zheng, & Ge, 2024).

According to Rahmani et al., 2015. Aloe Vera contains several biologically active constituents, including vitamins, minerals, saccharides, amino acids, Anthraquinones, enzymes, lignins, saponins, and salicylic acids. In addition, Aloe vera contains products of the isoprenoid pathway, such as carotenoids, steroids, terpenes, and phytosterols, and some essential amino acids/nonessential amino acids and enzymes, such as bradykinase, carboxypeptidase, cyclooxygenase, and carboxypeptidase (Rahmani, Aldebasi, Srikar, Khan, & Aly, 2015).

Bee pollen is composed of copious amounts of pollen grains, which were foraged by workers using the weak electrostatic field generated between the negatively charged flower and the positively charged body, mixed with a small dose of the secretions from salivary glands or nectar, and placed in specific baskets situated on the tibia of their hind legs. There are many biological substances, including carbohydrates, proteins, vitamins, minerals, polyphenols, dietary fiber, volatile compounds, and lipids, in bee pollen. The moisture content ranges from 1.82 to 7.33% in commercial bee pollen and 20 to 30% in the original bee pollen. Bee pollen contains approximately 40–85% carbohydrates, including 15.2–22.4% fructose, 7.0–21.9% glucose, 14–19.8% sucrose, and others (W/W, dry weight, DW). There are approximately 13.6–26.8% (W/W, DW) protein with a total of 20 amino acids, 1–10% total lipids, 0.0019–0.0344% vitamin B, 0.0015% vitamin A, 0.0062% vitamin E (α-tocopherol), and trace amounts of vitamin C in bee pollen. It contains rich micronutrients such as potassium (K), sodium (Na), calcium (Ca), magnesium (Mg),

phosphorus (P), zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn). There is also a very diverse group of yellow-to-red-color polyenes, polyphenols, dietary fiber, and volatile compounds, among which polyphenols include 19 phenolic acids, 25 flavonoids, and seven glycosylated flavonoids (He, Wang, Li, & Yang, 2024).

Freckles are a common hyperpigmentation disorder primarily caused by excessive melanin production due to sun exposure and genetic predisposition. While various commercial creams and dermatological treatments are available for freckle reduction, they often contain harsh chemicals like hydroquinone, which may lead to adverse effects such as skin irritation, dryness, and long-term sensitivity. With increasing demand for safer, natural, and cost-effective cosmetic alternatives, there is a need to scientifically evaluate the potential of herbal and bioactive compounds such as bee pollen and aloe vera in managing skin pigmentation. Despite their historical use in skincare, limited comparative clinical data exist assessing the efficacy of bee pollen and aloe vera against standard commercial treatments for freckles. This lack of evidence hinders the integration of natural remedies into mainstream cosmetic dermatology. Therefore, this study aims to address this gap by systematically comparing the depigmenting effects, patient satisfaction, and safety profiles of bee pollen, aloe vera, and a commercially available ointment in the treatment of freckles.

Significance of Study

The increasing prevalence of freckles and other pigmentary disorders has led to a growing demand for safe, effective, and cosmetically acceptable treatments. While commercially available depigmenting agents are widely used, concerns over their long-term safety and tolerability have prompted interest in natural alternatives. Bee pollen and aloe vera, both rich in bioactive compounds, have shown promising antioxidant and anti-melanogenic properties in preclinical studies, yet their comparative efficacy in clinical settings remains underexplored. This study contributes to the limited clinical evidence by systematically evaluating and comparing the cosmetic effectiveness and safety profiles of bee pollen, aloe vera, and a commercial ointment in the treatment of freckles. The findings aim to support the integration of natural ingredients into dermatological formulations and offer a foundation for further research into plant- and bee-derived compounds in cosmetic dermatology.

Materials & Methods

Study Design

The current research work was a controlled research, which aimed at comparing the effectiveness of two complementary therapies bee pollen and Aloe Vera with a commercialized ointment in the elimination of freckles. These substances were evaluated in the study considering the effects they would have on freckle loss, increase in skin tone and also on general safety.

Selection of Participants

The recruitment of participants was done according to preset criteria under inclusion and exclusion of participants. The inclusion criteria included any person who was aged between 20 and 40 years, freckles on the hands, face, and neck, and had at least 6-12 dark spots on the skin. Medications that cause allergies in pharmaceuticals, recent use of anti-pigmentation drugs, fewer than five regions of pigmentation, and the appearance of dark spots as a result of injuries or existing medical conditions were some of the exclusion factors.

Preparation of Formulations

Preparation of Aloe vera and Pollen

To ensure that the natural treatment utilized in this researched was pure and would be effective we had effective measures undertaken when collecting bee pollen & Aloe barbadensis miller and processing it. The honey bee pollen, which is an essential constituent of the apiary at University of Sindh, was thoroughly carried out in a quest to maximize its medicinal property. In order to preserve the bioactive constituent of the pollen it was collected with extreme care and then shade dried. When it was dry, it was processed with a fineness to form a powder and this ensured consistency and particle size of the size of the powder. Honeybee pollen powder was extracted using 100 millilitres of 95 percent ethanol to dissolve 200 milligrams of powder. This was done because this is the solvent that has the capacity to effectively extract a wide range of phytochemicals present in bee pollen. Subsequently, the mixture was gently heated at 60 ^{o} C. Over four hours in order to maximize the bioactive components extraction. This product was then sieved to remove any remaining solids which resulted in a very concentrated ethanol tincture which was highly enriched with healthy ingredients consisting of bee pollen. In this study, a home herb garden was used to select the Aloe barbadensis miller carefully. Once the leaves had been collected in the right quantities, the tough scales on the leaf peel were then carefully picked off using a cutter to produce the gel. The gel, which has a reputation for being calming and moisturizing, was processed further to increase its effectiveness. The pure gel was produced using a homogenizer which specially homogenized the aloe plant leaves at the speed of 30 rpm. Maximization of biologically active substances extraction was ensured by this procedure, as it yielded full mix and destabilization of the gel matrix. The gel was then resin sediment was filtered out by carefully and systematically squeezing and filtering the homogenized gel in order to eliminate any remaining traces of contaminants in order to obtain a pure Aloe barbadensis miller gel ready to be formulated. The selection and preparation procedure of the bee pollen and Aloe barbadensis miller applied in this research transformed the constituents into powerful, standardized constituents which is the foundation of the development of effective natural therapies in freckle therapy.

Preparation of Ointment

Vaseline Base (Paraffin) had to be heated to 70°C to give the best consistency and it was incorporated in the manufacture of the ointment. The melted Vaseline was then combined with an equal amount of Aloe barbadensis miller gel and bee pollen grain tincture and a few drops of vitamin-e, which is the preservative (1 capsule per 49 mL gel). This was stirred thoroughly to ensure that there was even distribution of ingredients and was homogenized for ten minutes. It was then left to settle at room temperature (25 ^{o} C) and stored in the fridge ready to use later on at 4 ^{o} C. There were altogether four unique formulations consist of varying quantities of Aloe barbadensis miller gel, pollen grains. The level of pollen powder and aloe vera was varied to get different levels of the cream base (Vaseline). This allowed coming up with different formulations which were specially tailored to evaluate the impact of various concentrations of the constituents on the efficacy of freckle treatment.

Table 4.1. Composition of serval formulation prepared

S.No	Ingredient (%w/w)	A1	A2	A3	A4
1	Aloe barbadensis miller gel	1%	1.6%	2%	2.5%
2	Pollen	0.2%	0.8%	0.6%	1%
3	Ointment base	Qs	Qs	Qs	Qs

Physicochemical Characterization
The formulations readied were intensively characterized, where the color, odor, consistency, determination of pH, measurement of viscosity, and rheology were assessed. The stability was also determined by conducting stability studies to determine shelf-life and performances under various storage conditions.

Skin Irritation Testing
Normal volunteer skin was used to conduct skin irritation test to determine the safety of the formulations. On application of the formulations, any itching or redness in the area was noted in the participants and all the formulations showed a zero negative effect.

Selection of Optimized Formulation:
Referring to the outcomes of the physicochemical characterization and skin irritation test, Formulation A4 was chosen as an optimized final formulation to be given in the subsequent clinical trials because of its best physico-chemical profile and safe profile.

Clinical Trial Protocol
We recruited fifty participants who met our participation criteria to take part in our research trial. we split them up pretty arbitrarily into two groups: Group-II subjected 20 days of a usual commercial medication to their face, whereas Group-I or Formulation A4 was rubbed on the skin of the subject. The control group was the patients given plain Vaseline base. We recorded how many dark spots were on their skin each time before the three-week treatment and after the treatment. Also, we took clinical photos to be able to determine the effectiveness of the therapy visually.

Data Analysis
We statistically analyzed the data to evaluate the effect of these various treatments in the reduction of occurrence of black spots. The results obtained as quantitative data, underwent analysis by using the appropriate statistics and any p-value observed below 0.05 was considered to be statistically significant.

Ethical Considerations
The research plan was commissioned with the Research Ethical committee, University of Sindh, through the notification No. (US/Ethical Committee/1355) and consent permission of every participant was obtained before being involved. Only during the whole trial, all information regarding participants was confidential and privatized.

Results
Characteristics of Ointment
The ointments that were produced were characterized to the extreme in order to assess the stability of the ointments and identify which kind of formulation would perform accordingly in further testing. To ensure that the outcome and quality of the final product was of value, several criteria were evaluated.
The first one was the appearance of the ointments like the colour, smell and the consistency. Visual examination was also conducted to assess any change of the colors or appearance that would indicate instability or degradation of the formulation. In order to determine whether the ointments are acceptable to the consumers, sense testing was also put into consideration to determine the texture of the ointment as well as, smell.

The physicochemical tests such as compatibility and ointments stability were also carried out. These included rheological analysis to determine flow properties under different conditions, viscosity tests to determine consistency along with spreadability and such ph measurements to understand whether it was acidic or alkaline. These measurements give significant evidence of how the formulation's stability and use when applied topically reflects on its performance.

Stability tests also were conducted to determine the efficacy and shelf life performance of the ointments with different storage conditions. Degeneration of the formulation with time was tested by accelerated stability testing in order to determine the robustness of the formulation.

In order to ensure the safety and cleanliness in accordance with the law, the ointments were not only subjected to microbiological examination, but also to chemical and physical characterization.

The assessment of the quality of products regularly is an important aspect of microbiological examination because the microbial contamination can compromise the safety and efficacy of topical formulations of a product.

By critically evaluating the criteria, the objective of the characterization methodology was to identify the optimal performing formulation in the most efficient manner to be tried in further clinical attempts. A suitable formulation is always important to advance studies of freckle therapy and ultimately successful distribution of safe and efficient skincare products to patients. Analysis was done in terms of the analysis.

pH

Using a digital pH meter, pH of each of the formulations was measured carefully to give accurate and reliable results. The pH of each formulation (1 g) was measured after 3 h interval over a period of 3 h after being dispersed in 100 mL of purified water. This process allowed determining the pH stability of formulas and the possible changes that would occur over the long term. Having the pH is very important in the characterization of the formulations as changes thereof can affect the efficiency and shelf life of such topical products. At the predetermined intervals, the measurements of sudden changes observed in pH were taken to trace the long-term stability of the formulations. Monitoring the pH during the three hours would enable the identification of any instability or degradation of formulation and address it. The results of these tests provided pH values that provided significant insights on whether the formulas were alkaline or acidic which is a very significant factor when considering the overall stability and compatibility with the skin. Although significant variations could mean potential issues should be investigated further and corrected, consistency of pH level over time implied that formulation did not have serious problems with its stability. Based on all of this, the process of pH determination was instrumental in carrying out the analysis of the formulation stability and quality, ensuring that they were suitable to use further in the clinical evaluation and subsequent use in the study of the freckles treatment. Topical applications should have the ideal PH of 4-6 (Lukic et al., 2024), and in the current study, such a range was contained in all preparation of the formulations (Figure 4.1).

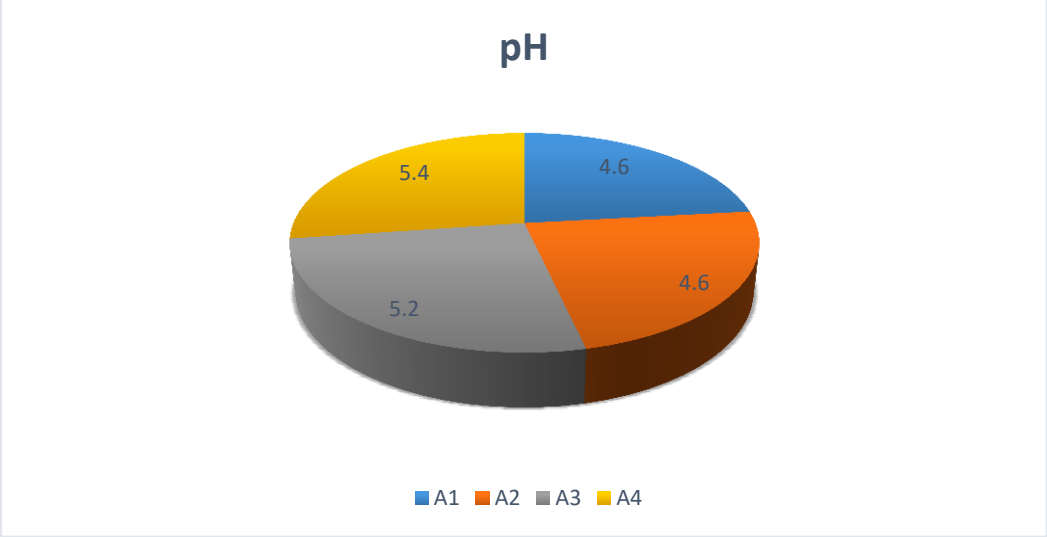


Figure 4.1 pH determination procedure

Spreadability

We noticed that spreadability of ointments decreased with increased base concentration so formulation A4 had no high spreadability as formulation A1. (Table 2)

Extrudability

Extrudability was assessed by tube extrudability method and was evident that Formulation A1 had a good extrudability compared to all other examined formulations (Table 2).

Viscosity

This resulted in thicker formulations with the increased concentration of the base; hence, the highest concentration of 15 percent produced formulation A4 which had a high viscosity whereas the lowest concentration of 5 percent produced formulation A1 which had the lowest viscosity (Table 2).

Stability Studies

Stability forms one of the essential factors that influence sustainability of a formulation on the shelf. It was clear that A3 and A4 were stable when we checked our formulas in 2 months that we kept them at 40 C temperature in order to test the stability.

Table 4.1. Composition of serval prepared formulation

S.No	Formulation	Viscosity	Spreadability (mm ±SD)	Extrudability (g ±SD)	Stability 40°C
1	A1	52,124±1.1	19.2±1.1	2.1±0.04	Unstable
2	A2	54,778±1.1	13.6±0.9	1.2±0.3	Unstable
3	A3	65,23±1.1	11.2±1.21	0.9±0.02	Stable
4	A4	68,323±1.1	11.0±1.3	0.62±0.04	Stable

Physical characterization of Ointments

The physical properties of the herbal ointment compositions that are the colour, the odor, the smoothness, and the grittiness were also noted. It was observed that all formulation A1-A4 met the palatable ointment parameters (Table 3).

Table 4.2. Physical parameters of prepared formulation

S.No	Formulation	Color	Consistency	Odor	Homogeneity
1	A1	Light Yellow	Good	Agreeable	Excellent
2	A2	Light Yellow	Good	Agreeable	Excellent
3	A3	Light Yellow	Good	Agreeable	Excellent
4	A4	Dark Yellow	Good	Agreeable	Excellent

Patients Trials

Formulation A4 was then refined and used in clinical trials because it was the best final composition since it passed the test on physicochemical characterization and skin irritation. The sample size of thirty patients all of whom were female between the age of fifteen and thirty were selected to be part of the study. Most of the people under treatment were married and most of them had black places that had developed over the past two months.

The patients were randomly divided into two groups, A and B that comprised 17 patients with five to Eight black patches per person. In addition, five others were provided Vaseline base pure as controls. Group A, study group, was looked after with the use of the topical form of the treatment after four weeks whereas Group B, control group, was administered with the normal commercial drug (5% magnesium ascorbyl phosphate) within the same duration. The freckles were counted in all groups at baseline and after the period of four weeks of treatment. Clinical photos were taken prior and following the procedures to be able to assess the successfulness of the procedures visually. The results were compared in order to determine whether the treatments had succeeded in reducing the number of black spots. Since the objective of the study was to assess the effectiveness of the developed freckles treatment against a common commercial medication, the title of the study dictated to what the clinical experiment was intended. By way of systematic counting of the dark spots and graphic registration of changes in skin appearance, the study tried to provide valuable new data on the effectiveness of home remedies freckles. The findings were rated as valid and reliable in the sense that there was control group that was uses Vaseline base only, as well as the patients were randomly treated. Objective data on the evaluation of the appearance of dark spots elimination were complemented with clinical photos to demonstrate the objective result of the treatment. Taking everything into consideration, clinical trial was also a very crucial step in the evaluation of the developed treatment effectiveness and its comparison with a standard commercial medication. The results of the trial would go a long way in encouraging the natural skincare field since, together with the physicochemical characterization and skin irritation assays done previously, would provide valuable evidence of the efficacy of the formulation in treating freckles.

Table 4.3. Physical parameters of prepared formulation

S.No	Patient Characteristics	No of Patients in A4 group	No of Patients in study group	Total Patients
1	**Age Group**			
	15-20	3	5	8
	20-25	3	7	10
	25-30	7	5	12
2	**Gender**			
	Female	17	17	30
3	**Marital status**			
	Married	9	8	17
	Unmarried	6	7	13
4	**Site of dark spot**			
	Face	11	10	21
	Molar	4	5	09
5	**Duration since appeared**			
	1-2month	7	7	14
	2-4 month	5	3	8
	4-6 months	5	3	8

As mentioned above the patients were administered with formulation A4 and usual medicine and in the stipulated time dark patch marks were observed on the faces of patients. The formulation A4 produced a significant ($p<0.05$) superior results compared with the conventional medicine and a significant ($p<0.05$) reduction on black spot was observed with the use of A4 formulation (Figure 4.2).

Figure 4.2: Treatment of patients with A4 up to 4 weeks

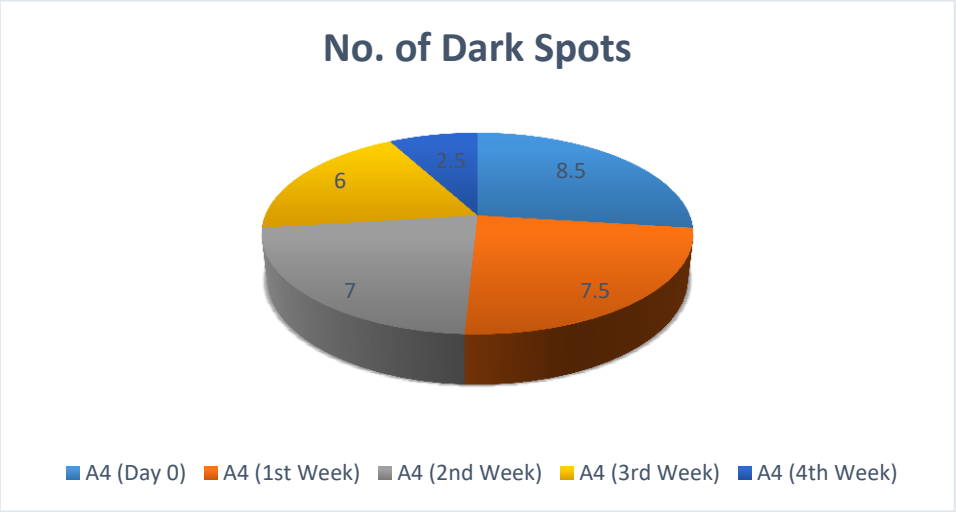
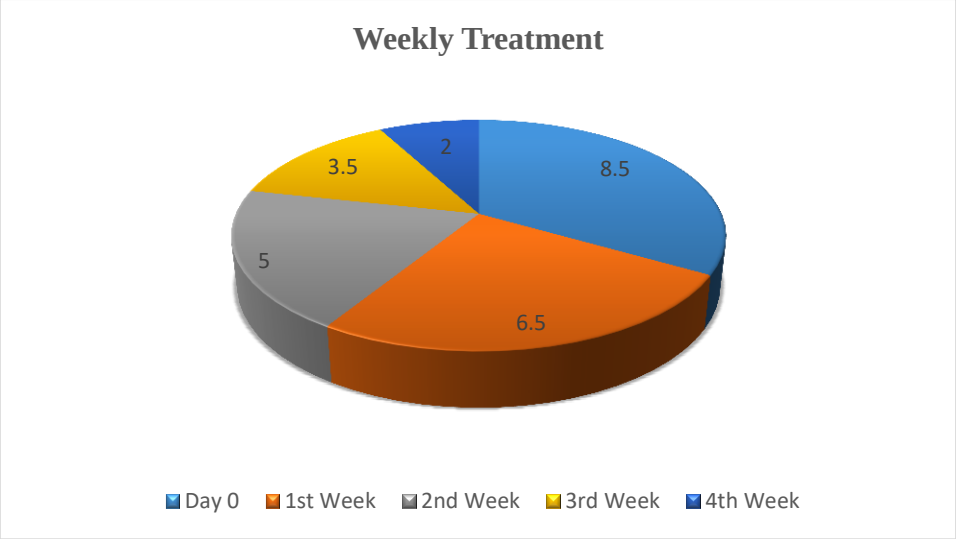


Figure 4.3: Treatment of patients with test drug up to 4 weeks



Discussion

The result of the study that involved comparing the effectiveness of bee pollen particles and aloe vera in comparison to a world brand known ointment in testing out freckles is one that is very educative as far as natural skin care products are concerned. The objectives listed in the title of the study align with the consideration of the safety, skin tone, and freckles setback.

The remarkable finding that Formulation A4 would be far more effective than the usual commercial ointment denotes how effective the natural healing approaches may be in the treatment of freckles. This finding just confirms the purpose of the thesis of comparing the effectiveness of aloe vera to Bee pollen so that those people with freckles can have safer, more effective and perhaps more permanent options of treatment.

It is also illustrated by the manner in which the formulations were produced, where there was a commitment to using the natural ingredients such as the University of Sind his apiary source of bee pollen and Aloe Vera gel. The formulations were aimed at maximizing the curative properties of these natural elements by incorporating Aloe Vera to a Vaseline background, and by pounding bee pollen in order to enhance the dimensions of the particles.

The demographics of the study population consisted of 30 persons, all of who were females aged between 15 and 30. This additional component of the study, namely, the introduction of control population together with the randomization of the participants into the treatment groups, further strengthens the validity of the study.

With the application of Formulation A4 instead of the typical commercial ointment, a reduction in dark spots is observed, and this demonstrates that bee pollen combined with aloe vera could have synergistic effects in the treatment of freckles. This result proves the study to quantify the effect of the natural treatment on the improvement of the skin tone and removal of freckles.

The safety profile of the natural therapies lies in its acceptability in uses which are purely cosmetic since its risk of side effects is minimal and tolerability is high. This confirms the node of the study to assess the overall effect of bee pollen and aloe vera in the treatment of freckles and assure the one seeking natural therapies.

Alongside these good scores, there are certain minor negative factors that have to be looked into. There may be a limitation on generalization of the result due to the fact that there is a short intervening time, and the sample size is relatively small. Further evidence of the usefulness of bee pollen and aloe vera in the management of freckles in terms of improved effectiveness and extended effects can be established in the future with larger cohorts and the longer follow-up period.

More research is needed to identify the most effective dosages and combination of the products to harness completeness with aloe vera and bee pollen as a medicine. Modifying these parameters, it is possible to develop standardized freckles treatment products in skincare, occupying an enormous market niche in dermatology.

Conclusion

The study's conclusions highlight the possibility of aloe vera and bee pollen as secure and efficient substitutes for traditional therapies for freckles. This study advances natural skincare products and gives freckle-prone people additional options for effectively and comprehensively managing their skin issues by comparing their relative efficacy and safety. This study has great contribution socially for infected individuals and on industrial level as well.

Limitations of the Study

Sample Size: The study was conducted on a limited number of participants, which may affect the generalizability of the results to a larger population.

Short Duration: The treatment period was relatively short (e.g., 4 weeks), which might not fully capture the long-term effects or potential recurrence of freckles.

Subjective Assessments: Some outcomes, such as the visual reduction of freckles, were based on subjective evaluation rather than advanced dermatological imaging or pigmentation analysis.

Variation in Skin Types: The effectiveness of the treatments might vary across different skin types or ethnicities, but the study did not stratify results accordingly.

Environmental Factors: External factors such as sun exposure, diet, or use of additional skin products were not fully controlled, potentially influencing the results.

Recommendations

Further studies on bee pollen and aloe are required as it is promising agent in cosmetics. Bee pollens and aloe velar further use for treatment of other skin diseases due to presence of many beneficial compounds. Cosmeceutical and pharmaceutical industries needs replacements of natural products due to no side effects.

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