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Design and Evaluation of a Herbal-Based Topical Pain Relief Roll-On

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ABSTRACT:

A roll-on is a liquid preparation that comes in a small container with a rolling ball at the top, which makes it easy to apply directly onto the skin. Herbal roll-ons are commonly used to relieve various types of pain such as headaches, joint pain, neck pain, and muscle soreness. These roll-ons are formulated using natural, plant-based ingredients known for their soothing and anti-inflammatory properties.

The formulation typically includes extracts of mint leaves, basil leaves, ajwain (carom seeds) arqe (distillate), mint arqe, camphor, coconut oil, and glycerin. Each of these ingredients plays a specific role in pain relief: mint and camphor provide a cooling effect and stimulate blood flow; basil and ajwain have anti-inflammatory and analgesic properties; coconut oil acts as a carrier oil and moisturizer; while glycerin helps retain moisture and improves skin absorption.

This topical pain relief roll-on offers a natural alternative to synthetic pain relievers. When applied, it produces a cooling and soothing sensation on the affected area, which helps distract from the pain and promotes relaxation. It is easy to carry, non-greasy, and suitable for quick, on-the-go use.

Keywords: Roll-on, Herbal formulation, Pain relief, Mint extract, Basil extract, Ajwain arqe, Mint arqe, Camphor, Coconut oil, Glycerin, Topical application, Natural ingredients, Analgesic, Anti-inflammatory, Headache relief, Joint pain, Muscle soreness, Cooling effect, Non-greasy, On-the-go use

Introduction:

A roll-on is a type of topical liquid preparation housed in a small, portable container equipped with a revolving ball applicator. This design allows for easy and direct application to specific areas of the body. Herbal roll-ons are natural formulations that typically contain volatile essential oils and plant-based extracts known for their therapeutic properties, particularly in relieving pain, stress, and muscle tension.

Pain, whether acute or chronic, is an unpleasant sensory and emotional experience often associated with actual or potential tissue damage. Its perception involves a complex interaction of physical, emotional, and psychological factors. Herbal roll-ons aim to address this discomfort through the use of essential oils and plant extracts that exhibit analgesic, anti-inflammatory, and calming properties.

The current formulation incorporates a blend of natural ingredients, including **dry mint leaves powder**, **dry basil leaves powder**, **ajwain arqe**, **mint arqe**, **camphor**, **peppermint oil**, **glycerin**, and **jojoba oil**. Each component contributes uniquely to the pain-relieving and soothing effects of the product. For example, **mint and peppermint oil** provide a cooling sensation and help stimulate blood flow, while **basil and ajwain** offer anti-inflammatory and antispasmodic benefits. **Camphor** acts as a counterirritant, producing a warming or cooling effect that distracts from pain. **Glycerin and jojoba oil** serve as moisturizers and enhance skin absorption, improving the overall efficacy of the roll-on.

The essential oils and herbal extracts used in such formulations are typically derived from various parts of plants—leaves, stems, seeds, or roots—and extracted using methods like steam distillation, cold pressing, or hydrodistillation. The yield and quality of these volatile oils are influenced by numerous environmental and processing factors, including climate, soil type, harvesting time, and method of extraction.

In summary, herbal roll-ons offer a natural, convenient, and non-greasy solution for managing everyday pain and stress, making them a popular choice for those seeking holistic, plant-based relief.

Literature Review:

- **Topical Herbal Formulations for Pain Relief**

  Topical applications of herbal products have gained popularity due to their **localized action, ease of application, and minimal systemic side effects**. Studies have shown that herbal roll-ons are effective in managing minor aches, muscle stiffness, and headaches due to their rapid absorption and soothing effects (Singh et al., 2018).

- **Role of Essential Oils in Pain Management**

  Essential oils such as **peppermint, eucalyptus, lavender, and camphor** possess significant analgesic and anti-inflammatory properties. Peppermint oil, in particular, contains menthol, which produces a **cooling sensation** and helps relieve pain through counter-irritant mechanisms (Ali et al., 2015).

- **Mint and Basil in Traditional Medicine**

  Mint (**Mentha arvensis**) and basil (**Ocimum sanctum**) have been widely used in **Ayurveda and Unani medicine** for their carminative, antispasmodic, and anti-inflammatory actions. Extracts from these plants help reduce muscle spasms and nerve pain (Deshpande et al., 2016).

- **Ajwain (Trachyspermum ammi) Arqe and Its Benefits**

  Ajwain arqe is known for its **antiseptic, anti-inflammatory, and analgesic properties**. It is often used in traditional remedies for relieving joint and muscular pain (Patel et al., 2019).

- **Camphor and Menthol in Pain Relief**

  Camphor and menthol are common ingredients in over-the-counter pain relief formulations. They act as **counterirritants**, creating a cooling or warming sensation that distracts from the underlying pain (Gupta et al., 2020).

- **Carrier Oils and Absorption Enhancers**

  Jojoba oil and **glycerin** are used in topical preparations for their ability to moisturize the skin and improve the **absorption of active ingredients**. These components also help maintain the stability and consistency of the formulation (Kumar & Verma, 2017).

- **Increasing Demand for Herbal Products**

  Due to growing concerns over the **side effects of synthetic drugs**, consumers are increasingly turning toward **herbal and natural alternatives**. Herbal roll-ons fit this demand by offering pain relief without harmful chemicals (WHO Guidelines, 2011).

Objectives:

The primary purpose of this study is to **develop a safe, effective, and natural herbal roll-on formulation** for topical pain relief. With increasing awareness about the side effects of synthetic medications, there is a growing demand for plant-based, non-invasive alternatives for managing common types of pain. This project aims to harness the **therapeutic potential of traditional herbal ingredients**—such as mint, basil, ajwain, and essential oils—to create a convenient, fast-acting, and skin-friendly roll-on product. The formulation is intended to provide relief from **headaches, joint and muscle pain, neck stiffness**, and general body aches while also promoting a sense of relaxation and well-being.

- ✓ To develop a **natural and effective herbal roll-on** for topical pain relief.
- ✓ To provide a **safer alternative to synthetic pain relievers** with fewer side effects.
- ✓ To utilize the **therapeutic properties of traditional herbal ingredients** like mint, basil, ajwain, and essential oils.
- ✓ To offer relief from **common types of pain**, including headaches, joint pain, muscle soreness, and neck aches.
- ✓ To design a **convenient, easy-to-use, and skin-friendly formulation** suitable for daily and on-the-go use.
- ✓ To promote the use of **plant-based, non-invasive treatments** for pain management.
- ✓ To encourage the integration of **aromatherapy and herbal medicine** in modern pharmaceutical preparations.

Ingredients used in formulation:

1. **Mint Leaves (Mentha arvensis):**

- **Botanical Name**: *Mentha arvensis*
- **Common Name**: Field mint, Pudina
- **Family**: Lamiaceae

Phytochemical Constituents

- Contains **menthol**, menthone, isomenthone, limonene, pulegone, and flavonoids.
- Menthol is the **active compound** responsible for its cooling and analgesic effects.

Medicinal Properties

- **Analgesic**: Menthol provides a cooling sensation and acts as a counterirritant, helping relieve pain.
- **Anti-inflammatory**: Reduces inflammation in muscles and joints.
- **Antispasmodic**: Relaxes muscles and relieves cramps and spasms.
- **Antioxidant**: Helps in reducing oxidative stress.
- **Antimicrobial**: Inhibits the growth of certain bacteria and fungi.

Traditional Uses

- Used in **Ayurveda and traditional medicine** to treat headaches, digestive issues, muscle pain, and cold symptoms.
- Often applied externally in the form of balms or oils for **relieving pain, itching, and skin irritation**.

Role in Herbal Roll-On Formulations

- Provides an **instant cooling and soothing effect** on application.
- Enhances blood circulation at the site of application, helping reduce pain.
- Improves the **aroma and sensory appeal** of the roll-on product.
- Acts as a **natural alternative to synthetic analgesics** in topical formulations.

2. Basil Leaves:

- **Botanical Names**: *Ocimum sanctum* (Holy Basil / Tulsi), *Ocimum basilicum* (Sweet Basil)
- **Common Name**: Basil, Tulsi

- **Family**: Lamiaceae

Phytochemical Constituents

- Contains **eugenol**, linalool, ursolic acid, methyl chavicol, carvacrol, camphene, and flavonoids.
- **Eugenol** is the key component responsible for its analgesic and anti-inflammatory properties.

Medicinal Properties

- **Analgesic**: Eugenol and other compounds help reduce pain sensation.
- **Anti-inflammatory**: Reduces swelling and inflammation in tissues and joints.
- **Antioxidant**: Protects tissues from oxidative damage.
- **Antimicrobial**: Inhibits bacterial and fungal infections.
- **Adaptogenic**: Helps the body respond to physical and emotional stress.

Traditional Uses

- Widely used in **Ayurvedic, Siddha, and Unani systems** of medicine.
- Traditionally applied as a poultice or paste for **muscle pain, insect bites, and skin inflammation**.
- Also used for **headaches, arthritis, and nerve pain** due to its soothing and calming properties.

Role in Herbal Roll-On Formulations

- Provides **natural pain relief** through anti-inflammatory and analgesic action.
- Helps calm stressed nerves and muscles, contributing to **stress and tension relief**.
- Enhances the **synergistic effect** when combined with other herbal ingredients like mint and camphor.
- Adds a **pleasant herbal aroma** and contributes to the soothing sensation upon application.

3. Ajwain (Trachyspermum ammi):

- **Botanical Name**: *Trachyspermum ammi*
- **Common Name**: Ajwain, Carom seeds
- **Family**: Apiaceae

Phytochemical Constituents

- Contains **thymol**, γ-terpinene, p-cymene, and other volatile oils.
- Thymol is the primary active compound responsible for its medicinal properties.

Medicinal Properties

- **Analgesic**: Helps reduce pain through its action on nerve endings.
- **Anti-inflammatory**: Thymol reduces inflammation and swelling in tissues.
- **Antispasmodic**: Relieves muscle spasms and cramps.

- **Antimicrobial**: Exhibits antibacterial and antifungal activity.
- **Carminative**: Aids in digestion and reduces gas and bloating.

Traditional Uses

- Used in traditional medicine systems such as Ayurveda and Unani for **relieving joint pain, muscle aches, and digestive disorders**.
- Applied topically in the form of oils or extracts for **muscle soreness and inflammatory conditions**.
- Ajwain arqe (distillate) is commonly used as a natural remedy for **pain relief and inflammation**.

Role in Herbal Roll-On Formulations

- Provides **anti-inflammatory and analgesic effects** that help reduce localized pain and discomfort.
- Acts as a **natural muscle relaxant**, easing stiffness and spasms.
- Enhances the **overall therapeutic effect** when combined with other essential oils like mint and camphor.
- Adds a **characteristic warm, pungent aroma** that complements the cooling effects of other ingredients.

4. Camphor:

- **Chemical Name:** Cinnamomum camphora (source tree)
- **Common Name:** Camphor
- **Chemical Structure:** Terpenoid ketone

Phytochemical Constituents

- Primarily contains **camphor** as the active ingredient.
- Also includes small amounts of **cineole, borneol**, and other terpenes.

Medicinal Properties

- **Analgesic:** Acts as a counterirritant, producing a cooling or warming sensation that helps distract from underlying pain.
- **Anti-inflammatory:** Reduces swelling and inflammation in tissues.
- **Antipruritic:** Relieves itching and irritation.
- **Rubefacient:** Increases blood flow to the applied area, promoting healing.
- **Antimicrobial:** Exhibits antibacterial and antifungal effects.

Traditional Uses

- Widely used in traditional medicine and over-the-counter topical analgesics for relief from **muscle pain, arthritis, sprains, and neuralgia**.
- Commonly found in balms, ointments, and liniments designed for **pain and inflammation relief**.
- Also used in aromatherapy for its **refreshing and stimulating effects**.

Role in Herbal Roll-On Formulations

- Provides a **cooling or warming effect** that soothes painful muscles and joints.
- Enhances **blood circulation** at the site of application, aiding in faster recovery.
- Acts synergistically with other herbal ingredients like mint and basil to enhance pain relief.

- Adds a distinctive **aromatic fragrance** that improves user experience.

Material and methodology:

Ingredients:

1) Dry Mint Leaves Powder: 0.3 g
2) Dry Basil Leaves Powder: 0.25 g
3) Ajwain Arqe: 0.8 ml
4) Mint Arqe: 0.8 ml
5) Camphor: 0.2 g
6) Paper Mint Oil: 0.1 ml
7) Glycerin: 0.8 ml
8) Jojoba Oil: 7.75 ml

Ingredients and Their Uses:

Ingredient	Use / Benefit
Mint Leaves Extract *(Mentha spp.)*	Provides a natural cooling effect due to menthol; relieves headaches, muscle tension, inflammation, and minor aches. Also has antimicrobial and soothing properties.
Basil Leaves Extract *(Ocimum sanctum or Ocimum basilicum)*	Acts as an anti-inflammatory and antioxidant; helps reduce swelling and pain, supports circulation, and calms the nervous system.
Ajwain Arq *(Trachyspermum ammi)*	Contains thymol, which has strong analgesic, antibacterial, and anti-inflammatory effects. Useful for relieving joint and muscular pain. Also helps in improving blood flow.
Mint Arq	Aqueous extract containing water-soluble menthol compounds; offers quick cooling, calming aroma, and helps reduce pain and mental fatigue.
Camphor	A powerful topical analgesic that provides a warming or cooling sensation; increases blood circulation and reduces inflammation and pain quickly. Commonly used in pain balms.

Ingredient	Use / Benefit
Peppermint Oil	High in menthol content; delivers deep cooling sensation, reduces pain signals, and soothes irritated muscles and nerves. Also acts as a mild anesthetic.
Glycerin	A natural humectant that helps retain skin moisture and improve application spread. Prevents drying or irritation of skin from essential oils.
Jojoba Oil	A skin-friendly carrier oil that deeply penetrates and nourishes the skin; also enhances the absorption of active ingredients and stabilizes the formulation. It's non-greasy and well-tolerated.

EXTRACTION:

Mint leaves extract, basil leaves extract.

- **Extraction of Mint Leaves by Decoction**

Materials Needed:

- Dry Mint Leaves Powder: 10–20 g
- Distilled Water: 200–300 ml
- Stainless steel or glass pot
- Strainer or muslin cloth
- Clean container for storage

Procedure:

1. **Weigh the Leaves:**
    - Take 10–20 grams of dry mint leaves powder for extraction.
2. **Add Water:**
    - Pour 200–300 ml of distilled water into a clean pot.
3. **Boiling (Decoction):**
    - Add the dry mint leaves powder to the water.
    - Heat the mixture and bring it to a boil.
    - Reduce the heat and let it simmer gently for 15–30 minutes.
    - Stir occasionally to help extract active compounds.
4. **Cooling:**
    - After simmering, remove the pot from heat and allow the mixture to cool to room temperature.
5. **Straining:**
    - Use a fine strainer or muslin cloth to filter out the solid leaf residue.
    - Collect the clear liquid, which is the **mint decoction** (aqueous extract).
6. **Storage:**
    - Transfer the decoction into a clean, airtight container.
    - Store in the refrigerator and use within 2–3 days to prevent microbial growth.

- **Extraction of Basil Leaves by Decoction**

Materials Needed:

- Dry Basil Leaves Powder: 10–20 g
- Distilled Water: 200–300 ml
- Stainless steel or glass pot

- Strainer or muslin cloth
- Clean container for storage

Procedure:

1. **Weigh the Leaves:**
    - Measure 10–20 grams of dry basil leaves powder.
2. **Add Water:**
    - Pour 200–300 ml of distilled water into a clean pot.
3. **Boiling (Decoction):**
    - Add the dry basil leaves powder to the water.
    - Heat the mixture and bring it to a boil.
    - Reduce the heat and simmer gently for 15–30 minutes, stirring occasionally to help release active compounds.
4. **Cooling:**
    - Remove the pot from heat and allow the decoction to cool to room temperature.
5. **Straining:**
    - Strain the mixture through a fine strainer or muslin cloth to remove solid particles.
    - Collect the clear liquid, which is the **basil decoction** (aqueous extract).
6. **Storage:**
    - Transfer the decoction to an airtight container.
    - Store in the refrigerator and use within 2–3 days to maintain freshness and prevent microbial growth.

Procedure:

Step 1: Preparation of Herbal Extract Base

1. **Infuse the Powders:**
    - Take the dry mint leaves powder (0.3 g) and dry basil leaves powder (0.25 g).
    - Add them to 5 ml of jojoba oil (from the total 7.75 ml).
    - Heat gently in a water bath at 40-50°C for 30 minutes to infuse the oils with herbal actives. Stir occasionally.
    - Let the infused oil cool, then filter through muslin cloth or fine mesh to remove solid residues. This gives a herbal-infused oil base.

Step 2: Prepare the Oil Phase

1. **Dissolve Camphor:**
    - Take camphor (0.2 g) and add it to the remaining 2.75 ml jojoba oil.
    - Warm gently until camphor dissolves completely.

Step 3: Mix the Liquid Ingredients

2. **Combine Arqes and Oils:**
    - In a clean container, mix the ajwain arqe (0.8 ml), mint arqe (0.8 ml), paper mint oil (0.1 ml), glycerin (0.8 ml), and the camphor-jojoba oil solution prepared in Step 2.

Step 4: Blend Oil Phases

3. **Mix Herbal-Infused Oil and Liquid Phase:**
    - Slowly add the herbal-infused jojoba oil (Step 1) into the liquid ingredients mixture (Step 3).
    - Stir gently but thoroughly to get a homogeneous mixture.

Step 5: Final Preparation

4. **Filling Roll-On Bottle:**
    - Using a small funnel or dropper, carefully fill the 10 ml roll-on bottle with the prepared formulation.
    - Fit the rolling ball applicator tightly to avoid leakage.

Step 6: Storage and Usage

5. **Storage:**
    - Store the roll-on in a cool, dry place away from direct sunlight.
    - Shake gently before each use to ensure even distribution of ingredients.
6. **Usage:**
    - Apply directly to painful areas like temples, joints, neck, or muscles.
    - Massage gently using the rolling ball for better absorption.

LABEL:

Herbal Pain killer roll on 10ml

Formula:

Ingredients	Quantity required
Mint leaves extract	2.0 ml
Basil leaves extract	1.5 ml
Ajwain arqe	1.5ml
Mint arqe	1.0ml
Camphor	1.0ml

Jojoba oil	q.s
Peppermint oil	0.5ml

Finished product analysis of Pain killer Roll on:

Sr. No.	**Test**	**Specification**	**Observation**
1	Description	Clear to pale green liquid with strong herbal-menthol aroma in a roll-on applicator	Clear to pale green liquid with strong herbal-menthol aroma in a roll-on applicator
2	pH	5.5 – 6.5	5.4
3	Appearance	Free-flowing, non-sticky, no suspended particles	Free-flowing and non-sticky
4	Net Filled Volume	As per label claim (e.g., NLT 10 ml ± 1 ml)	7 ml
5	Leakage Test	No leakage or seepage from roll-on applicator	Complies
6	**Identification By TLC**		
A	Dry Mint Leaves Powder	Complies with Test	Complies
B	Dry Basil Leaves Powder	Complies with Test	Complies
C	Ajwain Arq	Complies with Test	Complies
D	Mint Arq	Complies with Test	Complies
E	Camphor	Complies with Test	Complies
F	Peppermint Oil	Complies with Test	Complies
G	Jojoba Oil	Complies with Test	Complies
H	Glycerine	Complies with test	Complies
7	**Microbial limit Test:**		
a	Total Bacterial Count	NMT 10^3 CFU / ml	Not $<100^{CFU}$ / ml
b	Total fungal Count	NMT 10^2 CFU / ml	Not <10 CFU / ml
c	*E. Coli*	Absent / ml	Complies
d	*Salmonella*	Absent / 10 ml	Complies
e	*Pseudomonas aeruginosa*	Absent /ml	Complies
f	*Staphylococcus aureus*	Absent / ml	Complies

Discussion:

The formulated herbal pain relief roll-on is a topical liquid preparation designed for quick and effective relief from headaches, muscle pain, joint stiffness, and stress-related discomfort. The formulation incorporates traditional medicinal herbs and essential oils, combined with modern pharmaceutical knowledge to create a natural, non-greasy, and easy-to-apply product.

The key active components in the formulation—**mint leaves extract, basil leaves extract, ajwain arq, mint arq, camphor, and peppermint oil**—were selected for their well-documented analgesic, anti-inflammatory, and soothing properties. These ingredients work synergistically to provide both **cooling and warming sensations**, which help to counteract pain perception and improve blood circulation at the site of application.

- **Menthol** (from mint extracts and peppermint oil) offers a rapid cooling effect, which acts as a counterirritant to reduce the sensation of pain.
- **Camphor** produces a warming sensation that helps relieve muscle stiffness and enhances blood flow.

- **Ajwain arq**, rich in thymol, provides strong anti-inflammatory and pain-relieving action, making it beneficial for joint and muscular pain.
- **Basil extract** contributes to calming inflammation and stress, supporting mental relaxation as well as localized pain relief.

Glycerin acts as a humectant to keep the skin hydrated and reduce irritation, while **jojoba oil** serves as a non-comedogenic carrier oil that aids in deeper penetration of active compounds without making the skin greasy.

The formulation is based on **aqueous extracts (decoctions/arqs)** to ensure safety, minimize skin irritation, and maintain the herbal integrity of the preparation. The use of a roll-on applicator ensures **convenient, hygienic, and targeted delivery**, which enhances patient compliance, especially for individuals with busy lifestyles.

This polyherbal preparation avoids synthetic chemicals and offers a **natural alternative** to commercially available pain-relief products. Based on the known phytochemistry of the selected ingredients, the formulation is expected to be **effective, safe, and suitable for all skin types**, although further evaluation through stability studies, efficacy testing, and user trials is recommended to support its therapeutic claims

Conclusion:

The formulated **Herbal Pain Relief Roll-On** is a natural, safe, and effective topical preparation designed to relieve headaches, muscle pain, and joint stiffness. It combines traditional herbal extracts like **mint, basil, and ajwain arq** with essential oils such as **peppermint oil and camphor**, offering both cooling and soothing effects. The formulation is non-greasy, easy to apply, and free from harmful chemicals. Its convenient roll-on packaging enhances usability and ensures targeted relief. Overall, this herbal roll-on serves as a promising alternative to synthetic pain-relief products, with the potential for wide acceptance due to its natural origin and multiple therapeutic benefits.

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