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"GOLDEN THERAPY: CRAFTING AND ASSESSING TURMERIC EMULGEL FORMULATION"

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ABSTRACT:

Golden Therapy: Crafting and Assessing Turmeric Emulgel Formulation is a comprehensive study aimed at formulating and evaluating the efficacy of a turmeric-based emulgel for potential therapeutic applications. Turmeric, renowned for its medicinal properties, particularly its anti-inflammatory and antioxidant effects attributed to curcumin, serves as the key ingredient in this formulation. The emulgel combines the benefits of both emulsion and gel systems, providing enhanced skin permeability and prolonged drug release. The research begins with the development of the emulgel formulation using a combination of hydrophilic and lipophilic ingredients to optimize stability, texture, and drug release characteristics. Various emulsifiers, gelling agents, and penetration enhancers are meticulously selected and incorporated to achieve the desired rheological properties and skin permeation profile. Furthermore, the study evaluates the physicochemical properties, such as pH, viscosity, spreadability, and drug content uniformity, to ensure the formulation's suitability for topical application. In vitro assessments, including skin irritation studies and skin permeation studies using Franz diffusion cells, provide valuable insights into the safety and efficacy of the emulgel. Moreover, the formulation undergoes comprehensive in vivo evaluations to assess its therapeutic potential, including anti-inflammatory activity using carrageenan-induced paw Edema model and antioxidant activity utilizing appropriate assays. These evaluations aim to validate the effectiveness of the turmeric emulgel in alleviating inflammation and oxidative stress, thereby supporting its potential use in various dermatological conditions. Physicochemical characterization of the emulgel includes assessments of pH, viscosity, spreadability, and drug content uniformity to ensure quality and consistency. In vitro studies, such as skin irritation tests and skin permeation studies using Franz diffusion cells, provide insights into the formulation's safety and efficacy profile.

In vivo evaluations focus on assessing the therapeutic potential of the turmeric emulgel, including anti-inflammatory and antioxidant activities. Animal models are utilized to investigate its efficacy in mitigating inflammation and oxidative stress, thereby supporting its potential for dermatological applications. The findings of this study contribute to the growing body of research on turmeric-based formulations and highlight the promising prospects of turmeric emulgel as a novel therapeutic agent in skincare and dermatology. Overall, this study presents a systematic approach to the development and assessment of a turmeric-based emulgel formulation, offering promising prospects for its application in skincare and dermatological therapy.

KEY WORDS:

Golden Therapy, Turmeric, Emulgel formulation, Anti-inflammatory, Antioxidant, Dermatological applications, Excipients, Physicochemical characterization, In vitro studies, In vivo evaluations, Skin permeation, Rheological properties, Skin compatibility, Drug release kinetics, Animal models.

INTRODUCTION:

Turmeric, a golden-hued spice derived from the Curcuma longa plant, has been revered for centuries in traditional medicine for its diverse therapeutic properties. Curcumin, the primary bioactive compound in turmeric, has garnered significant attention for its anti-inflammatory, antioxidant, antimicrobial, and wound-healing effects. With growing interest in natural remedies and botanical extracts, turmeric has emerged as a promising candidate for various healthcare applications, particularly in dermatology. In recent years, there has been a surge in research exploring the potential of turmeric-based formulations for skincare and dermatological therapy. Among these formulations, emulgels have gained prominence due to their unique combination of emulsion and gel characteristics, offering advantages such as enhanced skin permeation, prolonged drug release, and improved cosmetic appeal. Emulgel formulations provide a versatile platform for incorporating hydrophilic and lipophilic active ingredients, making them well-suited for delivering bioactive compounds like curcumin to the skin. Golden Therapy: Crafting and Assessing Turmeric Emulgel Formulation aims to capitalize on the therapeutic potential of turmeric by developing a novel emulgel formulation for dermatological applications. This research endeavours to address the need for safe, effective, and natural alternatives in skincare, particularly for managing inflammatory skin conditions and combating oxidative stress-induced damage. The formulation process begins with the careful selection of excipients to achieve optimal stability, rheological properties, and skin permeation. Emulsifiers, gelling agents, and penetration enhancers are meticulously chosen based on their compatibility with turmeric extract and their ability to impart desirable texture and consistency to the emulgel. The synergy between these ingredients is critical in ensuring the uniform dispersion of turmeric particles, enhancing its bioavailability and therapeutic efficacy upon topical application. Physicochemical characterization of the emulgel is essential to evaluate its quality and performance. Parameters such as pH, viscosity, spreadability, and drug content uniformity are assessed to ensure consistency and reproducibility across batches. These analyses provide valuable insights into the formulation's suitability for topical use and its potential impact on skin physiology. In vitro studies play a crucial role in elucidating the emulgel's skin permeation profile and safety profile. Skin irritation tests

are conducted to assess the formulation's compatibility with the skin, while Franz diffusion cell experiments provide quantitative data on drug permeation through the skin barrier.

These studies aid in refining the formulation and optimizing its composition to enhance drug delivery efficiency while minimizing adverse effects. The evaluation of the turmeric emulgel extends beyond laboratory experiments to include comprehensive in vivo assessments of its therapeutic efficacy. Animal models are employed to investigate the formulation's anti-inflammatory and antioxidant activities in vivo. By utilizing appropriate animal models and experimental protocols, researchers aim to validate the emulgel's potential for alleviating inflammation, protecting against oxidative stress, and promoting skin health. In summary, Golden Therapy: Crafting and Assessing Turmeric Emulgel Formulation represents a concerted effort to harness the therapeutic properties of turmeric in a topical formulation tailored for dermatological use. Through systematic formulation development and rigorous evaluation, this research seeks to contribute to the advancement of natural skincare solutions and promote the integration of traditional remedies into modern dermatological practice.

Indian turmeric, belonging to the Zingiberaceae family, is extensively utilized in traditional medicine and is distinguished by its elevated Curcumin levels compared to varieties from other regions. Curcumin, a lipophilic polyphenolic compound of low molecular weight, characterizes this medicinal plant. This active constituent of turmeric is isolated from curcuma longa, and it provides colour to turmeric. Curcumin has various medicinal properties and shows Anti-inflammatory, antioxidant, anti-bacterial and anticancer activities. The yellow colour of the turmeric is due to the curcumin compound. (C21H20O6) was first described in 1910 by Lampe and Milobedeska and shown to be a diferuloylmethane, 1,7-bis (4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione and is practically insoluble in water.

Fig-01

Curcumin, characterized as a bis-α-β-unsaturated β-diketone under both acidic and neutral conditions, operates through mechanisms that remain to be fully understood for its anti-inflammatory effects. Research indicates that peroxisome proliferator-activated receptor gamma (PPAR-γ) is implicated in exerting these anti-inflammatory properties. PPARs, a subgroup within the nuclear receptor superfamily comprising three distinct

subtypes—PPAR-α, PPAR-δ, and PPAR-γ—have been extensively investigated, with PPAR-γ being the most studied variant.

Upon activation by a ligand, PPAR-γ forms heterodimers with the retinoid X receptor and binds to a peroxisome proliferation response element (PPRE) within a gene promoter, thereby modulating gene transcription. In that regard, we have recently shown that gene and protein levels of PPAR-γ in the liver decreased by approximately 50% at 20 hours after the onset of sepsis. In comparison to untreated wounds, wounds treated with curcumin in an animal model of wound healing showed significant increases in the infiltration of macrophages, neutrophils, and fibroblasts. The treatment led to heightened fibroblast expression of fibronectin and collagen, along with an accelerated rate of granulation tissue formation, indicating an improvement in wound healing. Emulgel, being a stable vehicle, is preferred for delivering hydrophobic or water-insoluble drugs like Turmeric. Its high patient acceptability stems from combining the benefits of both emulsions and gels. Consequently, they have recently been employed as carriers for delivering a variety of drugs to the skin.

PHYSIOLOGY OF SKIN:

Understanding the skin's physiology and function is crucial for the development of topical dosage forms, as the skin is treated with such formulations. The human skin Covers about $2m^2$ Of surface area and provides One-third of systemic circulation through the skin. Per square centimetre of human skin, there are Approximately 200-300 sweat ducts and 40-50 hair Follicles. The human skin pH Curcumin ranges between 4.7 To 5.73,4.

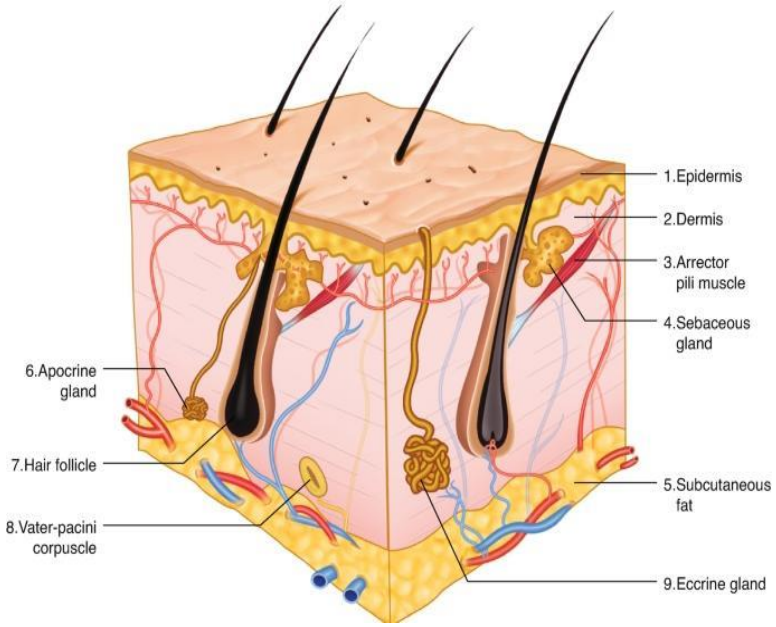

Fig-02

PHYSIOLOGICAL FACTORS:

- Lipid Content: Skin is an important water barrier; When the lipid weight in the stratum corneum Of skin is minimal, percutaneous penetration Increases.

- Skin Thickness: The thickness of the skin varies From the epidermal layer to the subcutaneous layer.
- The epidermal layer is thick, measuring 100–150 m.
- The Density of Sweat Glands.
- Hair Follicle Density: The storage capacity of the Hair follicle's infundibulum is approximately ten Times that of the stratum corneum.
- The pH of Skin: Skin pH increases due to an Increase in the secretion of fatty acids and sweat At the surface of the skin.
- Skin Temperature: As the temperature increases, The rate of skin permeation increases.
- Hydration of Skin: Enhance the permeation of The drug.
- Skin Inflammation: As the stratum corneum is Disrupted, the permeability increases5,6.

EMULSION:

Emulsions are made by combining two Or more liquids that are normally incompatible. In this system, the oil phase is miscible with the Aqueous phase using an emulsifying agent. Emulsifying agents aid in stabilizing emulsions, being easily removable and exhibiting good penetration capabilities.

GEL:

The word "gel" refers to enhancing the Viscosity of liquid preparations without changing Other properties. Gels serve as both a thickening agent and aid in enhancing the uniformity and texture of a formulation. They are employed to establish a gel base, which is subsequently blended with an emulsion to produce an emulgel. A gel is made up of a polymer that Enlarges when exposed to fluid and possibly within Its structure. The amount of fluid entrapped in the Gel determines its rigidity. These gels are wet and Smooth, with the appearance of being solid. These substances can undergo substantial physical deformation, transitioning from a solid to a liquid state.

INTRODUCTION TO EMULGEL:

An emulgel is recognized as an emulsion that has been transformed into a gel through the incorporation of a gelling agent. They can be Made either o/w or w/o type. Emulgel is a stable And superior system that incorporates poor water-Soluble drugs. In brief, emulgel is a combination Of emulsion and gel. Despite the many benefits of gels, a notable drawback is their challenge in delivering hydrophobic medications. To address this, an emulsion-based approach is being employed to overcome this limitation, enabling hydrophobic therapeutic compounds to leverage the distinctive characteristics of the gel. Emulgels possess the capability to transport both hydrophilic and lipophilic drugs owing to the inclusion of both aqueous and non-aqueous phases. In recent times, they have been utilized as controlled-release formulations. These Are biphasic systems that have better drug loading Capacity and better stability10,11. Emulgels exhibit numerous favourable properties, including excellent spreadability, non-greasiness, thixotropic, extended shelf life, lack of odour, and an aesthetically pleasing appearance compared to traditional topical formulations. Combining the characteristics of both gels and emulsions, emulgels serve as a dual-controlled release system.

Emulgel System = Emulsion + Gel

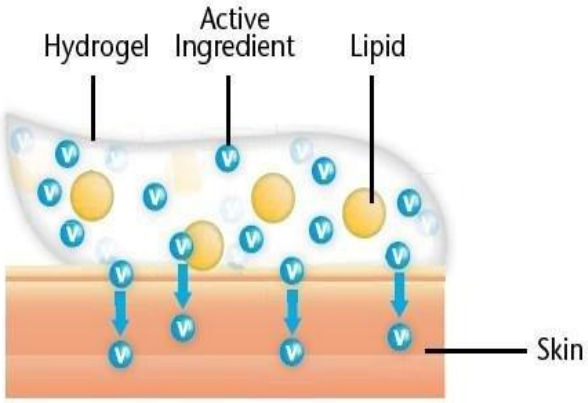

Fig-03

TYPES OF EMULGEL:

1]. MICROEMULSION:

Microemulsions are homogeneous blends of oil and water stabilized by a surfactant, demonstrating thermodynamic stability and optical clarity. Droplets with diameters between 10 and 100nm show no tendency to merge, and the composition typically includes precise proportions of oil, co-surfactant, surfactant, and water. To overcome the limited skin retention ability of microemulsions in pharmaceutical applications due to their low viscosity, gelling agents such as HPMC K100M, Carbopol 940, and guar gum are incorporated to form microemulsion-based gels suitable for topical use, while still maintaining their unique properties such as extremely low interfacial tension and broad interfacial region, Accelerating drug penetration by decreasing the diffusion barrier of the stratum corneum.

2]. NANOEMULGEL:

When a gel is combined with an emulsion, it's termed as a nanoemulgel. Nanoemulsions, which are transparent or translucent oil-water dispersions with thermodynamic stability maintained by surfactant and cosurfactant molecules, typically exhibit globule sizes ranging from 1nm to 100 nm. Compared to traditional formulations like emulsions and gels, nanoemulsions often result in enhanced transdermal permeation of many drugs. Due to its small globule size and high loading capacity, nanoemulsions exhibits improved transdermal and dermal delivery properties both in vivo and in vitro. This allows for easy penetration of the drug into the skin, resulting in a more rapid therapeutic effect over a shorter duration.

3]. MICROEMULSIONS GEL:

Emulgel with 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.

THE RATIONALE OF EMULGEL AS TOPICAL DRUG DELIVERY:

Various semisolids and other preparations Are available on the market for restoring the Skin's fundamental role or pharmacologically Altering an operation to the underline tissue18. Formulations like lotions, ointments, and creams suffer from various drawbacks such as stickiness, low spreading coefficient, and stability issues. Only transparent gels Have exposure in pharmaceutical and cosmetic Preparations due to overall limitations within The semisolid preparations19. As a result, an Emulsion-based solution is used to address this Limitation. Hence, the hydrophobic moiety of the Drug should be incorporated and provided through Gels. Hydrophobic drugs can be incorporated into emulgel formulations using drug/oil/water emulsions. Since Solubility acts as a barrier, most drugs cannot be Inserted directly into gel bases, causing problems During drug release. The emulgel system facilitates the integration of a hydrophobic drug into the oil phase, allowing for the easy dispersion of oily globules into the aqueous phase, forming an oil/water emulsion. This emulsion can then be blended into the gel base. This could lead to improved drug stability and release compared to just adding the drug to the Gel base20.

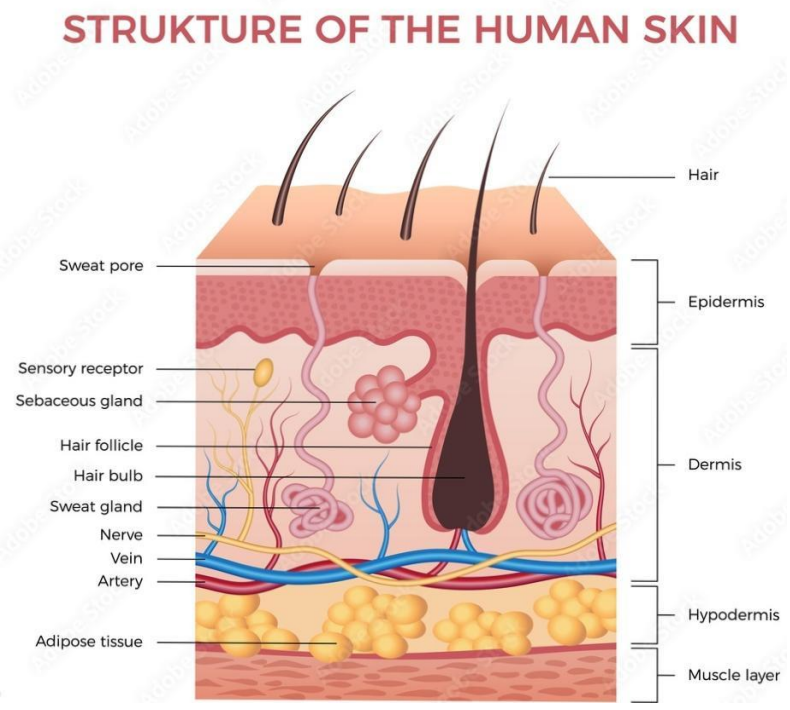

Fig-04

MATERIALS AND METHODS:

MATERIALS:

Material	Quantity
Turmeric extract	2.5g
Oleic acid	1.5g
Carbopol 934	1.5g
Methyl salicylate	Ig
Propylene glycol	2.5g
Cetostearyl alcohol	5g
Distilled water (q.s.)	q.s
Methyl paraben	0.05g
Propyl paraben	0.05g
Triethanolamine	0.6ml

Table No. 01 (Materials)

EQUIPMENT:

Equipment	Examining Emulgel Microstructure
Mixer or blender	Mixing emulgel ingredients
Heating mantle	Heating and melting emulsifying agents
pH meter	Measuring pH of the emulgel
Viscometer	Measuring viscosity of the emulgel
Homogenizer	Achieving uniform distribution of ingredients
Centrifuge	Separating phases during preparation or evaluation
Weighing Balance	Accurate measurement of ingredient quantities
Sonicator	Dispersing and deagglomerating particles
Stability chamber	Storing samples for stability assessment
Microscope	Examining emulgel microstructure

Table No. 02 (Equipment's)

METHODS:

EXTRACT PREPARATION AND SOLUBILITY STUDY:

Turmeric powder used for extraction. The ethanolic extract was obtained through the maceration process, followed by filtration and drying in a hot air oven. It was stored at refrigerator until use. Curcumin is coming from the Curcuma longa which gives golden colour and have the biological importance. The solubility of turmeric extract was found to be low in water but significantly higher in phosphate buffer at pH 7.4, achieving complete solubility with the aid of sonication. All experiments were conducted under pH 7.4 conditions throughout the study.

FORMULATION DESIGN OF TURMERIC EMULGEL PREPARATION:

1) **GEL PREPARATION:**

The Carbopol gel was formulated by dispersing the specified amount provided in the formulation table of Carbopol 934 into the designated volume of purified water, stirring continuously at a moderate pace, and allowing it to soak overnight.

2) **EMULSION PREPARATION:**

The oil phase of emulsion was prepared by mixing oleic acid, methyl salicylate, tween 20 and previously melted cetostearyl alcohol. Methyl paraben, propyl paraben was mixed in propylene glycol this added this mixture was dissolved in aqueous phase. Subsequently, the oil phase was gradually blended with the aqueous phase while maintaining a constant temperature of 50-60°C.

3) **EMULGEL PREPARATION:**

The emulsion obtained was blended with the gel and homogenized for 2 hours to produce Turmeric Emulgel. The pH was brought to a range of 6-7 by the addition of triethanolamine.

PRE-FORMULATION STUDY:

MEASURING THE MAXIMUM ABSORPTION WAVELENGTH OF TURMERIC USING UV-VISIBLE SPECTROSCOPY.

a) Preparation of 00µg/ml turmeric stock solution
b) Preparation of 100µg/ml turmeric standard solution.
c) Determination of absorption maxima of turmeric using UV-Visible spectroscopy Calibration curve of turmeric:

From the standard solution (100µg/ml) 2,4,6,8,10and 12ml was withdrawn and transferred to 100ml volumetric flask and final volume was making up to 100ml with phosphate buffer, this becomes 2,4,6,8,10 and 12µg/ml and absorbance's were noted at 425nm wavelength and graph was plotted between concentration vs. absorbance.

Ingredients	F1	F2	F3
Turmeric extract	2.5g	2.5g	2.5g
Oleic acid	1.5g	1.5g	1.5g
Carbopol 934	0.5g	1g	1.5g
Methyl salicylate	1g	1g	1g
Propylene glycol	2.5g	2.5g	2.5g
Cetostearyl alcohol	5g	5g	5g
Distilled water (q.s.)	q.s	q.s	q.s
Methyl paraben	0.05g	0.05g	0.05g
Propyl paraben	0.05g	0.05g	0.05g
Triethanolamine	Adjust pH 6-7	Adjust pH 6-7	Adjust pH 6-7

Table No.03 (Formulation Of Turmeric Emulgel)

CHARACTERIZATION OF EMULGEL:

1). PHYSICAL APPEARANCE: All the formulations were evaluated for colour, homogeneity and consistency. All formulations exhibited a consistent, creamy white appearance that was homogenous throughout.

2). DETERMINING PH: The assessment of pH for the topical formulation holds significance due to its potential to cause skin irritation when deviating from normal pH conditions. Additionally, polymers such as Carbopol contribute to consistency within the pH range of 5-7, prompting the evaluation of pH for all formulations.

3). SPREADABILITY ASSESSMENT: The determination of spreadability utilizes an apparatus recommended by Mutimer et al. (1956), which has been appropriately adapted for laboratory use. This apparatus includes a wooden block equipped with a pulley at one end.

Spreadability is assessed based on the 'Slip' and 'Drag' properties of the emulgel using this method. A ground glass slide is fixed on this block. Place approximately 2 grams of excess emulgel onto the ground slide for analysis. After sandwiching the emulgel between the slide and a fixed ground glass slide equipped with a hook, a 1 kg weight is applied atop the slides for 5 minutes to remove air and ensure uniform emulgel distribution. Any surplus emulgel is then removed from the edges. Subsequently, the top plate is subjected to an 80 gm pull force. With the help of string attached to the hook and the time (in seconds) required by the top slide to cover a distance of 7.5 cm be noted. A shorter interval indicates better spreadability. Spreadability was assessed via the application of a formula.

$$S = M\,L/T$$

In this context, where “S” represents spreadability, “M” denotes the weight attached to the upper slide, “L” signifies the length of the glass slides, and “T” indicates the duration required for complete separation of the slides.

4). DETERMINING DRUG CONTENT: The drug concentration within the emulgel was assessed using a UV spectrophotometer. Turmeric content in emulgel was measured by dissolving Known quantity of emulgel in solvent (methanol) by Sonication. After appropriate dilution, the absorbance at 425nm was determined using a UV/VIS spectrophotometer (UV-1800, Shimadzu Corporation, Japan).

$$\text{Content Uniformity} = \frac{\text{con mcg/ml} \times 100 \times \text{Dilution Factor}}{1000}$$

5). RHEOGRAM: For studying rheology of emulgel, this is very important for the above-mentioned reasons. Brookfield Viscometer LV dial type was used. To characterize the system’s behavior and generate rheograms, readings were recorded in both ascending and descending order, involving increasing shear stress followed by decreasing shear stress.

Rheogram obtained were plotted by taking RPM on Y-axis and Dial reading on X-axis.

6). RHEOGRAM INDEX: To determine the swelling index of prepared topical emulgel 1 gm. of gel is taken on porous aluminium foil and then placed separately in a petri plate containing 10 ml 0.1N NaOH. Then samples were removed from petri plate at different time intervals and put it on dry place for some time after it reweighed. Swelling index is calculated as follows:

$$\text{Swelling Index (SW)\%} = [(Wt. - Wo) / Wo] \times 100.$$

Were,

(SW) % = Equilibrium percent swelling,

Where Wo represents the original weight of the emulgel at zero time, and Wt denotes the weight of the swollen emulgel after time t.

7). EXTRUDABILITY:

In this study, evaluating the extrudability of emulgel formulations is a customary empirical test involving the measurement of force needed to extrude material from a tube. This method determines the applied shear in the rheogram region where shear rate surpasses the yield value, resulting in plug flow. The assessment involves quantifying the percentage of emulgel extruded from a lacquered aluminium collapsible tube within 10 seconds under the application of weight in grams to extrude at least a 0.5 cm ribbon of emulgel. Greater quantity extruded indicates better extrudability. Extrudability measurements are conducted in triplicate for each formulation, and the average values are calculated using the following formula:

Extrudability = Applied weight to extrude emulgel from tube (in gm.)/Area (in cm 2)

8). VISCOSITY: The viscosity of gel during handling, transport and storage is an important criterion. The viscosity of different Emulgel formulations was determined by using Brook field viscometer. The Emulgel were rotated at 10rpm, and viscosities were measured.

DETERMINATION OF TOTAL MICROBIAL COUNT IN FORMULATED EMULGEL:

9). **DETERMINATION OF MICROBIAL COUNT:** Microbial evaluation is essential to check the limits of microbial contamination and extent of pathogenicity.

The quality of products is directly influenced by this assessment. The plate count method was utilized to determine the total microbial count.

PREPARATION OF CULTURE MEDIA (SOYABEAN CASEIN DIGEST AGAR):

The medium was prepared as per direction stated on container 4gm of soyabean digest agar with 2 gm of Agar-agar powder was dissolved in 100ml distilled water. The solution was sterilized by heating in an Autoclave at 1210C for 15 mines. Test tubes, pipettes and Petri dishes were also sterilized by heating in an Autoclave at 121OC for15-20 mines.

11). STABILITY STUDY:

Stabilitymaybedefinedastheabilityofthedrugtoretainitspropertywithinspecifiedlimitsthroughoutitsshelflife.IMproperstorageofcosmeticproductcanleadtotheirphysicaldeterioration&chemicaldegradationresultinginredu

Cedactivity &occasionally in the form of toxic degradation product. Stability studies are conducted for every product. The present stability studies are carried out according to guidelines given by international Council of Harmonization

12). DRUG RELEASE KINETIC STUDY:

For analyzing the mechanism of drug release from the topical gel, the release data were applied to the following equations.

a) **Zero-Order Model:** Drug dissolution from dosage forms that do not disaggregate and release the drug slowly can be represented by the equation:

$$Qt = Q0 + K0\ t$$

Were,

In this context, "Qt" represents the quantity of drug dissolved at time "t".

To investigate the release kinetics, data collected from in vitro drug release experiments were graphed as cumulative drug release over time.

Application: This correlation can be applied to explain the drug dissolution of various types of modified release pharmaceutical formulations, such as certain transdermal systems and matrix tablets containing poorly soluble drugs. Coated forms and osmotic systems are utilized in various formulations.

b) **First –Order Model:** This model has been employed to characterize the absorption and elimination of certain drugs, although it is challenging to conceptualize this mechanism theoretically. The drug release, which adhered to first-order kinetics, can be articulated using the equation:

$$dC/dt = -KC$$

Here, "K" represents the first-order rate constant, measured in units of reciprocal time.

This equation can also be expressed as:

$$Log\ C = log\ C0 – Kt / 2.303$$

Were,

C0 is the initial concentration of drug,

K is the first order rate constant, and T is the time.

The data can be represented by plotting the log cumulative percentage of drug remaining against time, resulting in a straight line with a slope equal to -K/2.303.

Application: This equation is applicable for explaining how drugs dissolve in pharmaceutical products, particularly those with water-soluble medications in porous matrices.

c) **Higuchi Model:** The first example of a mathematical model aimed to describe drug release from a matrix system was proposed by Higuchi in 1961. Originally designed for flat systems, it was later expanded to encompass various geometries and porous structures.

This model operates on the assumptions that:

i. The initial drug concentration in the matrix greatly exceeds the drug solubility limit.
ii. Drug diffusion occurs solely in one dimension, with negligible influence from edge effects.
iii. The drug particles are significantly smaller than the thickness of the system.
iv. Matrix swelling and dissolution are negligible;
v. Drug diffusivity is constant; an
vi. Perfect sink conditions always attained in the release environment

Accordingly, model expression is given by the equation:

$$\mathbf{Ft = Q = A \sqrt{[D\,(2C - Cs) * Cs\ t]}}$$

Were,

The rate of drug release per unit area (Q) over time (t) is determined by the initial concentration of the drug ©, its solubility in the matrix media (Cs), and the diffusion coefficient (D) of the drug molecules in the matrix base.

The Simplified Higuchi Model, generally referred to as the Higuchi model, can be simplified in a general manner.

$$\mathbf{Ft = Q = KH * t^{1/2}}$$

Where KH is the Higuchi dissolution constant. The obtained data were represented as a plot showing cumulative percentage drug release against the square root of time.

Application:

This correlation is applicable for explaining the dissolution of drugs in various modified-release pharmaceutical formulations, such as certain transdermal systems and matrix tablets containing water-soluble drugs.

d) **Hixson and Crowell Model:** Hixson and Crowell (1931) recognized that the Particle's regular area is proportional to the cube root of its volume. They derived the equation:

$$W_{01/3} - W_{t1/3} = k\,t$$

Were,

In this scenario, W0 denotes the original amount of drug in the pharmaceutical dosage form, Wt indicates the remaining quantity of drug in the dosage form at time t, and K (kappa) is a constant representing the surface-to-volume ratio.

The equation characterizes the release from systems in which there is a variation in the surface area and diameter of particles or tablets. To study the release kinetics, data obtained from in vitro drug release studies were plotted as cube root of drug percentage remaining in matrix (Wt1/3) versus time (t).

Application:

This formula is relevant to pharmaceutical dosage forms like tablets, where dissolution occurs in planes parallel to the drug surface if the tablet dimensions decrease proportionally, maintaining a constant initial geometric shape throughout.

e) **Korsmeyer-Peppas Model:** Korsmeyer et al. (1983) derived a simple semi-emperical relationship which relates exponentially drug release from a polymeric system with respect to relapsed time. To find out the mechanism of drug release, first 60% drug release data were fitted in Korsmeyer – Peppas model

$$M_t / M_\infty = K\ t^n$$

Were,

The ratio Mt / M∞ represents the fraction of drug released at time t.

K is the release rate constant and

N is the release exponent.

The n value is employed to distinguish between various release patterns for cylindrical-shaped matrices. Alternatively, this equation can be expressed as:

$$\log M_t - \log M_\infty = n \log t + \log K$$

To find out the exponent of n, the portion of the release curve, where $M_t / M_\infty < 0.6$ should only be used. For investigating release kinetics, data collected from in vitro drug release studies were graphed as the logarithm of cumulative percentage drug release against the logarithm of time. This approach is commonly applied to

analyze the release of polymeric dosage forms in scenarios where the release mechanism is unclear or multiple release phenomena are at play.

13). In-vitro Drug Diffusion Study: Cellophane membrane obtained from sigma chemicals was used for this study. In modified diffusion cell, 1 gm of gel was kept in donor compartment. The entire surface of membrane was in contact with the receptor compartment containing 30ml of pH 7.4 phosphate buffer. The receptor compartment was continuously stirred (530 rpm) using a magnetic stirrer. The temperature maintained was 37 ± 1°C. The experiment lasted 6 hours, with samples taken at intervals of 1, 2, 3, 4, 5, and 6 hours. At each interval, 5ml of sample was withdrawn and replaced with an equal volume of fresh pH 7.4 phosphate buffer. The absorbance of withdrawn sample was measured at 425 nm to estimate turmeric.

RESULTS AND DISCUSSION:

Pre-formulation Study:

1]. Construction Of Calibration Curve:

Table 2: Calibration Curve of turmeric in Phosphate Buffer pH 7.4

Sr.No	Concentration (ug/ml)	Absorbance
1	2	0.094
2	4	0.142
3	6	0.215
4	8	0.312
5	10	0.360
6	12	0.412

Characterization of Emulgel:

1) **Physical Appearance:**

Table 3: Physical Appearance Data

Batch No	Colour	Homogeneity	Consistency	Phase Separation
F1	Yellowish	Homogeneous	Smooth	-
F2	Yellowish	Homogeneous	Smooth	-
F3	Yellowish	Homogeneous	Smooth	-

2) **PH determination:**

Table No: 3 pH of Emulgel

Batch No.	pH
F1	5.22 ± 0.25
F2	6.79± 0.58
F3	6.83± 0.13

3) **Spreadability:**

Table No :4 Spreadability

Batch No.	Time (sec)	Length (cm)	Weight (gm)
F1	42	6.8	20
F2	45	6.8	20
F3	35	6.8	20

4) Drug Content Determination:

Table No 5: Drug Content Determination:

Batch No.	Drug Content (%)
F1	93.56± 1.02
F2	89.40± 0.96
F3	98.90± 1.26

5) Swelling Index:

Table no 6: Swelling index of formulation

Batch No.	Time (min)	Initial Weight of Emulgel (gm)	Final Weight of Emulgel (gm)	Avg.Weight	Swelling Index (%)
	10	**1.36**	**2.12**		
	20	1.36	1.98		
F1	30	1.36	1.88	**1.99**	**32.75±1.26**
	10	1.54	1.54		
F2	**20**	**1.54**	**1.94**		
	30	1.54	2.56	**2.01**	**30.5±1.74**
	10	1.16	1.67		
F3	**20**	**1.16**	**1.52**	**1.54**	**46.32±0.76**
	30	1.16	1.44		

6) Extrudability:

Table no 7: Data for Extrudability

Batch No.	Extrudability (cm^2)
F1	16.8±0.88
F2	15.0±0.46
F3	18.2±0.52

7) Viscosity:

Batch No.	Viscosity (cp)
F1	1750
F2	1856
F3	2250

Table 8: Rheological Study Data:

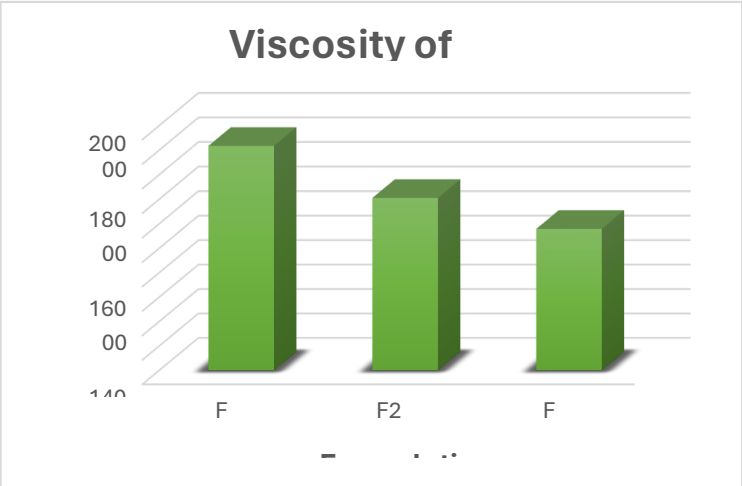

Fig-03

8) Drug Release Kinetic Study:

Table No 9: Kinetic Study of The In Vitro Release Data of Turmeric from Its Different Formulae.

Correlation Coefficient (R^2)					
Formulation	**Zero Order Kinetic**	**First Order Kinetic**	**Higuchi Model**	**Hixson & Crowel Model**	**Korsmeyer-Peppas Model**
F1	0.9943	0.9019	0.9750	0.9750	0.9807
F2	0.9861	0.9169	0.9752	0.9520	0.9763
F3	0.991	0.8606	0.9880	0.9360	0.9608

9) In-Vitro Drug Diffusion Study:

Table No 10: In Vitro Drug Release (%)

Time (Hrs)	F1 (%)	F2 (%)	F3 (%)
1	7.05±0.22	9.82±0.22	6.13±0.38
2	21.17±0.61	17.43±0.65	23.15±0.69
3	33.43±0.36	37.79±0.23	41.68±0.33
4	54.97±0.12	49.83±0.22	57.44±0.22
5	64.97±0.86	58.12±0.62	72.37±0.42
6	82.17±0.54	72.54±0.32	90.05±0.26

DISCUSSION:

1. Physical Appearance:

The prepared turmeric emulgel formulations exhibited a white, viscous, creamy texture, displaying a smooth and consistent appearance. The pH values of all prepared formulation ranged from 5 to 7 which are considered acceptable to avoid the risk of irritation upon application to the skin because adult skin pH is average 5-7.

2. Spreadability:

The values of spreadability indicate that the emulgel is easily spreadable by small amount of shear. Spreadability of F3 was 3.88cm/sec, indicating spreadability of emulgel containing turmeric was good as compared to the marketed gel.

3. Drug Content Determination:

The drug content in the emulgel ranged from 67.87% to 89.28%. The highest drug content was observed in F3, at 89.28%.

4. Stability Studies:

Stability studies of optimized formulation were performed. It can be observed that the emulgel formulation showed no major alteration in relation to the pH, consistency and in vitro release study. The formulation remained stable for 1 month, with no significant changes in pH observed under various storage conditions.

5. Swelling Index:

The optimized formulation of emulgel, specifically F3, exhibited a swelling index of 46.32%.

6. Extrudability Study (Tube Test):

During the test, Optimized batch 18.2gm/cm weight required to extrude 1 cm ribbon of emulgel in 10 sec from aluminium collapsible tube, Based on the results, it can be concluded that a greater amount of emulsion-based gel extruded with minimal applied pressure on the tube, indicating that a better emulgel possesses favourable extrudability.

7. Viscosity:

The measurement of viscosity of the prepared emulgel was done with Brookfield viscometer (Brookfield DV-E viscometer). Emulgel F3 exhibited the highest viscosity among all formulations.

8. Drug Release Kinetic Study:

Release data analysis involved the utilization of various kinetic models, including cumulative percentage drug release versus time (zero-order kinetic model) and logarithm of cumulative percentage drug remaining versus time. (first-order kinetic model) and the relationship between cumulative percentage of drug release versus. Square root of time (Higuchi model). The R2 values are tabulated in table. All formulae showed best fitting to kinetics.

9. Drug Release:

The in vitro release profiles of Turmeric from different emulgel formulations indicate that the drug is released most effectively from all formulations. The ranking of emulgel formulations can be arranged from highest to

lowest based on the percentage of drug released after 6 hours, which are 90.05%, 82.17%, and 72.56%, respectively.

SUMMARYANDCONCLUSION:

The aim was to design emulgel to enhanced Bioavailability Of Drug By Using Different Type Of Emulsifying And gelling agent such as Carbopol934 these emulgel shows more release in short time and it is proved by following result.

- **Physical Appearance:**
  Physical Appearance was lightly Yellowish
- **pH:**
  pH was in between 6.5-7.84
- **Viscosity:**
  Viscosity was found to be 11850.
- **Drug Content:**
  Drug content was found to be 92.30%.
- **Drug Release:**
  Drug Release was found to be 90.30% in6 hr.
- **Extrudability:**
  Extrudability was found to be excellent.
- **Spreadability:**
  Spreadability was found to be excellent.
- **Kinetic study:** optimized batch follow Hixon Crowell model.

CONCLUSION:

From the result and summary, we have concluded that the formulation F3 in which contain Carbopol 394, in which the ratio of Emulsion and Gel Base ratio was1:1 . The results demonstrate satisfactory outcomes compared to other batches, thereby achieving the objective of this study.

 To develop safe and efficient Turmeric Emulgel.

 To achieve improved bioavailability of drug

 To make a stable Turmeric emulgel.

 To improve patient compliance.

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