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FORMULATION AND EVALUATION OF POLYHERBAL EMULGEL FOR MANAGEMENT OF RHEUMATOID ARTHRITIS

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ABSTRACT

Rheumatoid arthritis (RA) is a chronic autoimmune disorder characterized by inflammation and destruction of joints, leading to pain, stiffness, and impaired mobility. Conventional treatments often focus on managing symptoms and slowing disease progression, but they may come with side effects and limited efficacy. Herbal remedies have gained attention for their potential to alleviate RA symptoms with fewer adverse effects.This project aims to develop a polyherbal emulgel, a topical formulation, utilizing the synergistic effects of Vitex negundo, Curcuma longa, Piper nigrum, and Zingiber officinale, known for their anti-inflammatory, analgesic, and antioxidant properties. Vitex negundo (Nirgundi) possesses anti-inflammatory and analgesic properties, while Curcuma longa (Turmeric) is known for its potent anti-inflammatory and antioxidant effects. Piper nigrum (Black Pepper) enhances the bioavailability of other herbal components, and Zingiberofficinale (Ginger) exhibits anti-inflammatory and analgesic properties.The emulgel formulation offers the advantage of both hydrophilic and lipophilic properties, ensuring better skin penetration and prolonged drug release. This project will involve the optimization of formulation parameters such as the concentration of herbal extracts, emulsifiers, and gelling agents to achieve the desired rheological and therapeutic properties .The developed polyherbal emulgel has the potential to provide symptomatic relief, reduce inflammation, and improve joint function in patients with rheumatoid arthritis, offering a safer and more holistic alternative to conventional therapies. The emulgel formulation was optimized for maximum efficacy and stability. Evaluation of the emulgel's physicochemical properties, such as pH, viscosity, and spreadability, stability testing ,rheogical behavior was conducted.

KEYWORDS: *Vitex negundo, Inflammation, Arthritis, polyherbal ,curcumin, piperin, joint pain.*

INTRODUCTION

Rheumatoid arthritis (RA) is a systemic autoimmune condition characterized by inflammatory arthritis and extra-articular manifestations. It is a chronic inflammatory disorder influenced by genetic and environmental factors, such as tobacco use, predominantly affecting synovial joints. RA manifests as joint pain, swelling, and stiffness, attributed to the immune system's misguided attack on healthy tissues, leading to inflammation. This condition affects joints and surrounding tissues, with potential long-term effects on various organs. While RA can develop at any age, it is more prevalent in middle-aged individuals, with women being more susceptible. Factors including infection, genetic predisposition, hormonal fluctuations, and smoking have been associated with the development of RA.[1]

Symptoms:

Most of the time, RA affects joints on both sides of the body inversely. Fingers, wrists, knees, bases, elbows, ankles, hips and shoulders are the most generally affected. The lower spine is usually not affected by RA.

The symptoms are commonly associated with rheumatoid arthritis including:

- Morning Stiffness Lasting Over An Hour
- Joint Warmth
- Tenderness
- Swelling,
- Symmetric Joint Pain
- Potential Deformities Over Time[2].

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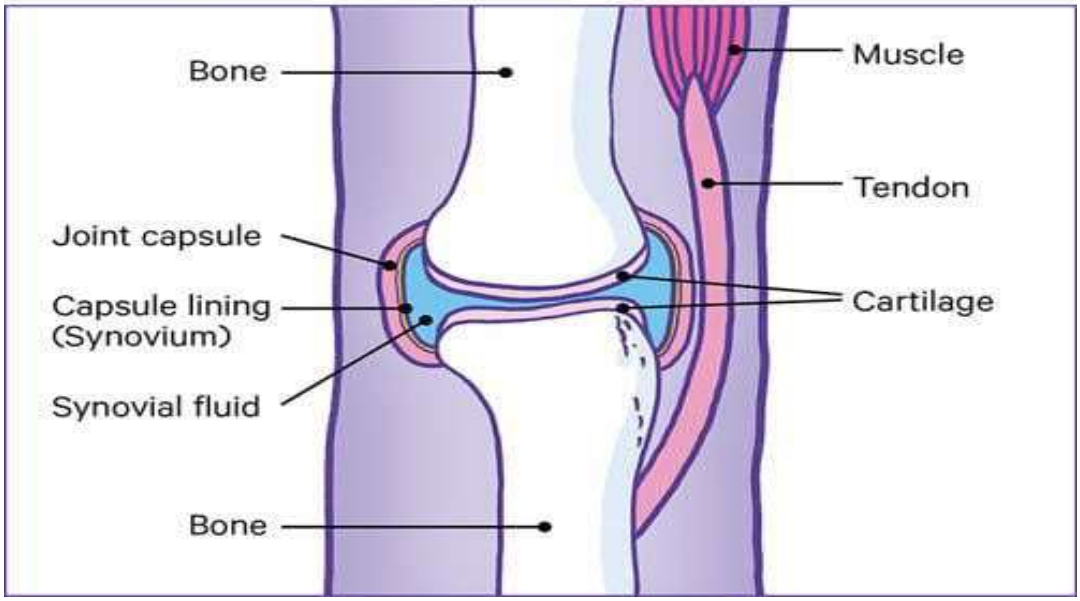
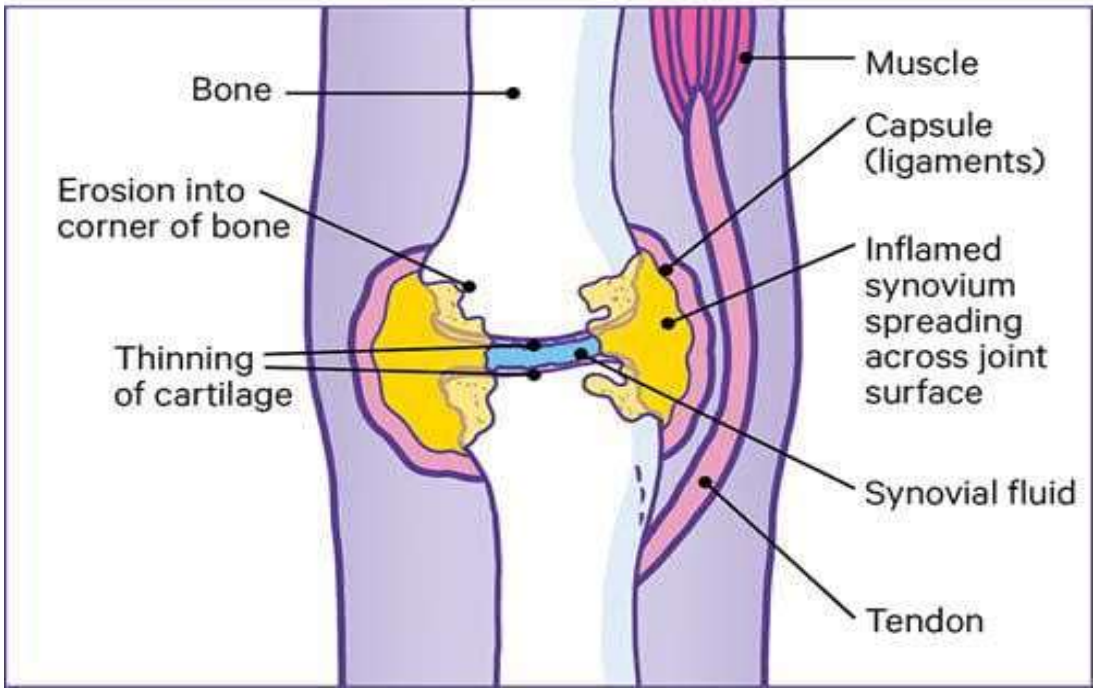
A healthy joint



A joint affected by rheumatoid arthritis



Aditionally symptoms may include:

- chest pain (pleurisy)
- dry eyes and mouth (Sjögren syndrome)
- eye irritation
- skin nodules, and numbness
- tingling in the extremities can occur.

Rheumatoid arthritis can affect any joint in the body, although it's frequently felt in the small joints in the hands and bases first. Both sides of the body are generally affected at the same time, in the same way, but this does n't always be[2].

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CAUSES

The following can play a part in why someone has rheumatoid arthritis:

- **Age**
  It's a common fact about rheumatoid arthritis, stating its prevalence among adults aged 40 to 60.
- **Sex**
  rheumatoid arthritis being higher in women than in men is a well-established fact in medical research.
- **Genetics**
  Rheumatoid arthritis arises due to a mix of genetic and environmental influences, like smoking and dietary factors. Although the exact genetic connection remains unclear, having a family member with the condition is believed to heighten the risk of developing it.
- **Weight**
  Being overweight significantly increases the likelihood of developing rheumatoid arthritis compared to maintaining a healthy weight. Body Mass Index (BMI) assesses weight in relation to height, with an ideal range for most adults falling between 18.5 and 24.9. Those with a BMI below 18.5 are considered underweight, while those between 25 and 29.9 are categorized as overweight.
- **Smoking**
  Cigarette smoking significantly increases the risk of developing rheumatoid arthritis.
- **Diet:** "Research suggests that a high intake of red meat coupled with low vitamin C consumption could elevate the likelihood of developing rheumatoid arthritis[3]."

Polyherbal formulations refer to mixtures containing two or more herbs. In Ayurveda, drug formulation is based on two principles: using a single herb and combining multiple herbs, with the latter being known as polyherbal formulation. This concept is integral to traditional Indian medicine, where plant formulations and combined extracts are preferred over individual plant extracts. Although the active phytochemicals in individual plants are known, they are often present in small amounts and are insufficient to achieve desired therapeutic effects on their own. Scientific research has shown that combining plants of varying potencies can produce greater therapeutic results compared to using the plants individually. This phenomenon, known as synergism, occurs when the pharmacological actions of herbal constituents are enhanced by the presence of other plants, which may not be evident when the herbs are used alone[4].

Introduction to Emulgel

Emulgel, which is indeed an emulsion that's been gelled using a gelling agent. This formulation can be either oil-in-water (o/w) or water-in-oil (w/o). Emulgels offer stability and are effective for delivering poorly water-soluble drugs, combining the advantages of both emulsions and gels. Despite the benefits, one drawback of gels is their limited ability to deliver hydrophobic medications, which Emulgel addresses by incorporating an emulsion-based solution. This allows even hydrophobic drugs to utilize the unique properties of gels.

Emulgels are capable of delivering both hydrophilic and lipophilic drugs thanks to their combination of aqueous and non-aqueous phases. They have gained popularity as controlled-release formulations in recent years, offering improved drug loading capacity and stability. Emulgels possess several desirable properties including good spreadability, non-greasiness, thixotropy, extended shelf life, lack of odor, and an appealing appearance compared to traditional topical formulations. Essentially, Emulgel acts as a dual control release system by combining the properties of both gels and emulsions[5].

Types of Emulgel

Microemulsion: Microemulsions are isotropic mixtures consisting of an oil-in-water system stabilized with surfactants, which are thermodynamically stable and optically clear. The droplet sizes range from 10 to 100 nm and remain separate without coalescing. They are composed of precise amounts of oil, co-surfactant, surfactant, and water. Microemulsions possess unique properties such as extremely low interfacial tension, a broad interfacial region, and the capacity to dissolve both aqueous and oil-soluble compounds. These properties can enhance drug permeation by reducing the diffusion barrier of the stratum corneum.

Despite their advantages, the low viscosity of microemulsions limits their use in the pharmaceutical industry due to poor skin retention. To overcome this, gelling agents like HPMC K100M, Carbopol 940, and guar gum are added to create microemulsion-based gels, providing a viscosity suitable for topical application[6].

Nanoemulgel

A nanoemulsion is a transparent or translucent oil-water dispersion that is thermodynamically stable, stabilized by surfactant and cosurfactant molecules, with droplet sizes ranging from 1 nm to 100 nm. When combined with a gel, it is referred to as a nanoemulgel. Nanoemulsions provide higher transdermal permeation compared to traditional formulations like emulsions and gels. They enhance transdermal and dermal delivery both in vivo and in vitro. Due to their high loading capacity and small droplet size, nanoemulsions allow drugs to penetrate the skin more easily, achieving therapeutic effects more efficiently[7].

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Macroemulsion Gel

Is a unique formulation for an emulgel, where the emulsion droplet particle sizes greater than 400nm. They are physically invisible, but under a microscope, the individual droplets can be seen clearly. Macroemulsions are thermodynamically unstable, but surface-active agents can help to stabilize them.

Advantages of Emulgel

- Hydrophobic drugs can be easily incorporated into the gel base using water/oil/water emulsions.
- Enhanced stability and drug load capacity.
- Simple and cost-effective production process.
- No need for sonication.
- Bypasses the first-pass metabolism.
- Avoids gastrointestinal incompatibility.
- Enables targeted drug delivery to specific body areas.
- Increases patient compliance.
- High acceptability and suitability for self-medication.
- Allows for easy termination of medication use[8].

Disadvantages of emulgel:

- The drug or excipients may cause skin irritation in individuals with contact dermatitis.
- Some medications have low skin permeability.
- There is a potential for allergic reactions.
- Drugs with larger particle sizes may not be easily absorbed through the skin[9].

The rationale of emulgel as topical drug delivery:

Various semisolid formulations, such as lotions, ointments, and creams, are available on the market for skin care and pharmacological purposes. However, these formulations often suffer from drawbacks like stickiness, low spreading coefficient, and stability issues. Transparent gels are preferred in pharmaceutical and cosmetic applications due to these limitations in semisolid preparations. To overcome these challenges, emulsion-based solutions are employed. This approach allows hydrophobic drugs to be effectively incorporated and delivered through gels.

Emulgels can integrate hydrophobic drugs by incorporating the drug into the oil phase, forming an oil-in-water emulsion. This emulsion is then mixed into the gel base, enhancing drug stability and release compared to directly incorporating the drug into the gel. This method overcomes solubility barriers and improves drug delivery efficiency[10].

Manufacturing And processing of the polyherbal emulgel for rheumatoid arthritis

The following drug ,plants ,excipients ,chemicals and equipments were used for the formulation and evalution studies of emulgel.

1. Ingredients:
   Vitexnegundo
   Zinger officinale
   Pippernigrum
   Curcuma longa
2. Excipients:
   Liquid paraffin
   Tween80
   Span20
   Carbapol 940
   Propylene glycol
   Methyl paraben
   Triethanolamine
3. Equipment:
   stoppered container, mortal pestle, measuring cylinder, maceration apparatus, magnetic stirrer, rotatory evaporator, soxhlet apparatus, whatmaan filter peper, PH meter.

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Preparation of Extract

1) Nirgundi (Vitex negundo):
The leaf powder of Vitex negundo was soaked in 50 mL of ethanol solvent for 72 hours at room temperature. The resulting menstruum was filtered, and the filtrate was evaporated using a rotary evaporator to obtain the residue[11].

2) Ginger (Zingiber officinale):
Aqueous-ethanolic extract of ginger was prepared using the maceration method. 2 g of ginger was ground and added to a mixture of 200 mL of 96% ethanol and 200 mL of deionized distilled water. The mixture was stirred continuously at room temperature for 72 hours. The final extract was filtered through Whatman filter paper and concentrated in an oven at 40°C for 72 hours[12].

3) Turmeric (Curcuma longa):
Finely ground turmeric powder (15 g) was dissolved in 100 mL of 70% alcohol and left undisturbed for 48 hours at room temperature. Afterward, the liquid extract was passed through filter paper or a filtration system to remove any remaining particles or debris[13].

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4) Black Pepper (Piper nigrum):
Black pepper was dried, ground into a fine powder, and approximately 10 g was placed in a Soxhlet thimble. It was then extracted using 100 mL of ethanol for 240 minutes. The solution obtained in the round bottom flask was concentrated using a water bath maintained at 90°C during the concentration process[14].

Parts used for extraction

Sr no.	Herbs	Parts used	Chemical constituents	uses
1	Nirgundi (vitexnegundo)	Leaves,roots	nisindine	Anti-inflammatory and analgesic properties
2	Zinzer (zingiberofficinale)	Rhizomes	Zingerol	Anti-inflammatory and analgesic properties.
3	Blackpepper (piper nigrum)	fruits	piperine	Anti-inflammatory
4	Turmeric (curcuma longa)	Zhizomes	curcumin	Anti-inflammatory and antioxidant

Preparation of Emulgel

1. Carbopol is mixed with purified water with continuous stirring on magnetic stirrer helps to disperse the Carbopol evenly in the solvent, ensuring proper gel formation. It's important to stir until the Carbopol is fully hydrated and no lumps remain.
2. The oil phase was prepared by dissolving span in liquid paraffin.
3. Aqueous phase was prepared by dissolving tween in purified water.
4. Methyl paraben dissolved in propylene glycol whereas extract where dissolved in water and mixed both solutions with aqueous phase.
5. Oil and aqueous phase heated separately at 70-80°c.
6. Then oil phase added drop wise to the aqueous phase with continuous stirring.
7. Resultant emulsion was cooled at room temperature.
8. Obtained emulsion was mixed with the gel in ratio 1:1 with moderate stirring to obtain emulgel.
9. The pH of formulation was adjusted to 6-6.5 using triethanolamine(TEA).

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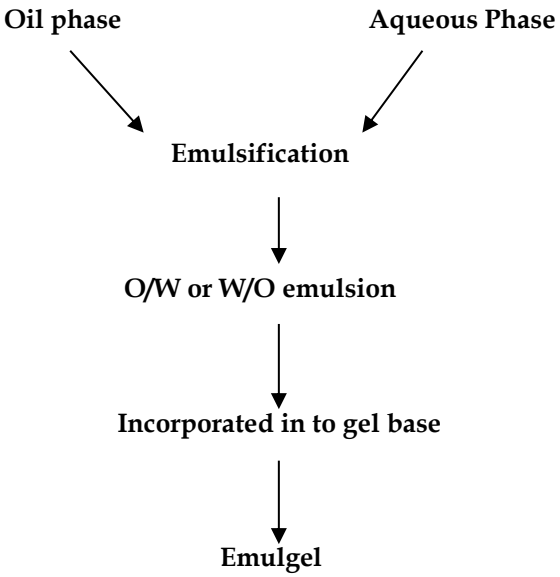

Fig: Emulgel preparation method

Formulation and composition of an emulgel.

Sr no.	Drug	Qty taken (50ml)	category
1	Nirgundiextract	2ml	Anti-inflammatory
2	Zinger extract	2ml	Anti-inflammatory
3	Turmeric extract	2ml	Anti-inflammatory
4	Black pepar extract	1ml	Anti-inflammatory
	Excipients	**Qty taken**	**category**
6	Carbapol940	4gm	Gelling agent
7	Tween80	1.2ml	Emulsifying agent
8	Span20	1.8ml	Emulsifying agent
9	Methyl paraben	0.04gm	preservative
10	Propylene glycol	14ml	Solvent
11	Liquid paraffin	15ml	Stabilizer
12	Triethanolamine	Q.S.	PH adjuvant
13	Distilled water	Q.S	vehicle

Uses

- Anti-inflammatory Properties:Vitexnegundo (Nirgundi) and Curcuma longa (Turmeric) are known for their potent anti-inflammatory properties. They can help reduce inflammation in the joints, which is a hallmark of rheumatoid arthritis. Inflammation contributes to pain, stiffness, and joint damage in rheumatoid arthritis patients.
- Analgesic Effects:The combination of these herbs offers analgesic (pain-relieving) effects. Piper nigrum (Black pepper) and Zingiberofficinale (Ginger) contain compounds that help alleviate pain by blocking pain signals to the brain and reducing the perception of pain in the affected joints.
- Improved Blood Circulation:Ginger officinale can help improve blood circulation, which is beneficial for individuals with rheumatoid arthritis as it promotes the delivery of oxygen and nutrients to the affected joints, aiding in their repair and reducing pain.
- Antioxidant Protection:Curcuma longa and Vitexnegundo are rich in antioxidants that help neutralize free radicals in the body.

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Free radicals contribute to inflammation and joint damage in rheumatoid arthritis. By scavenging these free radicals, the emulgel can help protect the joints from further damage[15].

- Enhanced Joint Mobility:Regular application of the emulgel can help improve joint mobility and flexibility. This is particularly beneficial for individuals with rheumatoid arthritis, as stiffness and limited range of motion are common symptoms of the condition.
- Local Application for Targeted Relief:Emulgels provide a convenient way to deliver the therapeutic effects of herbal extracts directly to the affected joints. The emulgel can be applied topically, providing targeted relief to the painful and inflamed joints without the systemic side effects associated with oral medications.
- Natural and Safe Alternative:Unlike some conventional medications used to treat rheumatoid arthritis, polyherbalemulgels are generally well-tolerated and have fewer side effects. They offer a natural and safe alternative for managing symptoms and improving quality of life for individuals with rheumatoid arthritis [16].

Mechanism of action

The mode of action of the emulgel containing herbal extracts of Vitexnegundo, Curcuma longa, Piper nigrum, and Zingiberofficinale involves a multi-faceted approach targeting various aspects of inflammation, pain, and oxidative stress:

- Penetration: Upon application, the emulgel base facilitates the penetration of herbal extracts through the skin barrier.
- Inhibition of Pro-Inflammatory Mediators: Active compounds from Vitexnegundo, Curcuma longa, Piper nigrum, and Zingiberofficinale inhibit the production or activity of pro-inflammatory mediators such as cytokines (e.g., IL-1, IL-6, TNF-α), prostaglandins (via COX inhibition), and leukotrienes.
- Reduction of Oxidative Stress: Antioxidant compounds present in the herbal extracts scavenge reactive oxygen species (ROS), reducing oxidative stress and inflammation.
- Modulation of Immune Response: The herbal extracts regulate the immune response by modulating the activity of immune cells involved in inflammation, such as macrophages and neutrophils.
- Analgesic Effects: Compounds with analgesic properties from the herbs alleviate pain by inhibiting pain-signaling pathways or by reducing inflammation-induced sensitization of pain receptors.
- Enhanced Bioavailability: Piper nigrum (black pepper) enhances the bioavailability of curcumin from Curcuma longa, maximizing its therapeutic effects.
- Synergistic Action: The combination of multiple herbs in the emulgel results in a synergistic effect, amplifying the overall anti-inflammatory and analgesic properties.
- Promotion of Tissue Healing: Some constituents of the herbal extracts promote tissue regeneration and wound healing, aiding in the resolution of inflammation and associated symptoms.
- By following these steps, the poly herbal emulgel effectively targets various aspects of the inflammatory process, providing comprehensive relief from inflammation and associated discomfort[17].

Application

steps for applying poly herbal emulgel

- Preparation: Wash your hands and the affected area with mild soap and water. Pat dry with a clean towel.
- Dispensing: Squeeze a small amount of poly herbal emulgel onto your fingertips. The amount needed depends on the size of the affected area.
- Application: Gently spread the emulgel over the affected area using your fingertips. Apply a thin, even layer to cover the area completely.
- Massage: Use circular motions to massage the emulgel into the skin. Continue massaging until the emulgel is fully absorbed.
- Reapplication: If necessary, reapply the emulgel according to the instructions provided on the product label.
- Cleanup: Wash your hands thoroughly after application to remove any residue.
- Storage: Close the container tightly and store it in a cool, dry place away from direct sunlight.

Pharmacology

In pharmacology, understanding the pharmacodynamics and pharmacokinetics of the polyherbal extract of vitexnegundo, zinger, turmeric, black pepper is crucial for assessing its efficacy, safety, and potential interactions. Here's a brief overview:

1. Pharmacodynamics: The pharmacodynamics of the polyherbalemulgel you mentioned would involve the study of how its active ingredients interact with the body to produce therapeutic effects..key aspects include:

- Mechanism of action: Many of the herbs in the formulation, such as Vitexnegundo, Curcuma longa, and ginger, contain compounds that can inhibit inflammatory pathways in the body. This can help reduce inflammation in the joints, which is a key feature of rheumatoid arthritis.

Analgesic properties: Some of the herbs, including ginger and Vitexnegundo, have analgesic properties that can help alleviate

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pain associated with arthritis.

Antioxidant activity: Curcuma longa and other herbs in the formulation may exert antioxidant effects, protecting joint tissues from oxidative damage often seen in arthritis.

Enhanced absorption: Piper nigrum (black pepper) contains piperine, which may enhance the absorption of other active compounds in the formulation, potentially increasing their effectiveness.

- Spectrum of activity: The spectrum of activity of the polyherbalemulgel would primarily target symptoms associated with rheumatoid arthritis, such as inflammation, pain, and stiffness in the joints.
- Concentration response curve: his relationship can help determine the optimal concentration or dosage of each herb needed to achieve the desired therapeutic outcome while minimizing any potential side effects..
- Time-course effects: Onset of action- This refers to how quickly the emulgel starts to alleviate symptoms after application. Some individuals may experience relief shortly after applying the emulgel, while for others, it may take some time for the active ingredients to penetrate the skin and exert their effects on the affected joints.

Duration of action: Once applied, the emulgel may provide relief from symptoms for a certain period. The duration of action can vary depending on factors such as the concentration of active ingredients, the formulation's ability to maintain sustained release of these ingredients, and individual differences in metabolism and skin absorption [18].

2. Pharmacokinetics: pharmacokinetics of the polyherbalemulgel for rheumatoid arthritis involves the study of how the body absorbs, distributes, metabolizes, and eliminates the active ingredients in the formulation. Here's how it applies:

   -Absorption: After topical application, the active compounds in the emulgel are absorbed through the skin. Factors such as the formulation's composition, the size and properties of the molecules, and the condition of the skin can influence the rate and extent of absorption.

   -Distribution: Once absorbed, the active ingredients may distribute to various tissues, including the joints affected by rheumatoid arthritis. The extent of distribution depends on factors such as blood flow to the tissues and the lipophilicity of the compounds.

   -Metabolism: Some of the absorbed compounds may undergo metabolism in the body, primarily in the liver or other tissues. Metabolism can involve processes such as oxidation, reduction, or conjugation, which may affect the activity and bioavailability of the compounds.

   -Elimination: Metabolized or unchanged compounds are eventually eliminated from the body, primarily through urine, feces, or exhalation. The rate of elimination depends on factors such as the compound's half-life and the efficiency of renal or hepatic clearance[19].

3. Safety and Toxicology: Acute toxicity- This involves determining the potential adverse effects of the emulgel after a single exposure. Acute toxicity studies may include evaluating skin irritation, allergic reactions, or systemic toxicity in animal models.

   -Chronic toxicity: Chronic toxicity studies evaluate the long-term effects of prolonged exposure to the emulgel, typically conducted over several months to years.

   -Skin irritation: Skin irritation studies assess the emulgel's potential to cause irritation or damage to the skin after repeated application.

   -Skin sensitization: Skin sensitization studies evaluate whether the emulgel has the potential to induce an allergic reaction upon repeated exposure.

4. Interactions: Investigating potential interactions between the extract and other drugs or herbal products, both pharmacodynamic and pharmacokinetic in nature.
5. Dose Optimization: Determining the optimal dose and dosing regimen based on pharmacokinetic and pharmacodynamic data, balancing efficacy with safety considerations.

   Overall, a comprehensive understanding of the pharmacology of the extract essential for its effective and safe use in polyherbalEmulgel formulations with Anti-inflammatory properties[20].

Therapeutic

1. Muscle relaxation: Ginger (Zingiberofficinale) has muscle relaxant properties, which could help alleviate tension and stiffness in the muscles surrounding the affected joints.
2. Improved circulation: Ingredients like ginger and black pepper (Piper nigrum) may help improve blood circulation when applied topically, promoting better nutrient delivery and waste removal in the affected area.
3. Warming sensation: Some users may experience a mild warming sensation upon application, which can provide temporary comfort and relief to sore joints.
4. Moisturization: Emulgel formulations typically contain moisturizing agents that can help hydrate the skin, which may be beneficial for individuals with dry or irritated skin around the affected joints.
5. Potential synergistic effects: The combination of multiple herbs in the emulgel may result in synergistic effects, enhancing

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the overall therapeutic outcome compared to using each herb individually.

6. Anti-arthritic: The combination of herbs may work synergistically to alleviate symptoms of arthritis, including joint swelling and stiffness.
7. Cartilage protection: Some herbs in the emulgel may have chondroprotective properties, potentially helping to preserve cartilage integrity and slow down the progression of joint degeneration.
8. Anti-rheumatic: The emulgel may help reduce symptoms associated with rheumatism, such as pain and inflammation in the joints and surrounding tissues.
9. Antimicrobial: Certain herbs like turmeric (Curcuma longa) and ginger (Zingiberofficinale) have antimicrobial properties, which could help prevent infections in the affected joints or skin.
10. Enhanced absorption: The emulgel formulation may improve the absorption of active ingredients through the skin, allowing for targeted delivery to the affected area.
11. Improved quality of life: By providing relief from pain and discomfort, the emulgel may contribute to an overall improvement in quality of life for individuals with rheumatoid arthritis[21].

Evaluation Tests

Emulgel was evaluated for parameters like:

1)Physical examination:

The prepared emulgel formulation visually inspected for colour,odour,appearance, consistency, and homogeneity.

2)Determination of PH:

The pH of the poly herbal emulgel can be determined using a pH meter or pH strips.Take a small amount of the emulgel sample and place it in a clean container.Immerse the pH meter electrode or dip the pH strip into the emulgel sample. Allow the reading to stabilize.this process was repeated 3 times[23].

3)Spredability:

The spreadability of Emulgel formulations were determined by placing 0.5 g of respective Emulgel within a circle of diameter 1 cm, pre-marked on a glass plate over which a second glass plate was placed. A weight of 500 g was allowed to rest on the upper glass plate for about 15 seconds. The diameter due to spreading of the Emulgel was noted.

4) Viscocity:

The viscosities of formulations were determined by Brookfield viscometer using spindle no 7. The hydrogel sample was taken in a beaker and the dial reading was noted at 100 rpm.

5) Stability testing :

store samples in cool condition.

6) Swelling Index:

Take a known weight (W1) of the emulgel sample and place it in a suitable container.Completely immerse the emulgel sample in a large volume of distilled water at room temperature for a specified period.After the immersion period, carefully remove the excess water from the surface of the emulgel using a blotting paper or tissue.Weigh the swollen emulgel sample (W2) after excess water removal.Calculate the swelling index using the formula[22]:

Swelling Index = (W2 - W1) / W1

7) Antimicrobial activity study:

In this study we check the antimicrobial activity using a agar medium plate formation method we check the microbial growth are increasing or decreasing.

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Fig: Antimicrobial activity of Polyherbal Emulgel against two types of microbial organisms viz. E.Coli& Pseudomonas.

8)Compatibility Testing:

Conduct compatibility testing of the emulgel with packaging material to ensure Compatibility and prevent any leaching or interaction between the formulation and. packaging

RESULTS & OBSERVATIONS:

Sr no.	1)Physical Test	2)Sensory Test
1	Appearance: smooth texture	Odour: warm slightly aromatic fragrance
2	Colour: yellowish	
3	Texture: smooth	
4	Consistency: semi-solid	Irritancy: No irritation and edema found

Fig: shows Appearance characteristics of emulgel:

Srno .	Tests	Inference
1	Spreadability	4.33
2	PH	6.68
3	Viscosity	31.312
4	Swelling Index	48.23%

Fig : shows spredability,PH,Viscosity and swelling index of emulgel formulation

CONCLUSION

The aim of the study was to formulate and evaluate polyherbalEmulgel as a topical drug delivery system for the treatment of rheumatoid arthritis by using anti-inflammatory, drugs likenirgundi,turmeric, ginger, black paper as these are lipophilic and hydrophilic drugs having problem to incorporate directly into, gelling base or cream base.

So Emulgels are a unique approach for the hydrophobic drugs as compared to conventional gels. They overcome the drawback hydrophobicity because the Emulgel possess both phases hence it is suitable for both hydrophilic and lipophilic drugs.

Topical drug delivery system has great advantage that it allows to target the site and reduces the dose of drug owing to it topical treatment is choice of treatment for rheumatoiddeseases.

In conclusion, the formulation and evaluation of a polyherbalemulgel for rheumatoid arthritis present a promising approach for managing the condition. Through careful selection of herbs with anti-inflammatory and analgesic properties, coupled with an appropriate emulgel base, a formulation with potential therapeutic benefits can be developed. Evaluation of the emulgel should encompass various parameters such as rheological properties, stability, skin compatibility, and efficacy in alleviating arthritis symptoms. Further research, including preclinical and clinical studies, is warranted to validate the efficacy and safety of the developed emulgel for practical use in managing rheumatoid arthritis.

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