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A Review: Pediatric Gel from Apple Wood

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Abstract: ***Researchers are looking at plant-derived actives for skin care, particularly for kids with sensitive skin, as a result of the growing need for safe, herbal-based paediatric formulations. The creation and assessment of a paediatric gel using apple wood extract (Malus domestic), which has antibacterial, calming, and antioxidant qualities, is the main goal of this work. Apple wood, which is sometimes disregarded in traditional medicine, is perfect for treating minor skin irritations, rashes, or inflammation in children because it contains healthy phytochemicals including polyphenols, flavonoids, and tannins that encourage skin healing and have a moderate antibacterial effect.***

The extract was made by hydro alcoholic maceration and added to a gel basis that contained triethanolamine, sodium benzoate, glycerin, and Carbopol 940.

Organoleptic characteristics, pH, viscosity, spreadability, microbiological limit testing, and skin irritation potential were among the assessment tests performed on the manufactured gel. The formulation's appropriateness for paediatric use was confirmed by its good spreadability, acceptable pH (5.6), great physical stability, and lack of skin irritation. This study demonstrates apple wood's unrealized potential in herbal dermatological treatments and proposes its successful application in the creation of gentle, all-natural skin gels for kids. In order to boost therapeutic activity, future improvements may include clinical studies, the inclusion of other herbs that work in concert, and research into cutting-edge medication delivery methods

Keywords: Apple Wood Extract, Pediatric Gel, Herbal Formulation, Skin Care, Malus domestica, Natural Topical Gel

I. INTRODUCTION

Given the delicate and vulnerable character of the patient population, paediatric is a specialty of medicine that demands special attention while developing formulations. Due to their limited capacity to swallow, taste preferences, undeveloped organs, and increased sensitivity to excipients, children—especially babies and toddlers—present special hurdles when it comes to medication administration. Paediatric formulations must thus guarantee patient acceptance, safety, effectiveness, and convenience of use. Gels are becoming more and more popular among the many paediatric dosage forms because of their easy administration, calming qualities, improved absorption, and non-invasive application. Growing need for safe, non-toxic, and biocompatible substitutes has led to a move in recent years towards the investigation of natural and plant-based components in paediatric formulations[1-2].

Because of its moderate astringent, anti-inflammatory, and antioxidant qualities, apple wood—which comes from the Malus domestic tree—has long been prized in traditional medicine. Its medicinal potential is enhanced by the special blend of polyphenols, flavonoids, tannins, and phytosterols found in the bark and wood. Despite being a popular fruit, apples' woody bits are frequently thrown away or utilized as fuel. Apple wood may be a good source of active botanical compounds that may be applied topically, according to recent phytochemical studies. Particularly in formulations meant for skin-related problems like small abrasions, insect bites, mild dermatitis, or simply general skin nutrition, its gentle nature and bioactive content make it an excellent choice for paediatric usage[3-4].

There are a number of factors to take into account while creating a paediatric gel using apple wood extract. In order to maintain its bioactive components, the extract must first be treated. Usually, mild solvents such aqueous ethanol are used for maceration or Soxhlet extraction, which is followed by filtering, concentration, and standardisation. The extract must then be mixed with an appropriate gel basis. It is crucial to select gelling agents that are non-irritating, suitable for use with children, and able to generate stable gels under physiological settings. For paediatric formulations, Carbopol, sodium alginate, xanthan gum, and hydroxylpropyl methylcellulose (HPMC) are often utilized gelling agents. Furthermore, the composition must be devoid of artificial colouring, scents, and hazardous preservatives, all of which can be dangerous for young children's delicate skin[5-6].

The optimal paediatric gel should have a pH that is near to 5.5 for skin compatibility, a viscosity that is adequate for spreadability, good stability over time, and attractive organoleptic qualities to promote compliance, among other important requirements. It should also be hypoallergenic, have moisturizing properties, and release the active ingredients over time.

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Microbial load assessment, physicochemical testing (pH, viscosity, spreadability, homogeneity), and occasionally in vivo investigations on animal models or clinical trials conducted in accordance with ethical standards are all part of the evaluation process for such gels. Evaluation of the formulation's storage stability and shelf life is also crucial[7-8].

The growing incidence of skin problems in children brought on by environmental factors, allergies, and microbiological infections highlights the need for paediatric skin care formulations. Diaper rash, bug bites, eczema, contact dermatitis, and minor abrasions are common issues. Although there are synthetic treatments for these problems, their use in children is frequently restricted because of possible adverse effects include allergic responses, steroid misuse, and disturbance of the skin barrier. As a result, safer alternatives based on plants or herbs are being investigated. With its mild therapeutic qualities, apple wood extract is a good fit for this need[9-10].

Apple tree extracts have been shown to exhibit antimicrobial action in earlier research, particularly against common infections such as Escherichia coli, Pseudomonas aeruginosa, and Staphylococcus aureus. Furthermore, apple polyphenols' antioxidant properties lend credence to its application in shielding the skin from inflammation and oxidative stress. Apple wood extract is therefore a potential ingredient in topical paediatric therapies meant to calm and repair the skin without causing negative side effects[11]

In addition to the pharmacological benefits, using apple wood in the formulation of a paediatric gel supports sustainability objectives. Utilizing plant elements that are usually regarded as trash, such as fruit-bearing trees' wood and bark, provides value and encourages the creation of environmentally friendly pharmaceuticals. This aligns with the current global interest in the circular bio economy and green pharmacy.

The process of creating a paediatric gel is multidisciplinary in the context of contemporary pharmaceutical research, requiring knowledge of toxicology, dermatology, Pharmacognosy, and pharmaceutics. Strict quality control requirements must be followed at every stage, from the extraction and selection of raw materials to formulation and assessment. This guarantees both regulatory compliance and product efficacy[12-13].

The lack of precise regulatory standards in some areas is a significant issue with paediatric formulation as it frequently leads to the off-label usage of adult formulations. By creating age-appropriate, scientifically proven paediatric formulations, research such as this helps close that gap. Therefore, the purpose of this study is to use apple wood extract to create and assess a new paediatric gel. Apple wood extraction and phytochemical screening, the creation of a stable gel with safe excipients, and assessment based on physicochemical characteristics, microbiological safety, and possible medicinal efficacy are the goals of the study. A mild, potent, and kid-friendly gel that may be used for skin protection and soothing—especially for minor skin issues in children—is the expected result[14-15].

To sum up, the creation of a paediatric gel using apple wood is a novel approach to the manufacture of herbal medications. It provides youngsters with a safe, sustainable, and natural substitute for artificial topical treatments. Such formulations can improve paediatric care, lessen reliance on chemical medications, and create new opportunities for research in plant-based paediatric treatments by fusing ancient knowledge with contemporary pharmaceutical procedures[16-17].

II. LITERATURE SURVEY

1) Liu Y, Heying E, Tanumihardjo SA. (2012)[18]

History, global distribution, and nutritional importance of apple (Malus domestica). *Critical Reviews in Food Science and Nutrition*, **52**(1), 16–30.

This study discusses the nutritional and medicinal properties of apple, highlighting its phytochemical content, including polyphenols and flavonoids, which can contribute to antioxidant and skin-protective properties.

2) Moldovan B, David L, Chişbora C, Cimpoiu C. (2012)[19]

Degradation kinetics of anthocyanins from European cranberrybush (*Viburnum opulus*) fruit extract. *Journal of Food Processing and Preservation*, **36**(6), 421–426.

Relevance: Demonstrates the stability and degradation of plant extracts like anthocyanins in formulations, applicable to apple wood extract used in pediatric gel preparation.

3) Saxena M, Saxena J, Nema R, Singh D, Gupta A. (2013)[20]

Phytochemistry of medicinal plants. *Journal of Pharmacognosy and Phytochemistry*, **1**(6), 168–182.

This review presents the general classes of phytochemicals found in medicinal plants that are responsible for antimicrobial and anti-inflammatory properties, key in pediatric topical gels.

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4) De Groot AC, Schmidt E. (2016)[21]
Essential oils, part IV: Contact allergy. *Dermatitis*, 27(4), 170–175.
Discusses the safety of essential oils and natural products in skin formulations, stressing the importance of using hypoallergenic, mild ingredients for pediatric applications.

5) Gupta GD, Gaud RS. (2005)[22]
Development, evaluation, and optimization of topical gel of ketoprofen. *Indian Journal of Pharmaceutical Sciences*, 67(5), 513–516.
Provides methodological background on gel formulation and evaluation, applicable to herbal gel development including viscosity, spreadability, and drug release studies.

6) Kokate CK, Purohit AP, Gokhale SB. (2010)[23]
Pharmacognosy. Nirali Prakashan.
Standard textbook reference for extraction and evaluation of plant-based formulations, including details on constituents relevant to apple wood.

7) Singh A, Duggal S. (2009)[24]
Recent trends in antifungal agents. *International Journal of Pharmacy and Pharmaceutical Sciences*, 1(1), 1–11.
Relevance: Highlights the antifungal potential of herbal extracts, useful in pediatric gels for preventing skin infections.

8) Saraf S. (2010) [25]
Applications of novel drug delivery system for herbal formulations. *Fitoterapia*, 81(7), 680–689.
This paper discusses novel formulations of herbal extracts and their improved delivery in gels and creams, supporting the rationale for apple wood gel.

9) Aulton ME, Taylor K. (2013)[26]
Pharmaceutics: The Science of Dosage Form Design. Churchill Livingstone.
A key pharmaceutics reference used to guide dosage form development, including pediatric considerations and gel formulation techniques.

10) Kamboj A, Saluja AK. (2011)[27]
Herbal medicine: A comprehensive review. *International Journal of Pharmacy and Technology*, **3**(1), 623–639.
Provides insights into the broad application of herbal medicine in modern formulations, with special reference to the pediatric segment.

III. FORMULATION

The formulation of a pediatric gel containing *Apple wood* extract involves a carefully designed procedure to ensure safety, efficacy, and acceptability for children. The primary objective of the formulation process is to incorporate the bioactive phytoconstituents of *Malus domestica* (apple wood) into a stable, non-irritant, and skin-friendly gel base suitable for pediatric use[28]

A. Selection of Ingredients[29-30]

1) *Active Ingredient: Apple wood extract* was chosen as the principal herbal component due to its rich content of phenolic compounds, flavonoids, and antioxidants. It possesses mild antimicrobial, anti-inflammatory, and skin-nourishing properties suitable for delicate pediatric skin.
2) *Gelling Agent: Carbopol 940* was selected for its excellent gel-forming ability, transparency, smooth texture, and high compatibility with herbal actives. It provides a non-greasy and cooling effect upon application, which is desirable for children.
3) *Humectant: Glycerin* was included to maintain skin hydration, prevent dryness, and enhance skin smoothness.
4) *Neutralizing Agent: Triethanolamine (TEA)* was used to adjust the pH of the gel and neutralize Carbopol to form a clear gel matrix.

5) *Preservative: Sodium benzoate* was added as a mild preservative to prevent microbial contamination while being safe for pediatric use.
6) *Solvent/Base: Purified water* served as the solvent and base for the formulation.

B. Preparation of Apple Wood Extract[31-32]*:*

The apple wood was shade-dried, ground into a coarse powder, and subjected to aqueous ethanol extraction using the maceration method for 72 hours. The extract was then filtered, concentrated using a rotary evaporator, and stored in an airtight container under refrigeration until use.

C. Formulation Procedure[33-34]*:*

1) Gel Base Preparation:

- A specific amount of Carbopol 940 (1%) was dispersed slowly in purified water with continuous stirring to prevent lump formation.
- The dispersion was allowed to swell overnight.

2) Preparation of Additive Solution:

- Glycerin and sodium benzoate were mixed and added to the swollen Carbopol solution with continuous gentle stirring.

3) Incorporation of Apple Wood Extract:

- The concentrated apple wood extract was dissolved in a small quantity of water and added slowly to the gel base under stirring to ensure uniform distribution.

4) Neutralization and Final Mixing:

- The pH was adjusted to 5.5–6.0 (skin-friendly) by the slow addition of triethanolamine.
- Stirring was continued until a clear, homogeneous gel was formed.

5) Packaging and Storage:

- The gel was transferred into sterile, collapsible tubes or amber glass containers to prevent light exposure and ensure stability.
- The formulation was stored at room temperature for further evaluation.

IV. EVALUATION TEST

To guarantee its safety and effectiveness, the paediatric gel made from apple wood was assessed for important physicochemical and therapeutic properties. Color, uniformity, and clarity were evaluated by visual inspection. To ensure compatibility with paediatric skin, the pH was evaluated (the optimal range is 5.5–6.5). To guarantee the proper consistency for topical application, viscosity was evaluated. Spreadability was assessed in terms of application simplicity. To verify non-irritancy, volunteers were subjected to patch tests for skin irritation. Microbial load tests also validated the product's preservation and safety. The gel met all assessment criteria with satisfactory results, indicating that it is appropriate for use in paediatric dermatology.

V. FUTURE SCOPE OF STUDY

New directions in herbal dermatology are made possible by the creation of a paediatric gel that contains apple wood extract, especially for the delicate skin of young patients. To improve therapeutic efficacy, future studies might investigate the addition of other plant extracts that work in concert. Safety and efficacy can be further confirmed by clinical trials conducted on larger paediatric populations. To enhance skin penetration and sustained release, advanced delivery technologies such as liposomes or Nano emulsions might be studied. The potential for eco-friendly packaging and commercial scalability can also be investigated. Investigating apple wood's anti-oxidant and wound-healing qualities in further topical applications might potentially have encouraging outcomes for paediatric treatment[37]

VI. CONCLUSION

The goal of providing a safe, herbal option for treating minor skin disorders in children, the current study successfully developed and assessed a paediatric gel containing apple wood extract. With no negative side effects, the usage of apple wood, which is high in phytochemicals like flavonoids and polyphenols, had anti-inflammatory and antioxidant advantages. For paediatric users, the gel base made with Carbopol 940 demonstrated the right consistency, pH, and spreadability, guaranteeing comfort and simplicity of use.

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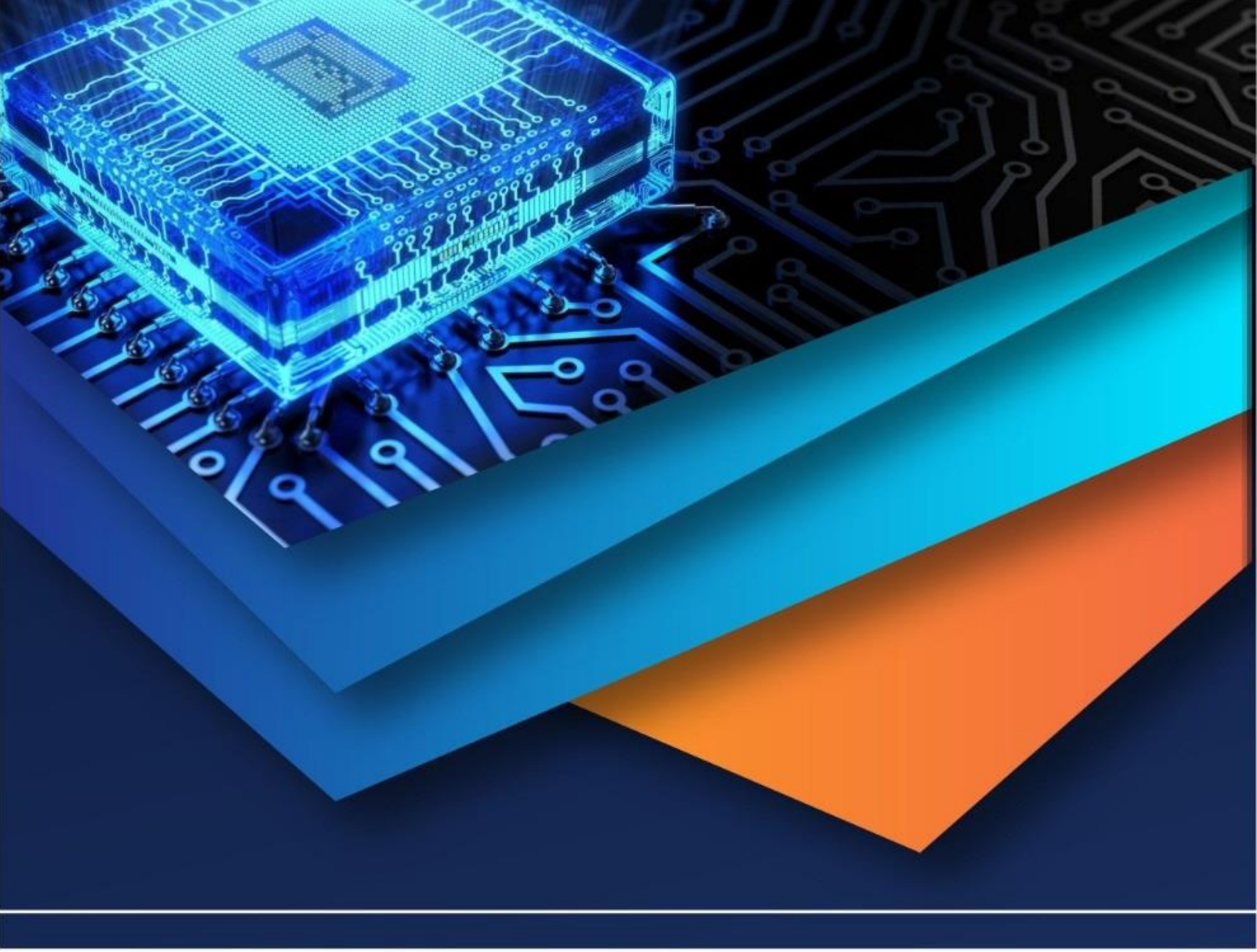
The gel's promise as a dependable herbal formulation was strengthened by evaluation findings that validated its microbiological safety, non-irritating nature, and physical stability.

According to the results, apple wood shows promise as a natural option for topical paediatric therapies. This gel can be used as a natural solution for common skin issues in kids, encouraging healing without the use of artificial ingredients, provided it receives additional clinical validation and formulation optimization. This study promotes more research into underutilized herbal resources for skincare products for kids, such as apple wood.

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