REVIEW ON: TOPICAL GEL FORMULATIONS BY USING BLACKBERRY, ORANGE PEEL, AND AMLA AS NATURAL ANTIOXIDANTS

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ABSTRACT
Oxidative stress caused by excessive production of reactive oxygen species (ROS) plays an important role in skin damage and premature ageing. Natural plant-derived antioxidants have gained attention as potential ingredients in topical formulations. Blackberry (Rubus fruticosus L.), orange peel (Citrus sinensis (L.) Osbeck) and amla (Phyllanthus emblica L.) contain bioactive compounds such as anthocyanins, flavonoids, phenolic acids, tannins and vitamin C, which are associated with antioxidant activity. This review discusses their phytochemical constituents, antioxidant potential, aqueous extraction approaches and incorporation into herbal gel formulations. It also describes formulation strategies and evaluation parameters, including pH, viscosity, spreadability, extrudability, DPPH radicalscavenging activity and stability studies. The combined extracts represent a promising research approach for developing topical antioxidant gels, although further experimental studies are required to establish their efficacy and safety.

KEYWORDS
Blackberry, Orange peel, Amla, Natural antioxidants, Oxidative stress, Herbal gel, Aqueous extraction, DPPH assay, Topical formulation.

INTRODUCTION:-

- Overview of skin:

Skin is the largest organ of the human body and acts as a protective barrier against physical, chemical and biological environmental factors. It consists mainly of three layers: epidermis, dermis and hypodermis.

The epidermis is the outermost layer and provides protection against external damage. The dermis contains collagen, elastin, blood vessels and other structural components responsible for skin strength and elasticity. The hypodermis is the innermost layer and consists mainly of adipose tissue. Continuous exposure to sunlight, pollution and other environmental conditions can affect normal skin functions. Oxidative stress is one of the mechanisms associated with this damage.

- Free radicals and reactive oxygen species:

Free radicals are atoms or molecules containing one or more unpaired electrons. Due to the presence of unpaired electrons, they are generally reactive and may interact with cellular components. Reactive oxygen species include oxygen-derived reactive molecules such as superoxide radicals, hydroxyl radicals and hydrogen peroxide. Some ROS are free radicals, while others, such as hydrogen peroxide, are non-radical reactive species. ROS are naturally produced during cellular metabolism. At controlled levels, they participate in normal cell signalling. However, excessive ROS production may damage cellular structures.

- Oxidative stress:

Oxidative stress develops when the production of reactive oxygen species exceeds the capacity of antioxidant defence mechanisms. The body's antioxidant defence system includes enzymatic antioxidants such as superoxide dismutase, catalase and glutathione peroxidase, along with non-enzymatic antioxidants such as glutathione and certain dietary antioxidants.

Excessive oxidative stress may cause:

Lipid peroxidation of cellular membranes.
Oxidation and alteration of proteins.
Damage to DNA.
Inflammatory responses.
Changes in collagen and elastin.
Premature skin ageing.

- Oxidative damage to skin:

Ultraviolet radiation is an important environmental factor responsible for increasing ROS formation in the skin. Excessive ROS may activate cellular pathways associated with inflammation and matrix metalloproteinase production. These enzymes can contribute to the breakdown of collagen and other extracellular matrix components. The resulting changes may be associated with wrinkles, loss of elasticity, uneven pigmentation and other signs of photoageing.

- Need for natural antioxidants:

Natural antioxidants obtained from fruits and plants are receiving attention because they contain several classes of bioactive compounds.

Examples include:

Anthocyanins.
Flavonoids.
Phenolic acids.
Tannins.
Ascorbic acid.
Other polyphenolic compounds.

These compounds may show antioxidant activity through different mechanisms, including free-radical scavenging, electron donation and metal-ion chelation.

The use of natural extracts in topical formulations is a research area of interest. However, antioxidant activity observed in a laboratory chemical assay does not automatically prove protection against skin ageing or clinical skin damage. Appropriate formulation, stability, safety and biological studies are necessary

ANTIOXIDANT PROFILE OF SELECTED PLANT MATERIALS

1. BLACKBERRY:



Scientific name: Rubus fruticosus L.
(blackberry group)
Family: Rosaceae
Common name: Blackberry
Plant part used: Fruit
Nature: Perennial, thorny shrub

Botanical description:

Blackberry is a perennial fruit-bearing shrub belonging to the family Rosaceae. It generally grows as a climbing or erect shrub with thorny stems, compound leaves and white or pinkish flowers. The fruit is

an aggregate fruit composed of several small drupelets. Initially, the fruit is green, then red, and finally turns dark purple to black when fully mature.

Major phytochemical constituents:

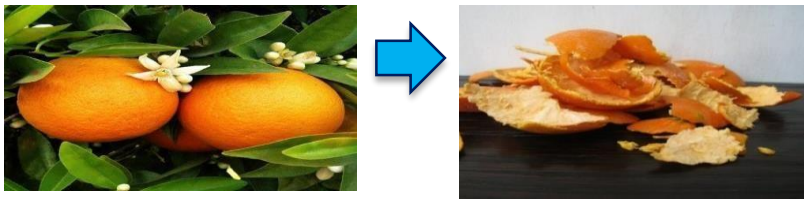
Anthocyanins
Tannins
Flavonoids
Vitamin C
Phenolic acids
Dietary fibre
Ellagitannins

Antioxidant importance:

Blackberry is rich in anthocyanins, which are responsible for its dark colour. These compounds exhibit antioxidant activity by scavenging free radicals and reducing oxidative damage. Its phenolic compounds make it a potential natural ingredient for antioxidant topical formulations.

2. ORANGE PEEL:

Scientific name: Citrus sinensis (L.) Osbeck
Family: Rutaceae
Common name: Sweet orange
Plant part used: Fruit peel
Nature: Evergreen fruit-bearing tree



Botanical description:

Orange is an evergreen fruit-bearing tree belonging to the family Rutaceae. It is widely cultivated in tropical and subtropical regions. The plant has a branched stem, green leathery leaves and fragrant white flowers. The fruit is round to oval in shape, with a thick outer peel and juicy segments inside. The peel consists of two main layers: the outer coloured layer called flavedo and the inner white spongy layer called albedo.

Major phytochemical constituents:

- Flavonoids (hesperidin and narirutin)
- Essential oils
- Limonene
- Phenolic acids
- Pectin
- Ascorbic acid (vitamin C)
- Polymethoxyflavones
- Carotenoids

Antioxidant importance:

Orange peel is a valuable source of natural antioxidants, particularly flavonoids such as hesperidin and other phenolic compounds. These constituents help neutralise free radicals and may protect cells against oxidative stress. Orange peel also contains essential oils and vitamin C, making it a useful natural ingredient for research on topical antioxidant formulations.

3. AMLA (INDIAN GOOSEBERRY):

Scientific name: Phyllanthus emblica L.
Synonym: Emblica officinalis Gaertn.
Family: Phyllanthaceae
Common name: Amla, Indian gooseberry
Plant part used: Fruit
Nature: Deciduous tree



Botanical description:

Amla is a small to medium-sized deciduous tree belonging to the family Phyllanthaceae. It is widely distributed in India and other tropical regions. The tree has a crooked trunk, spreading branches and small, simple, closely arranged leaves that resemble pinnate leaves. Its flowers are small and greenish-

yellow. The fruit is spherical, greenish-yellow in colour, smooth and fleshy, with six prominent vertical furrows. It has a sour, bitter and astringent taste.

Major phytochemical constituents:

- Ascorbic acid (vitamin C)
- Chebulagic acid
- Gallic acid
- Chebulinic acid
- Ellagic acid
- Corilagin
- Emblicanin A and B
- Flavonoids
- Tannins
- Phenolic compounds

Antioxidant importance:

Amla is considered an important natural source of antioxidant compounds. Its fruits contain vitamin C, tannins and polyphenolic constituents, including emblicanins, gallic acid and ellagic acid. These compounds contribute to free- radical-scavenging activity and help protect against oxidative damage. Therefore, amla is a promising herbal ingredient for developing topical antioxidant formulations.

HERBAL GEL FORMULATION STRATEGIES:

Topical gels: A gel is a semisolid preparation in which a liquid phase is entrapped within a three-dimensional network created by a gelling agent. Topical gels are commonly used for skin application because they are easy to spread, generally non-greasy and can provide a cooling sensation after application.

Advantages:

Convenient application to the skin.

Easy spreading and removal.

Less greasy than many ointment bases.

Suitable vehicle for water-soluble plant extracts.

Can be prepared using commonly available pharmaceutical excipients. May allow localised delivery of selected ingredients.

Gelling agents:

Carbopol 940 and Carbopol 934 are cross-linked polyacrylic acid polymers commonly used to prepare clear or translucent gels. They require neutralisation, often with triethanolamine, to develop theircharacteristic viscosity. Hydroxypropyl methylcellulose (HPMC), xanthan gum and sodium carboxymethyl cellulose are alternative thickening or gelling agents. The choice depends on extract compatibility, target viscosity, pH, appearance, preservative compatibility and stability.

Common excipients:

Ingredient	Function
Blackberry dry extract	Antioxidant-associated plant ingredient
Orange peel dry extract	Antioxidant-associated plant ingredient
Amla dry extract	Antioxidant-associated plant ingredient
Carbomer 940 / HPMC / sodium CMC / xanthan gum	Gelling polymer
Glycerin	Humectant
Propylene glycol	Cosolvent/humectant, if required

Suitable preservative	Microbial preservation
Triethanolamine	Carbomer neutraliser / pH adjustment
Purified water	Vehicle

Formulation considerations:

Blackberry, orange peel and amla extracts may differ in colour, pH, solubility and stability. The extracts should be filtered to remove coarse particles, and unnecessary heating should be avoided. Blackberry extract should be protected from strong light because anthocyanins may degrade. The final pH, viscosity and appearance should be monitored because plant extracts can alter gel characteristics. A blank gel without plant extracts should be prepared as a control. This allows the effect of the extracts on pH, viscosity, colour, spreadability and antioxidant activity to be assessed more clearly.

Extraction Method: Aqueous Maceration:

An aqueous extraction procedure is proposed for the three plant materials to maintain a consistent water-based approach. Because fruit materials differ in moisture, texture and chemical composition, the extraction conditions should be optimised separately rather than assuming that one time and temperature will suit all three. A small pilot study should compare practical extraction conditions and record yield, colour, filtration behaviour and antioxidant response.

General procedure: use authenticated, cleaned and dried plant material. Reduce
it to a uniform coarse powder or small pieces as appropriate. Weigh a known quantity and add a measured volume of purified water. Keep the material in a closed vessel with intermittent stirring for a defined period at room temperature or under controlled mild warming, depending on the selected protocol. Filter through muslin cloth followed by filter paper. If necessary, repeat extraction and combine filtrates. Concentrate the
filtrate at a suitably low temperature and protect it from prolonged heat and light.

Record the exact drug-to-water ratio, particle size, extraction time, temperature, number of extraction cycles and final volume. Dry or concentrate the extract to a reproducible endpoint before weighing. Store the extract in a labelled airtight container under conditions justified by its stability. Aqueous extracts are susceptible to microbial growth; prepare fresh where possible or use validated storage and preservation procedures. Percentage Yield Formula:

Percentage yield = (Weight of dried extract / Weight of powdered crude drug) × 100

Gel preparation:

A Carbopol-based gel can be prepared by hydrating the polymer, incorporating filtered aqueous extracts and adjusting pH to obtain a uniform semisolid product.

General method:

- Weigh the required quantity of Carbopol 940.
- Disperse it slowly in purified water with continuous stirring.
- Allow sufficient time for complete hydration.
- Dissolve glycerin and other compatible water-soluble excipients separately.
- Add the filtered plant extracts gradually to the hydrated polymer dispersion.
- Add a suitable preservative at a compatible and validated concentration.
- Adjust pH gradually using triethanolamine, if Carbopol is used.
- Mix gently until a uniform gel is obtained.
- Make up the final weight with purified water.
- Allow entrapped air bubbles to disappear.
- Fill the gel into clean, labelled containers.

EVALUATION OF HERBAL ANTIOXIDANT GEL:

- Organoleptic and physical evaluation: Colour, odour, appearance, physical nature and the presence of visible particles should be observed and recorded. Homogeneity may be checked by applying a small quantity of gel to a glass slide and examining it for lumps, grittiness or separation.
- pH determination: The pH meter should be calibrated using appropriate standard buffers before measurement. A suitable dispersion of the gel in purified water may be prepared according to the selected laboratory method, and the stable pH reading should be recorded. A skin-compatible pH is desirable, although the acceptable range depends on the polymer, extracts and intended use.
- Viscosity: Viscosity may be measured using a Brookfield viscometer or another suitable instrument. The spindle number, rotational speed, temperature, sample volume and units must be recorded. Results should be compared only when measurement conditions are identical.
- Spreadability: Spreadability reflects the ease with which a gel can be applied to the skin. It may be determined using the slide method and calculated as: **$S = (M \times L) / T$** where S is spreadability, M is the weight applied to the upper slide, L is the length of the glass slide, and T is the time required for the slides to separate. A higher value generally indicates easier spreading.
- Extrudability: Extrudability may be assessed by filling a tube with a known weight of gel and applying a standard force for a fixed time. The percentage extrudability is calculated as:

Extrudability (%) = (weight extruded / total weight taken) × 100

- DPPH antioxidant assay: DPPH is a stable free radical that produces a purple colour in solution. Antioxidants reduce DPPH, causing a decrease in absorbance commonly measured around 517 nm. Different concentrations of extract or gel sample are mixed with DPPH solution, incubated in the dark, and their absorbance is measured. Percentage inhibition is calculated as:

DPPH inhibition (%) = [(A control − A sample) / A control] × 100

Ascorbic acid or gallic acid may be used as a reference standard. The blank gel must also be tested because polymers, preservatives and pH-adjusting agents may interfere with the assay. The concentration producing 50% inhibition, IC50, may be calculated where appropriate.

- Total phenolic and flavonoid content: Total phenolic content may be estimated using the Folin–Ciocalteu method and expressed as gallic acid equivalents. Total flavonoid content may be estimated using an aluminium chloride colorimetric method and expressed as quercetin equivalents. These assays provide screening information but do not identify individual compounds or establish clinical efficacy.
- Stability studies: The gel should be stored in suitable containers under room-temperature, refrigerated and elevated-temperature conditions. Samples should be examined at defined intervals for changes in colour, odour, appearance, phase separation, pH, viscosity and spreadability. Antioxidant activity may be repeated at selected time points.
- Safety and microbial quality: The final product should not be applied to humans without appropriate safety assessment and institutional approval. The pH, preservative system, excipient safety and microbial quality should be considered. Plant materials may contain microbial load; therefore, hygienic handling, cleaning, drying and filtration are important.

FUTURE SCOPE:

- Optimisation of extraction conditions using experimental design.
- Standardisation using HPLC or other suitable analytical methods.
- Comparison of aqueous, hydroalcoholic and green extraction methods.
- Evaluation of individual extracts versus the combined extract.
- Use of DPPH, ABTS, FRAP and lipid peroxidation assays.
- Release and stability studies of marker compounds.

- Formal preservative-efficacy, microbial-limit and skin-irritation studies.

CONCLUSION:

Blackberry, orange peel and amla contain phytochemical groups associated with antioxidant activity, including anthocyanins, flavonoids, phenolic acids, tannins and vitamin C. A polyherbal topical gel prepared from their aqueous extracts may provide a simple preliminary approach for delivering plant-derived antioxidants to the skin.

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