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FORMULATION AND EVALUATION POLYHERBAL CREAM FROM TRADITONALLY USED AYURVEDIC PLANTS FOR MULTIPURPOSE SKIN CARE

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Abstract: Herbal cosmetics are the preparations are used to beautify and enhance the human appearances. The aim of the present research was to formulate and evaluate the herbal cold cream containing ayurvedic herbs will be prepare by using water in oil method for the purpose of nourishing and moistening the skin. The Manjista, Madhuyasti and Nagarmotha containing Ayurvedic Herbal cold cream is prepared by water in oil method by using suitable base for the purpose of nourishing and moisturizing the skin. The herbal extract containing cold cream gives cooling and soothing effect due to slow evaporation of water present in emulsion. The prepared herbal cold creams are characterized for FTIR studies, production yields, DSC and SEM. The production yields of formulations were from 78.4 to 87.5. FTIR and DSC studies are revealed that the drug and base are compatible with each other during preparation. The changes in physical properties of the formulated creams were not observed. The formulated cream shows good consistency and spreadability, homogeneity, pH, non-greasy and no evidence of phaseseparation during study period. Stability parameters like visual appearance, nature, viscosity and fragrance of formulated creams showed that there was no significant variation during the study period.

Key words: Herbal cosmetics, Cold cream, Water in oil emulsion, Manjista, Madhuyasti, Nagarmotha.

INTRODUCTION

The skin is the largest organ of the body, accounting for about 15% of the total adult body weight. It performs many vital functions, including protection against external physical, chemical, and biologic assailants, as well as prevention of excess water loss from the body and a role in thermoregulation. The skin is continuous, with the mucous membranes lining the body surface. The integumentary system is formed by the skin and its derivative structures. The skin is composed of three layers: the epidermis, the dermis, and subcutaneous tissue The outer most level, the epidermis, consists of a specific constellation of cells known as keratinocytes, which function to synthesize keratin, a long, threadlike protein with a protective role. The middle layer, the dermis, is fundamentally made up of the fibrillar structural protein known as collagen. The dermis lies on the subcutaneous tissue, or panniculus, which contains small lobes of fat cells known as lipocytes. The thickness of these layers varies considerably, depending on the geographic location on the anatomy of the body. The eyelid, for example, has the thinnest layer of the epidermis, measuring less than 0.1 mm, whereas the palms and soles of the feet have the thickest epidermal layer, measuring approximately 1.5 mm.[1]

Epidermis:

The epidermis is the outermost layer of the skin with a thickness of 0.2 mm on average. The epidermis can be further sub divided into four layers, beginning with the outermost layer; stratum corneum, granular cell layer, prickle cell layer and basal cell layer (Fig. 1). The stratum corneum, which is the outermost layer of the epidermis, has multifarious functions to repel water, acts as a barrier against bacterial and viral intrusion, and protects internal organs such as muscles, nerves, blood vessels and others from externalinjuries. The prime function of the epidermis is to act as a physical and biological barrier to the external environment, preventing penetration by irritants and allergens. At the same time, it prevents the loss of water and maintains internal homeostasis. The epidermis is composed of layers; most body parts have four layers, but those with the thickest skin have five. The layers are:

- Stratum conium (horny layer).
- Stratum lucidum (only found in thick skin – that is, the palms of the hands, the solesof feet and the digits).
- Stratum granulosum (granular layer).
- Stratum spinosum (prickle cell layer).
- Stratum Basale (germinative layer).

The epidermis also contains other cell structure. Keratinocytes make up around 95 % of the epidermis cell population - the others being melanocytes, Langerhans cells and Merkel cellsStratum corneum; can be visualized as a brick wall, with the corneocytes forming the bricks and lamellar lipids forming the mortar. As corneocytes contain water -retaining substance – a natural moisturizing factor-they attract and hold

water. The high-water content of the corneocytes causes them to swell, keeping the stratum corneum pliable and elastic, and preventing the formation of Fissures and cracks. The stratum corneum regulates the amount and rate of percutaneous absorption. One of the most important factors affecting this is skin hydration and environmental humidity.

Basement membrane zone (derma-epidermal junction) is a narrow, undulating, multi-layered structure lying between the epidermis anddermis which supplies cohesion between the two layers.

It is composed of two layers are;

- Lamina Lucida.
- Lamina dense.

Dermis: The dermis forms the inner layer of the skin and is much thicker than the epidermis (1-5) situated between the basement membrane zone and the subcutaneous layer, theprimary role of the dermis is to sustain and support the epidermis. The main functions of the dermis are,

- Protection.
- Cushioning the deeper structures from mechanical injury.
- Providing nourishment to the epidermis.
- Playing an important role in wound healing.

Hypodermis: The hypodermis is the subcutaneous layer lying below the dermis; it consists largely of fat. It provides the main structural support for the skin, as well as insulating the body from cold and aiding shock absorption. It is interlaced with blood vessels and nerves.

Functions of the skin

The skin has three main functions:

- Protection
- Thermoregulation
- Sensation

Protection:

The skin acts as a protective barrier from:

- Agents
- Excessive loss of moisture and protein
- Harmful effect Mechanical, thermal and other physical injury
- Harmful s of UV radiation.

Thermoregulation:

One of the skin's important functions is to protect the body from cold or heat, and maintain a constant core temperature.

Sensation:

Skin is the "sense-of-touch" organ that triggers a response if we touch or feelsomething, including things that may cause pain. This is important for patients with a skin condition, as pain and itching can be extreme for many and cause great distress. Also, touchis important for many patients who feel isolated by their skin as a result of color, diseaseor the perceptions of others as many experience the fact that they are seen as dirty or contagious and should not be touched.

Biochemical functions:

The skin is involved in several biochemical processes. In the presence of sunlight, a form ofvitamin D called cholecalciferol is synthesized from a derivative of the steroid cholesterol inthe skin. The liver converts cholecalciferol to calcidiol, which is then converted to calcitriol (the active chemical form of the vitamin) in the kidneys. Vitamin D is essential for the normal absorption of calcium and phosphorous, which are required for healthy bones. The skin also contains receptors for other steroid hormones (oestrogens, progestogensand glucocorticoids) and for vitamin A.[2]

ACNE

"Acne" is a Greek word of acne which means "Prime of life". Acne is a chronic inflammatory state which occurs in the skin (Acne vulgaris). The inflammation of skin occurs due to the oil secreted by the sebaceous gland or which is otherwise called as oilglands of the skin. Acne is seldom life-threatening condition, but it affects the self-esteem of an individual. People with the age group ranging from 12-24 are more prone to acne and about 85 % of the populations are being affected. Acne is otherwise called as acne vulgaris. It is a chronic inflammatory disease. It occurs on the parts like: face, neck, upper chest, upper back, etc. According to studies, acne is the most prevalent disease in the world. It affects the patient both psychologically as well as psychosocially.

Cosmetics are products that are often used to decorate the skin and cleanse the skin.A cosmetic is a word derived from the Greek word - 'kosmesticos' meaning adornment. Since then, the materials used to enhance or enhance the appearance of the skin are called cosmetics. From ancient times to the present, people have used polyherbalor herbal cosmetics to enhance the appearance of the skin. Cold water-based oil emulsion cold cream provides longer contact time in the application area compared to other forms of semisolid dosage or composition. They give beauty to the skin and are not too oily. Due to the oil phase, it gives emollience to the skin. The function of the cold cream is to restore moisture to dry skin, allowing it to remove impuritiesfrom the pores and cool the body. It washes easily with water and is easy to wash. They do not irritate when applied to the skin. The water phase provides additional protection for the skin. Be liquid at body temperature. It penetrates through the skin epidermis through natural pores.

Several medicinal plants have been used as cosmetics since ancient times, and have shown promising effects on various skin ailments such as acne, blackheads, age spots, skin rashes, allergies and skin rashes, skin aging, wrinkles, whitening skin etc. Some of the most common plants such as Aloe vera, Manjista, Madhuyasti, Nagarmotha, Azadirachtolides, Annona squamosa, Aterocarpusheterophyllus, Carica papaya, Centellaasiatica, Curcuma long, Mangiferaindica, Moringa citrifolia, Ocimumsanctum, Phyllanthus emblica, Psidium gujajuva, njidi, gujajuva, njc, etc. and Unani programs for their beauty products.

The introduction of cold cream is recommended by Galen, a physician who planted a mixture of oil and water and is now classified as a cold cream in the spice and "Ceratum Galeni" pharmacy. Cold cream is an emulsion of water and certain oils, often combining & a variety of aromatic beeswax, designed to smooth the skin and remove makeup. The emulsion is a type of "oil in oil" in contrast to the emulsion "oil in water" dissolving cream, which is said to be due to its apparent disappearance whenapplied to the skin. The name, cold cream, comes from the cool feeling that the cream leaves on the skin.

Many vegetable and animal fats and oils contain a small amount of free fatty acids that combine with alkaline substances (e.g., borax ammonia) to make soap; later emulsifying the remaining oily ingredients. The emulsion formed is water-based oil. This type is better for cold cream because the water in the continuous phase can evaporate more freely from the thin film, and when evaporated, it will release heat to the skin, thus producing a cooling action. The remaining oil on the skin, after almostor less water evaporation, is absorbed slowly quickly and not intentionally because theoil is applied due to its refreshing action on the upper layer of the skin. The use of herbal products as cosmetics is as prevalent in modern era as it was in ancienttimes. Herbal cosmetics are mostly preferred because of their less or nil side effects when compared to synthetic products and show enhanced effects upon application.

These herbal cosmetics used as beauty products help in enhancing and conditioning properties of skin. The herbal extracts used in these formulations are all derived from natural plant sourceswithout the use of any harmful synthetic drugs. Chemical or synthetic drug/ API is avoided in the preparations because of various skin problems. The concept of herbal cosmetics was established long back in different systems of medicine such as Rigveda, Yajurveda, Ayurveda, Unani and Homeopathy systems.

The herbs extracted by these systems show a number of properties like antiacne, anti- inflammatory, anti- bacterial, anti-septic, emollient and sometimes also show anti-cancer properties.

Thus, there is extensive use of herbal cosmetics in skin care systems and an ever-increasing demand in the market. Various kinds of creams such as vanishing cream, cold cream,multipurpose cream, etc. are most commonly used herbal cosmetic products for topical application. Cold Creams prepared are usually w/o type of emulsion instead of o/w type of emulsion as seen in vanishing creams and gives a cooling effect upon application.

This preparation of cold creams consists of herbal extracts of crude drugs such as rhizomes of Curcuma longa (turmeric), main active ingredients. The extract of Curcuma longa has been clinicallyproven to show anticancer properties upon topical application better than oral administration, in addition to many other properties. Curcumin shows many other properties such as wound healing, acne prevention, sun damage protection, aging treatment, skin cancer prevention (by selectively killing tumor cells and leaving the normal cells intact), and also treats chronic skin diseases. These herbs have been selected according to traditional systems and are based upon their modern researched uses.[3]

MATERIALS AND METHODS

Materials:

Drugs such as Manjista, Nagarmotha and Madhuyasti are purchased from Ayurvedic store, Chitradurga. All the other chemicals used in formulation are of analytical grades from local chemical distributors and some collected from medicinal garden.

Table No:01 Ingredients used to prepare herbal cold cream

Sl. No.	Ingredients	Suppliers
1	Beeswax	SD Fine chemicals Ltd.
2	Borax	SD Fine chemicals Ltd.
3	Liquid paraffin	SD Fine chemicals Ltd.
4	Cetyl alcohol	Yarrow Chemicals Pvt. Ltd.
5	Propyl paraben	Yarrow Chemicals Pvt. Ltd.
6	Perfume	Nice chemicals Pvt. Ltd

Table No:02 Role of ingredients used in the preparation of herbal cold cream

Sl. No	Ingredients	Role
1	Beeswax	Emulsifying agent, stabilizer and gives thickness.
2	Borax	Emulsifier and provide whiteness
3	Liquid paraffin	Lubricating agent
4	Cetyl alcohol	Emollient, which help to reduce rough and dry skin
5	Propyl paraben	Preservative
6	Perfume	Fragrance
7	Water	Vehicle

Table No:03 Equipment used in the preparation of herbal cold cream

Sl. No	Equipment name	Manufactured by
1	UV visible spectrophotometer	Shimadzu (1700)
2	FTIR	ATIR (broker α)
3	Brook field viscometer	Analytical technologies
4	Digital pH meter	Analytical technologies
5	Magnetic stirrer	Analytical technologies
6	Incubator	Sigma atomization

Preformulation studies:
Preformulation is a branch of pharmaceutical science that utilizes biopharmaceutical principles in the determination of physicochemical properties of the drug substances. Prior to the development of any dosage form new drug; it is essential that certain fundamental physical and chemical properties of drug powder is determined.

Solubility analysis:
The solubility of a candidate drug molecule is the amount of the drug (solute) that dissolves in a given solution (solvent) to produce a saturated solution at constant temperature and pressure

Melting point determination
The melting point was determined by using Thales tubes instrument.

Compatibility studies:
Compatibility study is the most important part of any pre-formulation testing of proposed dosage form, and it is necessary that it should be carried out before the development of first formulation of proposed dosage form with a new drug or new formulation of existing API.

IR spectroscopy:
The FTIR spectrum of the herbal cold cream formulation was compared with the standard FTIR spectra of the pure drugs. The FTIR spectral measurements were taken in ambient temperature using Bruker instruments using ATR technology.[4]

Spectrophotometric determination of Manjista, Nagarmotha and Madhuyasti by using phosphate buffer pH 6.8:
Accurately weighed 100 mg of Manjista, Nagarmotha and Madhuyasti were transferred to 3 different 100 ml volumetric flask separately. Manjista is dissolved in little quantity of hot water; To these 3 different volumetric flasks add 60 ml of phosphate buffer pH 6.8 and again make up to that mark of volumetric flask by using same solution. It was considered as stock solution I. Pipette out 10 ml from stock I solution to another 100 ml volumetric flask and make up to the mark by using phosphate buffer pH 6.8. It was considered as stock II. From stock II prepared aliquots of working solution of Manjista, Nagarmotha and Madhuyasti 0.2-1µg/ml. This was prepared by transferring 0.2, 0.4, 0.6, 0.8 and 1 ml to 3 different 10 ml volumetric flask and made to the mark by using phosphate buffer pH 6.8. Then the absorbance of the above concentrations was measured by using Shimadzu UV visible double beam spectrophotometer. Calibration curve was obtained by plotting Concentration v/s Absorbance without using drug sample as blank. Measurement of the absorbance of Manjista sample at the range of **270 nm**, Nagarmotha sample at the range of **305 nm** and Madhuyasti sample at the range of **254 nm** was obtained by plotting Concentration v/s absorbance. The method was validated for linearity, accuracy and precision. The method obeys Beers-lambert's law in the concentration range of 0.2-1 µg/ml.

Preparation of Phosphate buffer solution (pH6.8)
Dissolved 28.20g of disodium hydrogen phosphate and 11.45g of Potassium dihydrogen phosphate in 1000 ml of distilled water. Adjust the pH to 6.8 by using Ortho-phosphoric acid and Sodium hydroxide pellets.

PREPARATION OF HERBAL COLD CREAM

Table No:04 Formulation Table of Herbal Cold Cream

Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9
	Manjista			Nagarmotha			Madhuyasti		
Drug (gm)	50	100	150	50	100	150	50	100	150
Beeswax (gm)	08	08	08	08	08	08	08	08	08
Liquid paraffin (ml)	25	25	25	25	25	25	25	25	25
Cetyl alcohol (gm)	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Borax (gm)	0.2	0.2	0.2	0.2	0.2	20.2	0.2	0.2	0.2
Propyl paraben (gm)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Water (ml)	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
Perfume (ml), Qsto 50gm	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs	Qs

Formulation of herbal cold cream involves three steps

a. Step one preparation of aqueous phase
In a 50 ml of beaker 16.6ml of water, 0.2g of Borax and 0.1 ml of propyl paraben is added and heated up to 75^0C by using water bath.

b. Step two preparation of oil phase
Simultaneously, 8 gm of bee's wax, 25 ml of liquid paraffin and 0.52 gm of cetyl alcohol are added in porcelain china dish separately and melted up to 75^0C by using water bath.

c. Step three mixing of both the phases
To an oil phase, aqueous phase is added drop wise with constant stirring until it comes to 45 to 50^0C. Then, to this mixture the herbal drug and perfume are added with constant stirring.

Characterization of herbal cold cream Percentage yield
The prepared herbal cold cream of all batches was accurately weighed. The measured weight of prepared herbal cold cream was divided by total amount of all the excipients and drug used in the preparation of the herbal cold cream gives the total percentage of herbal cold creams. It was calculated by the following equation.

$$\text{Percentage yield} = \frac{\text{Actual weight of the product}}{\text{Total weight of the excipients and drug}} \times 100$$

Morphology study using SEM
The morphological studies were carried out by ZEISS EVO. US Scanning electron microscope (SEM), connected with fine coat, JEOL JFC-1100E Ion sputter. The sample was loaded on copper sample holder and sputter coated with carbon followed by Gold.

Morphological study using DSC

Differential scanning calorimetry (DSC) study was carried out to evaluate thermal behavior and thermo tropic characteristic of the drug. Nearly 5 mg sample (Manjista F1, Nagarmotha F5 and Madhuyasti F9) were sealed in aluminum pan followed by heating at a rate of 10^0 C/min over temperature range of 40-300^{0}C under nitrogen atmosphere of flow rate 10 ml/min and thermo gram (Mettler-Toledo DSC821e Switzerland) was obtained.[5]

Evaluation of Herbal Cold Cream

Physical Evaluation:

In this test, the cream was observed for color, odor, texture, state.

Wash ability:

A small amount of cream was applied on the hand and it is then washed with tap water.

pH:

0.5g cream was taken and dispersed in 50 ml distilled water and then pH was measured by using digital pH meter.

Viscosity:

Viscosity of the herbal cream was determined with the help of Brook field viscometer at 100 and 60 rpm with a spindle number 64.[6]

$$cP = TK \times SMC \times \frac{10000}{RPM}$$

cP = Viscosity
TK= Torque%
SMC= Spindle multiplier constant

Spread ability test:

The herbal cream sample was applied between the two glass slides and was compressed between the two glass slides to uniform thickness by placing 100 g of Weight for 5 minutes then weight was added to the weighing pan. The time in which the upper glass slide moved over the lower slide was taken as a measure of spread ability.

$$\text{Spreadability} = \frac{M \times L}{T}$$

M=weight tied to upper slide
L=length moved on the glass slide
T=time taken to separate the slide

Irritancy test:

Mark an area (1sq.cm) on the left-hand dorsal surface. Then the cream was applied to that area and the time was noted. Then it is checked for irritancy, erythema, and edema if any for an interval up to 24 h and reported.[7]

Homogeneity:

The formulations were tested for the homogeneity by visual appearance and by touch.

Greasiness:

The cream is applied in the form of smear on the surface of skin and observed if smear was oily or grease like.

***In-vitro* diffusion study**

Cellophane membrane was used for this study in franz diffusion Cell. 100 mg of prepared manjista, nagarmotha and madhuyasti herbal cold cream is placed in donor compartment separately which is filled phosphate buffer 6.8. The membrane was mounted between the compartments of the Frantz Diffusion Cell. Reservoir compartment was filled with the phosphate buffer 6.8. The study was carried out at 37±1^0 and speed were adjusted to 100-200 rpm and it is carried out for 24 hours. 5ml of sample was withdrawn from each reservoir compartment by the help of hypo dermic syringes at half an hour interval for 2 hours, then 1 hour interval for 10 hours and finally 6 hours to next 24 hours and absorbance was measured spectrophotometrically at 270 nm for Manjista, 305 nm for Nagarmotha and 254 nm for Madhuyasti. Each time reservoir compartment was replenished with the 5ml fresh volume of phosphate buffer 6.8 pH solution to maintain constant volume.[8]

RESULTS

Preformulation studies

Solubility Studies

Curcumin

Practically completely soluble in ethanol, chloroform, acetone and dichloromethane.

Manjista

Practically completely soluble in alcohol and water.

Nagarmotha

Practically completely soluble in alcohol and water.

Madhuyasti

Practically completely soluble in alcohol and water.

Melting point of Curcumin (n=3)

The melting point of Curcumin drug was found to be 183-190ºC.

Melting point of Manjista (n=3)

The melting point of Manjista drug was found to be 98-100ºC.

Melting point of Nagarmotha (n=3)

The melting point of Nagarmotha drug was found to be 220-225ºC.

Melting point of Madhuyasti (n=3)

The melting point of Madhuyasti drug was found to be 160-164ºC.

UV Spectrophotometric study:

Standard calibration curve of Nagarmotha in phosphate buffer(6.8pH)

Table No.5 shows the absorbance of standard solution of Nagarmotha ranging from 0.2 to 1µm/ml in phosphate buffer (6.8pH). The curve was found to be linear in the range of 0.2 to 1µm/ml at λ_{max} 305nm. The regression value was found to be 0.9994 as shown in Figure No:01.

Table No:05. Standard calibration curve of Nagarmotha

Sl. No.	Concentration(µg/ml)	Absorbance
01	0	0
02	0.2	0.142
03	0.4	0.144
04	0.6	0.137
05	0.8	0.145
06	1	0.152

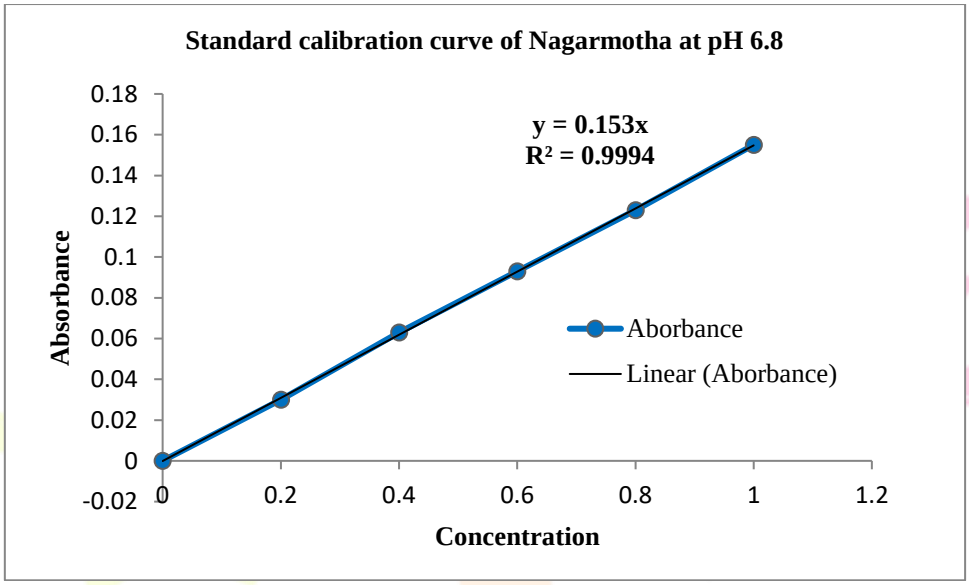

Figure No:01 Calibration curve of Nagarmotha phosphate buffer 6.8

Standard calibration curve of Manjista in phosphate buffer (6.8 pH)

Table No.6 shows the absorbance of standard solution of Manjista ranging from 0.2 to1µm/ml in phosphate buffer (6.8pH). The curve was found to be linear in the range of 0.2 to 1µm/ml at λ_{max} 270nm. The regression value was found to be0.9996 as shown inFigure No:02.

Table No:06 Standard calibration curve of Manjista

Sl. No.	Concentration(µg/ml)	Absorbance
01	0	0
02	0.2	0.18
03	0.4	0.193
04	0.6	0.2
05	0.8	0.22
06	1	0.23

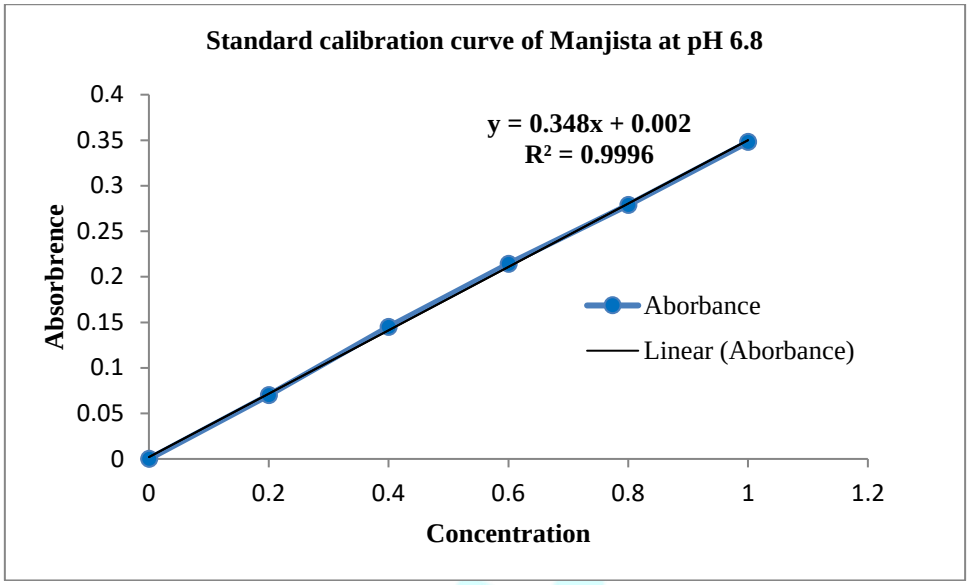

Figure No:02 Calibration curve of Manjista phosphate buffer6.8

Standard calibration curve of Madhuyasti in phosphate buffer(6.8pH)

Table No.7 shows the absorbance of standard solution of Madhuyasti ranging from 1.2 to 1µm/ml in phosphate buffer (6.8pH). The curve was found to be linear in the range of 0.2 to 1µm/ml at λ_{max} 254nm. The regression value was found to be 0.9997 asshown in Figure No:03.

Table No:07 Standard calibration curve of Madhuyasti

Sl. No.	Concentration(µg/ml)	Absorbance
1	0	0
2	0.2	0.25
3	0.4	0.22
4	0.6	0.21
5	0.8	0.24
6	1	0.69

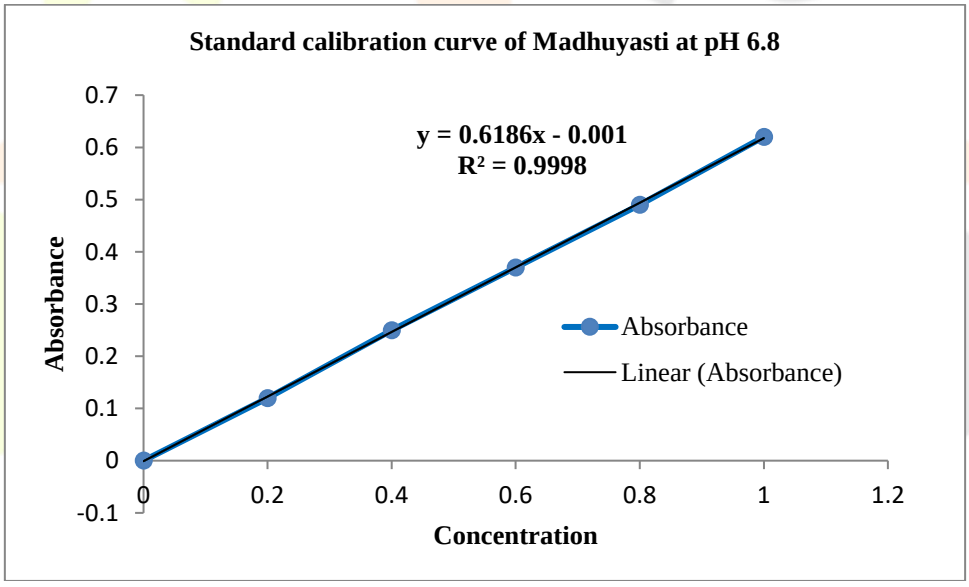

Figure No:03 Calibration curve of Madhuyasti phosphate buffer 6.8

Compatibility studies:

FTIR studies:

The FTIR Spectrum of the Manjista, Nagarmotha and Madhuyasti pure drug were found to be similar to standard spectrum of Manjista, Nagarmotha and Madhuyasti The spectrum of Manjista, Nagarmotha and Madhuyasti showed the following functional group at their frequencies.

MANJISTA

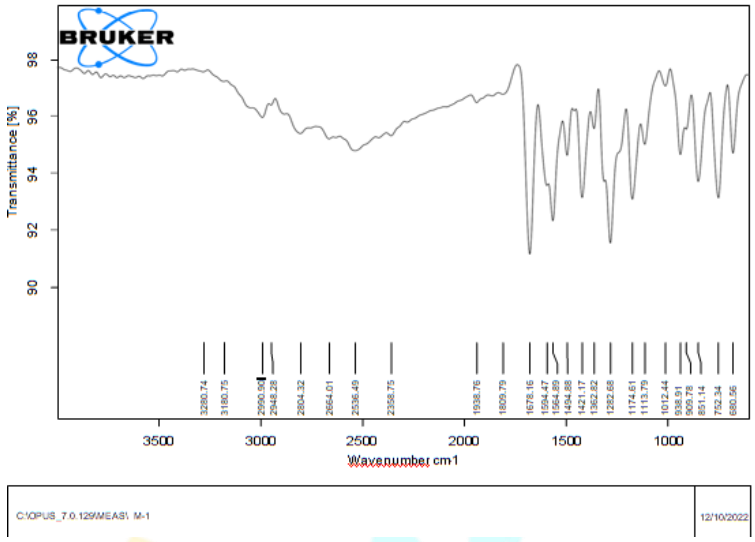

Figure No:04 IR spectra of Manjista drug

Characteristics group	cm^{-1}
O-H stretching	3280
COO stretching	1809
C-H stretching	3180
C=O stretching	1678
C=C stretching	1564
C-O-C stretching	1282

NAGARMOTHA

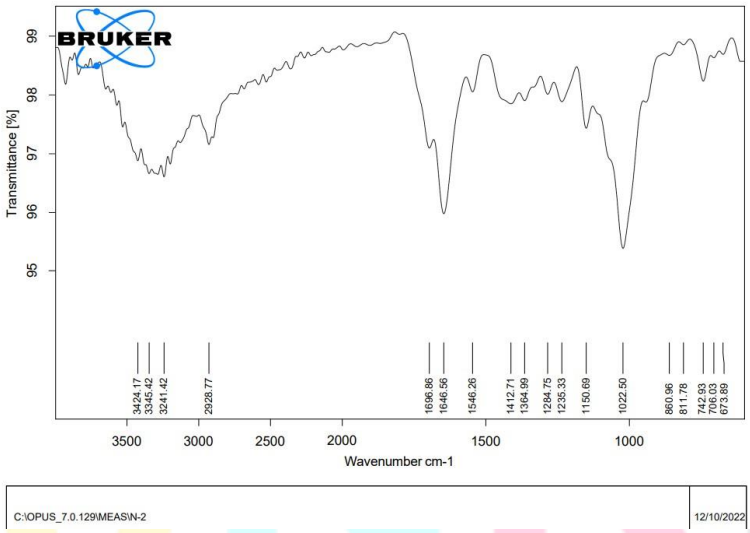

Figure No:05 IR spectra of Nagarmotha drug

Characteristics group	cm^{-1}
O-H stretching	3345
C-H stretching	2928
C=O stretching	1696
C=C stretching	1546
C-O-C stretching	1022

MADHUYASTI

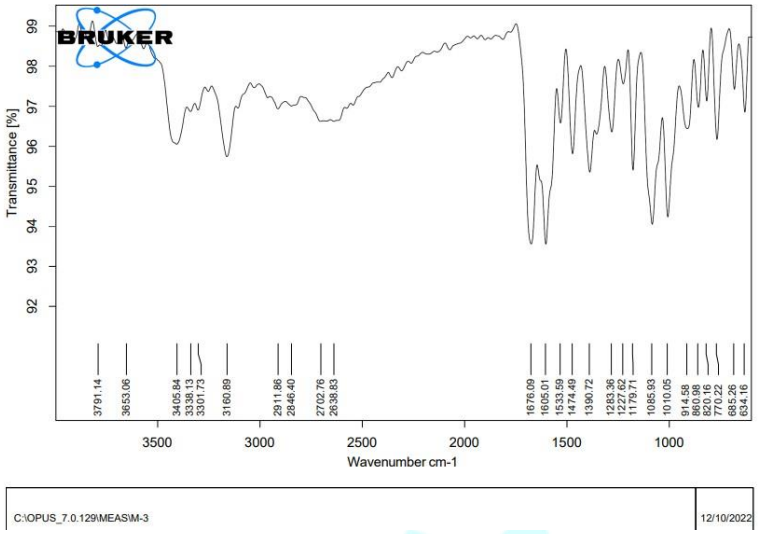

Figure No:06 IR spectra of Madhuyasti drug

Characteristics group	cm^{-1}
O-H stretching	3405
C-H stretching	2911
C=O stretching	1605
C=C stretching	1533
C-O-C stretching	1227

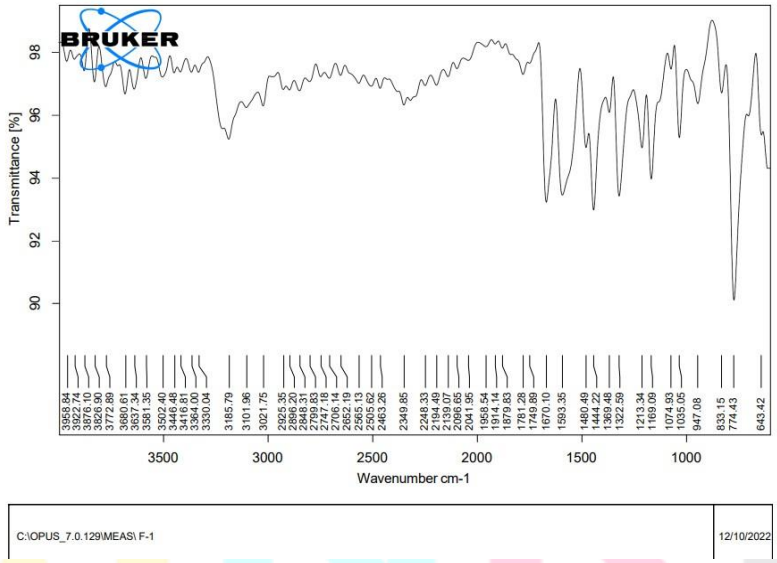

Figure No:07 IR spectra of Manjista Herbal cold cream F1

Report: IR spectra of Manjista herbal cold cream F1 shows peaks at:

- Peaks at 3125 shows OH stretching
- Peaks at 1749 shows C-O-O stretching
- Peaks at 1670 shows C=O stretching
- Peaks at 1593 shows C=C stretching
- Peaks at 1322 shows C-O-C stretching

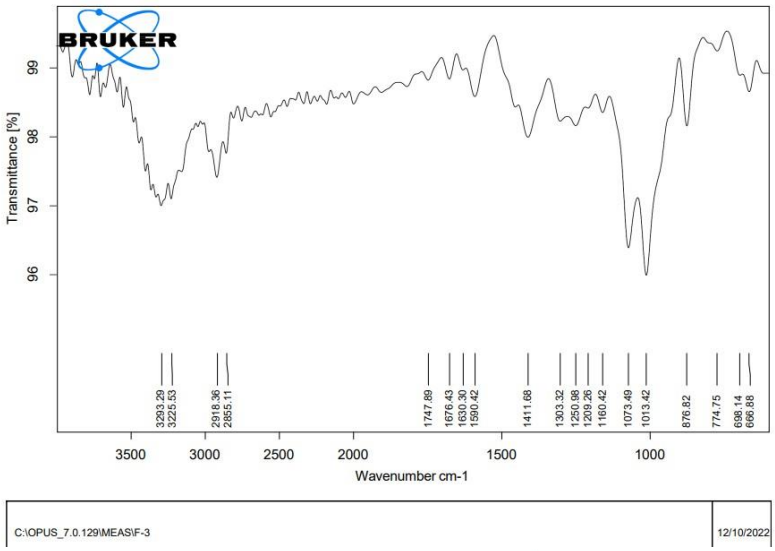

Figure No:08 IR spectra of Nagarmotha Herbal cold cream F5

Report: IR spectra of Nagarmotha herbal cold cream F4 formulation shows peaks at:

- Peaks at 3293 shows O-H stretching
- Peaks at 2918 shows C-H stretching
- Peaks at 1676 shows C=O stretching
- Peaks at 1546shows C=C stretching
- Peaks at 1013 shows C-O-C stretching

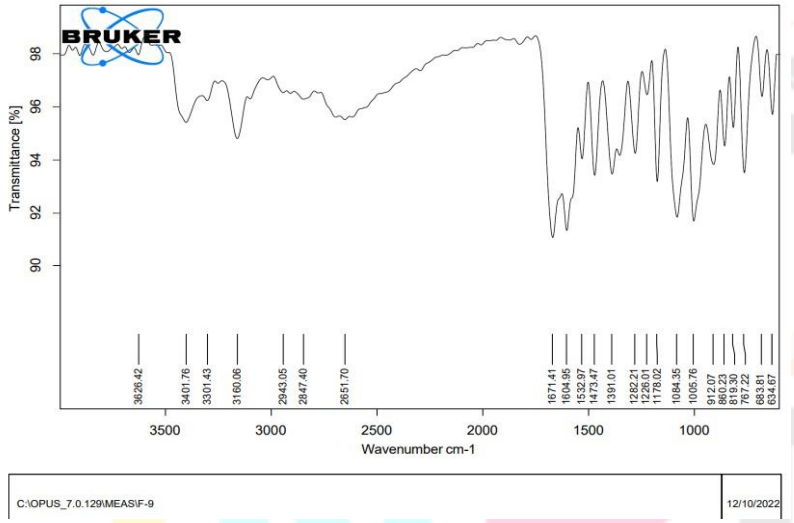

Figure No:09 IR spectra of Madhuyasti Herbal cold cream F9

Report: IR spectra of Madhuyasti herbal coldcream F9 show speaks at:

- Peaks at 3401 shows O-H stretching
- Peaks at 3160 shows C-H stretching
- Peaks at 1604 shows C=O stretching
- Peaks at 1640 shows C=C stretching
- Peaks at 1280 shows C-O-C stretching

From the FTIR spectra of the pure drugs and combination of drugs with the bases was observed that all the characteristic peaks of Manjista, Nagarmotha and Madhuyasti were present in combined spectra as well thus indicating the compatibilityof the drugs with the bases. The individual FTIR spectra of the pure drug Manjista, Nagarmotha and Madhuyasti as well as combination spectra of the drug and bases (Formulation F1, F and F9) are shown in Figure No.8,9,10,11,12 and 13 It was foundthat the drugs were compatible with bases in physical mixture.

Formulation of Herbal cold cream:

Manjista, Nagarmotha and Madhuyasti possess a various pharmacological activities like anti-acne, anti-inflammatory activity, antibacterial activity, antifungal activity, antiviral activity, immune modulatory activity and antioxidant activity. Theseare selected as a model drug to formulate an Herbal cold cream for topical delivery. Bases such as Beeswax, Borax, Liquid paraffin, Cetyl alcohol and Propyl paraben were used to formulate the Herbal cold cream. Bees wax is used as an emulsifying agent, stabilizer and also it gives thickness to the cream. Borax is

used as an Emulsifier and it provide whiteness. Liquid paraffin is used as a lubricating agent. Cetyl alcohol is used as an emollient, which help to reduce rough and dry skin. Propylparaben is used as a preservative to prevent the microbial growth.
Herbal cold cream was prepared by taking required quantity of waxy material and mineral oil in a porcelain China dish and heated on a water bath upto 75^0C to obtain a molten mask. (Phase-A or oily phase). In another beaker, take borax and water and heated up to 75^0 C (Phase-B or aqueous phase). Mix both the solutions by adding one phase into another phase with continuous stirring till a cream like consistency formed.

Characterization of herbal cold cream percentage yield:
Percentage yield of different formulation F1 to F9 were shown in Table No. 8, 9 and 10 respectively. The percentage of practical yield slightly increases with increase in the concentration of drug respectively.

Table No:08 Percentage yield of Manjista loaded herbal cold cream

Formulation code	Theoretical yield (gm)	Practical yield (gm)	Percentage yield (%)
F1	50	44.24	88.48
F2	50	44.42	88.84
F3	50	45.51	91.02

Table No:09 Percentage yield Nagarmotha loaded herbal cold cream

Formulation code	Theoretical yield (gm)	Practical yield (gm)	Percentage yield (%)
F4	50	42.76	85.52
F5	50	45.83	91.66
F6	50	46.25	92.05

Table No:10 Percentage yield of Madhuyasti loaded herbal cold cream

Formulation code	Theoretical yield (gm)	Practical yield (gm)	Percentage yield (%)
F7	50	44.42	88.84
F8	50	45.24	91.02
F9	50	46.44	92.88

SEM studies:
Determination of surface morphology was done by ZEISS EVO. US Scanning electron microscope. The F1, F4 and F9 formulations shows smooth surface characteristics. The SEM images of F1, F4 and F9 formulations are showed in Figure No.10, Figure No.11 and Figure No.12.

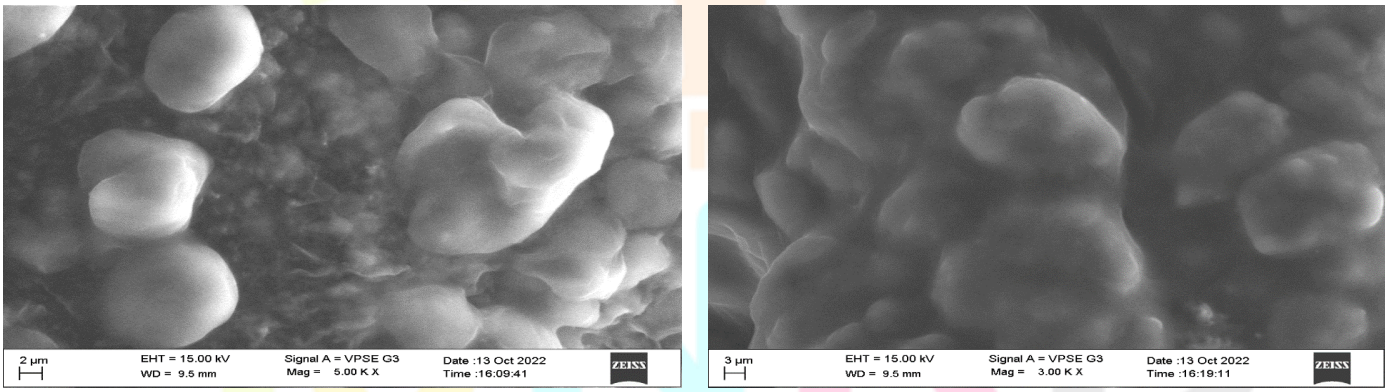

Figure No:10 SEM images of formulation F1

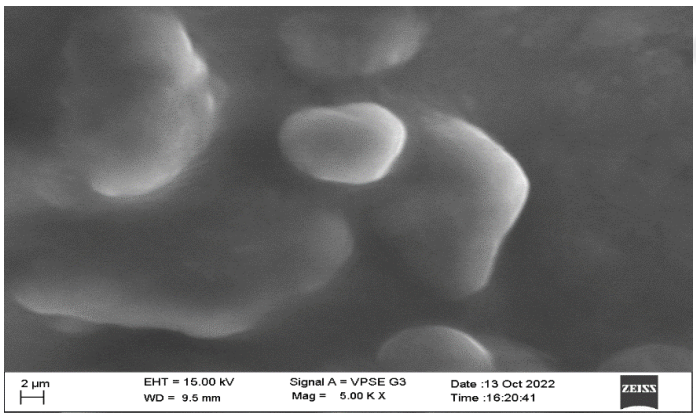

Figure No:11 SEM images of formulation F5

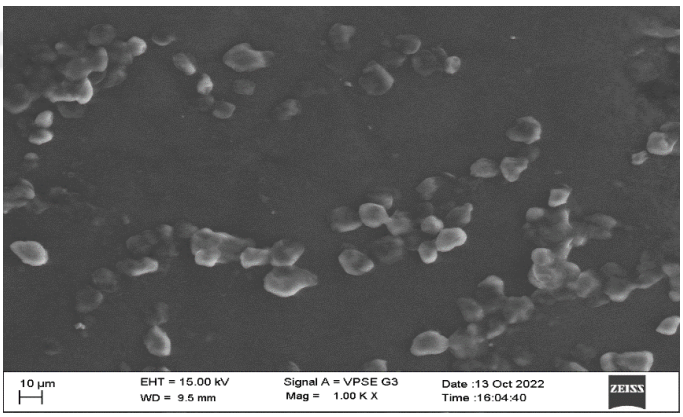

Figure No:12 SEM images of formulation F9

DSC studies:

The DSC report of pure drug Manjista, Nagarmotha and Madhuyasti were shown in Figure No. 13, 15 and 17 respectively. Manjista properties higher temperature has been exhibited melting point at 100.02^{0}C, Nagarmotha properties higher temperature has been exhibited melting point at 225^{0}C and Madhuyasti properties higher temperature has been exhibited melting point at 165^0 C. The DSC peaks of F1formulations has exhibited melting point at 100.02^0 C and peak is showed in Figure No.14. The DSC peaks of F5 formulations has exhibited melting point at 225^0 C and peak is showed in Figure No.16. The DSC peaks of F9 formulations has exhibited melting point at 165^{0}C and peak is showed in Figure No.18.

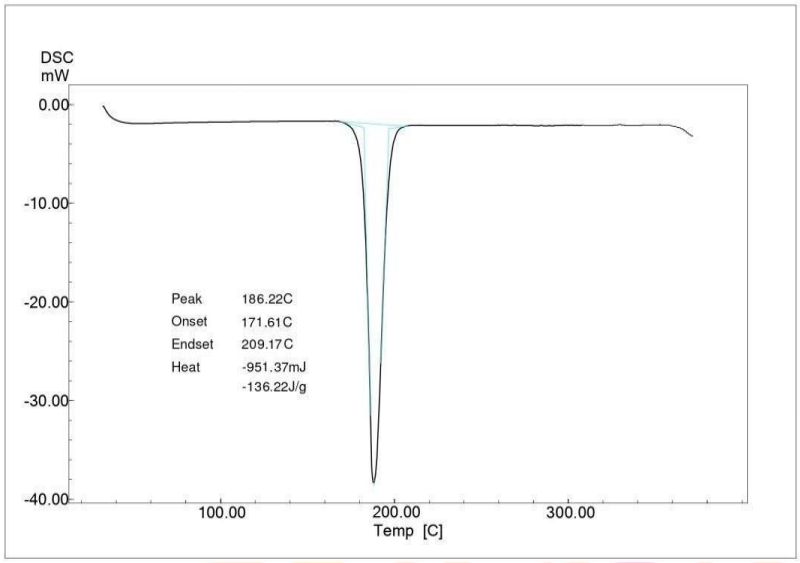

Figure No:13 Spectra showing DSC of pure Manjista

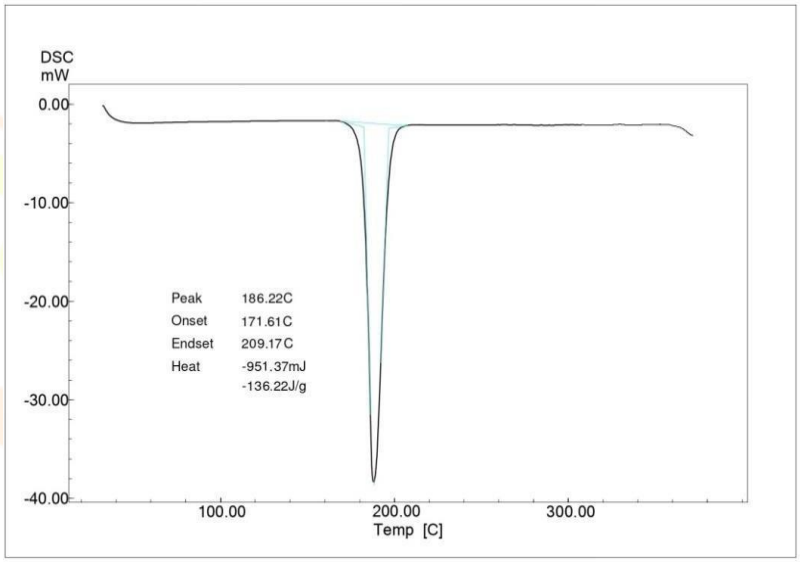

Figure No:14 Spectra showing DSC of F1 formulation

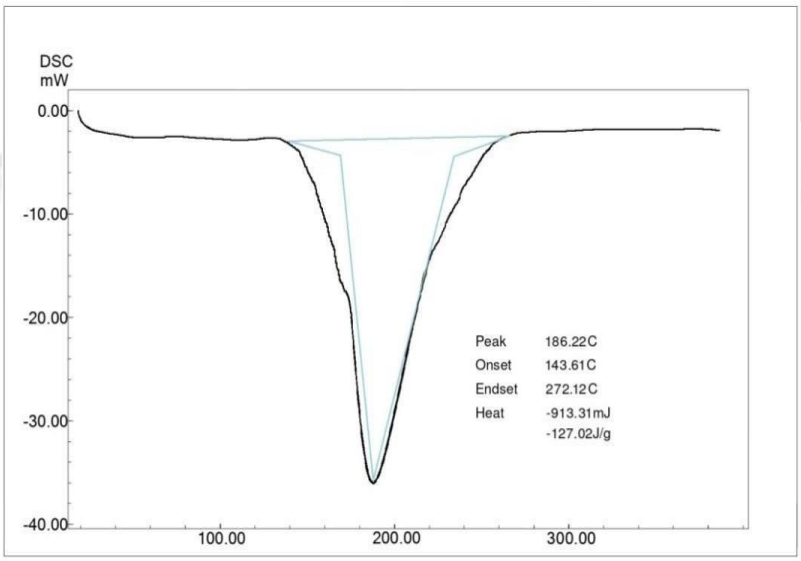

Figure No:15 Spectra showing DSC of pure Nagarmotha

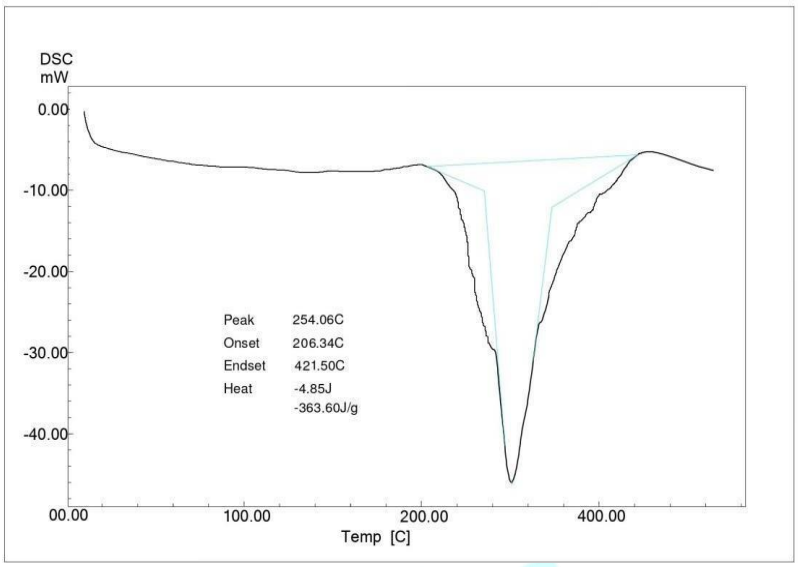

Figure No:16 Spectra showing DSC of F5 formulation

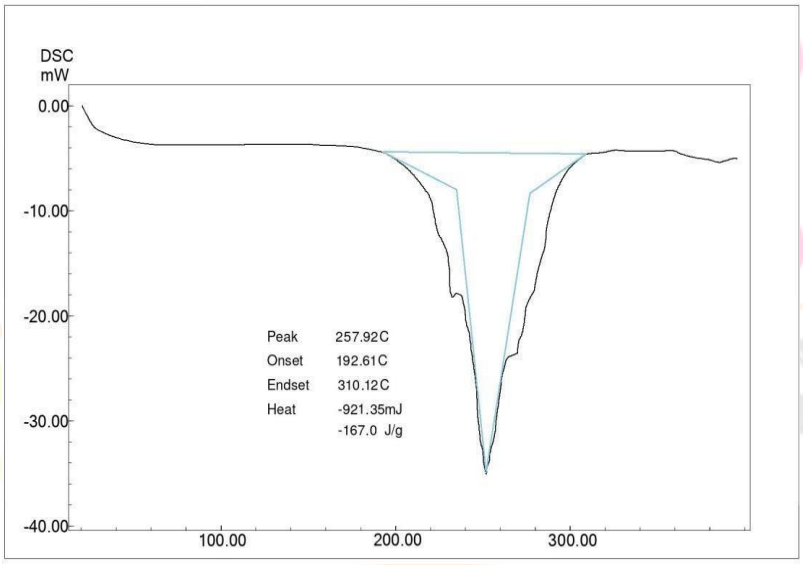

Figure No:17 Spectra showing DSC of pure Madhuyasti

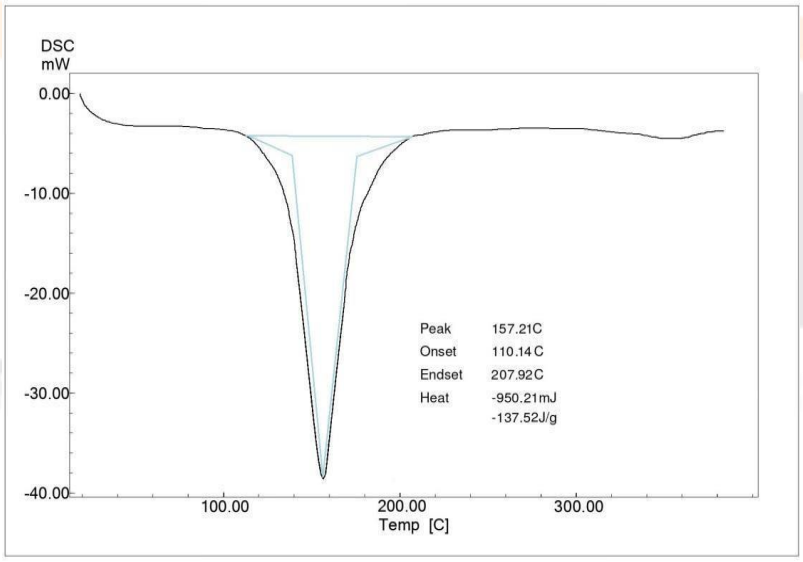

Figure No:18 Spectra showing DSC of F9 formulation

Evaluation of Herbal Cold Cream

Determination of Viscosity:

The Viscosity of different formulations from F1 to F9 was shown in Table No.11,12 and 13. The Viscosity was reported in a unit of centipoise (cps).

Table No:11 Study of Viscosity for F1 to F3 formulation

Formulations	Spindle No	RPM	Torque (%)	Viscosity(cps)
F1	SpindleNo.64	60	32.9	32304
		100	30.3	30108
F2	Spindle No. 64	60	18.4	38200
		100	22.9	36285
F3	Spindle No. 64	60	39.8	40140
		100	36.3	38192

Table No:12 Study of Viscosity for F4 to F6 formulation

Formulations	Spindle No	RPM	Torque (%)	Viscosity(cps)
F4	SpindleNo.64	60	27.1	42080
		100	21.3	41532
F5	Spindle No. 64	60	17.4	41789
		100	21.7	40236
F6	Spindle No. 64	60	22.3	40326
		100	20.3	39398

Table No:13 Study of Viscosity for F7 to F9 formulation

Formulations	Spindle No	RPM	Torque (%)	Viscosity(cps)
F7	SpindleNo.64	60	28.2	55162
		100	30.1	53768
F8	Spindle No. 64	60	24.4	53542
		100	26.2	50385
F9	Spindle No. 64	60	28.8	41431
		100	30.6	40759

Determination of pH:

The pH of different formulations from F1 to F9 was shown in Table No.14. The pHvaries from one formulation to another according to their basis's ratio with drug.

Table No:14 Study of pH for different formulation

Formulation code	pH
F1	5.2
F2	5.5
F3	5.6
F4	5.1
F5	5.2
F6	5.9
F7	5.4
F8	5.2
F9	5.9

Organoleptic evaluation

The color, odor, texture and state of all different formulations Manjista, Nagarmothaand Madhuyasti were shown in Table No.15,16 and 17.

Table No:15 Color, odor, texture and state of Manjista formulation F1 to F3

Sl. No.	Parameters	F1	F2	F3
1	Color	Light peach	Light peach	Light peach
2	Odor	Pleasant	Pleasant	Pleasant
3	Texture	Smooth	Smooth	Smooth
4	State	Semisolid	Semisolid	Semisolid

Table No:16 Color, odor, texture and state of Nagarmotha formulation F4 to F6

Sl. No.	Parameters	F4	F5	F6
1	Color	Ivory	Ivory	Ivory
2	Odor	Pleasant	Pleasant	Pleasant
3	Texture	Smooth	Smooth	Smooth
4	State	Semisolid	Semisolid	Semisolid

Table No:17 Color, odor, texture and state of Madhuyasti formulation F7 to F9

Sl. No.	Parameters	F7	F8	F9
1	Color	Golden yellow	Golden yellow	Golden yellow
2	Odor	Pleasant	Pleasant	Pleasant
3	Texture	Smooth	Smooth	Smooth
4	State	Semisolid	Semisolid	Semisolid

Irritancy test:

Mark an area (1cm^2) on the left-hand dorsal surface. Then the cream was applied to that area and the time was noted. Then it was checked for irritancy,erythema and edema if any for an interval up to 24hrs and reported. According the result, all the formulations i.e., F1 to F9 showed no sign of irritancy, erythema and edema.

Washability test:

Washability test was carried out by applying a small amount of cream on the hand and then washing it with tap water. All nine formulations were easily washable.

Spreadability test:

The spreadability of the three formulations that is F3, F6 and F9 were carried out and that is shown in Table No.18.

Table No:18 Study of spreadability for different formulations

Sl. No.	Formulations	Time(sec)	Spreadability (g xc m/sec)
1	F1 (Manjista)	10	22.8
2	F5 (Nagarmotha)	15	15.18
3	F9 (Madhuyasti)	7	32.4

Greasiness:

Here the cream was applied on the skin surface in form of smear and checked ifthe smear was oily or grease-like All the nine formulations showed non-greasy.

Diffusion studies (invitro drug release):

The drug release from the herbal cold cream was studied by using Franz diffusion cell. The *in vitro* release profiles of Manjista, Nagarmotha and Madhuyasti from herbal cold cream are shown in Table No. 19, 20 and 21. The cumulativepercentage release of Manjista, Nagarmotha and Madhuyasti herbal cold cream were varied depends on the drug bases ratio for 24 hrs.

In-vitro diffusion studies:

Table No:19 *In-vitro* drug release kinetics of F1 to F3 formulations

Time(hr)	%Drug Release *		
	ẋSD		
	F1	F2	F3
0	0	0	0
0.5	3±0.03	5±0.025	7±0.061
1	5±0.032	9±0.045	12±0.025
1.5	9±0.047	14±0.021	19±0.036
2	12±0.044	17±0.022	22±0.045
3	22±0.046	25±0.031	32±0.056
4	26±00.06	32±0.041	37±0.026
5	32±00.05	36±0.025	42±0.036
6	36±0.062	42±0.065	48±0.034
7	43±0.065	47±0.045	53±0.061
8	50±0.055	54±0.027	58±0.078
9	54±0.052	57±0.061	63±0.058
10	57±0.055	62±0.025	68±0.029
11	62±0.077	66±0.035	70±0.045
12	65±0.031	70±0.062	74±0.069
18	68±0.021	74±0.070	80±0.058
24	72±0.031	77±0.054	82±0.072

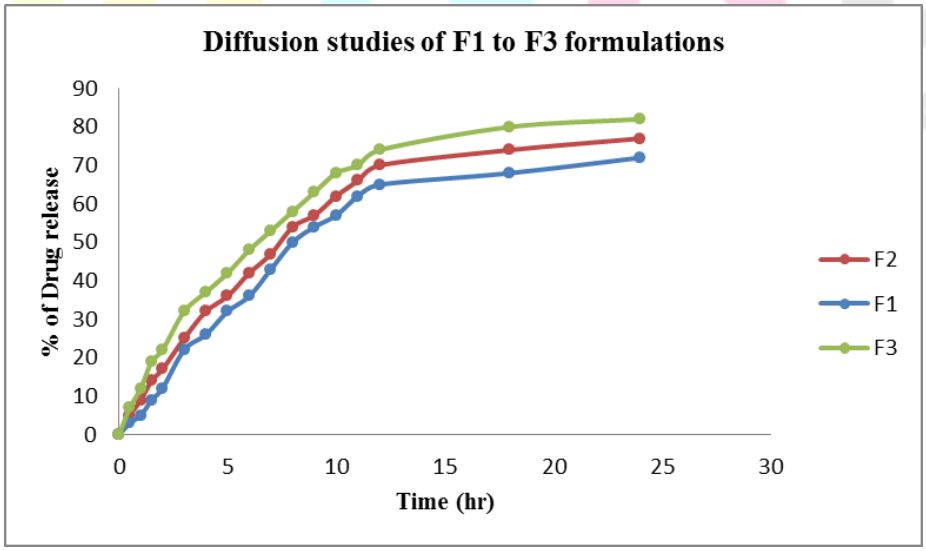

Figure No:19 Graph of *In-vitro* drug release of F1 to F3 formulations

Table No:20 *In-vitro* drug release kinetics of F4 to F6 formulations

Time (hr)	%Drug Release *		
	±SD		
	F4	F5	F6
0	0	0	0
0.5	4±0.015	5±0.025	6±0.011
1	8±0.065	10±0.066	13±0.065
1.5	11±0.025	15±0.025	19±0.015
2	13±0.034	18±0.045	22±0.024
3	19±0.026	25±0.075	29±0.036
4	22±0.041	28±0.014	32±0.027
5	26±0.056	34±0.026	36±0.019
6	36±0.075	39±0.031	44±0.045
7	40±0.072	46±0.026	50±0.049
8	47±0.029	52±0.011	55±0.015
9	56±0.038	57±0.019	62±0.026
10	59±0.061	60±0.024	67±0.033
11	64±0.075	65±0.026	71±0.023
12	66±0.062	69±0.079	74±0.014
18	70±0.036	74±0.048	77±0.057
24	75±0.081	77±0.044	81±0.051

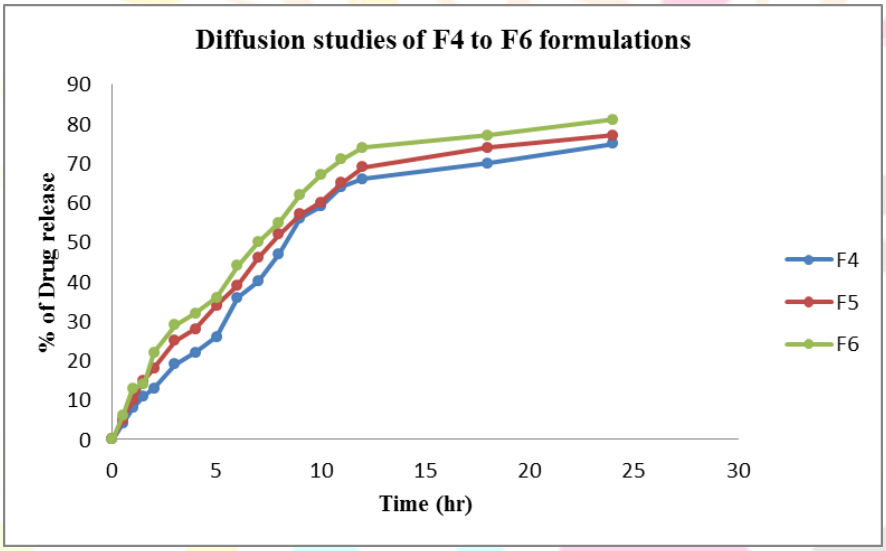

Figure No:20 Graph of *In-vitro* drug release of F4 to F6 formulations

Table No:21 *In-vitro* drug release kinetics of F7 to F9 formulations

Time (hr)	%Drug Release *		
	±SD		
	F7	F8	F9
0	0	0	0
0.5	2±0.026	2±0.022	3±0.036
1	3±0.024	6±0.012	7±0.011
1.5	7±0.011	10±0.024	12±0.018
2	12±0.047	14±0.056	16±0.021
3	16±0.046	20±0.048	22±0.017
4	21±0.032	25±0.036	28±0.059
5	28±0.026	35±0.025	39±0.068
6	35±0.019	44±0.011	47±0.026
7	42±0.054	49±0.015	52±0.055
8	48±0.079	55±0.019	58±0.046
9	58±0.023	60±0.035	64±0.078
10	60±0.011	65±0.031	70±0.019
11	68±0.019	71±0.039	74±0.045
12	72±0.055	73±0.018	77±0.026
18	73±0.022	76±0.045	80±0.048
24	76±0.026	80±0.049	83±0.011

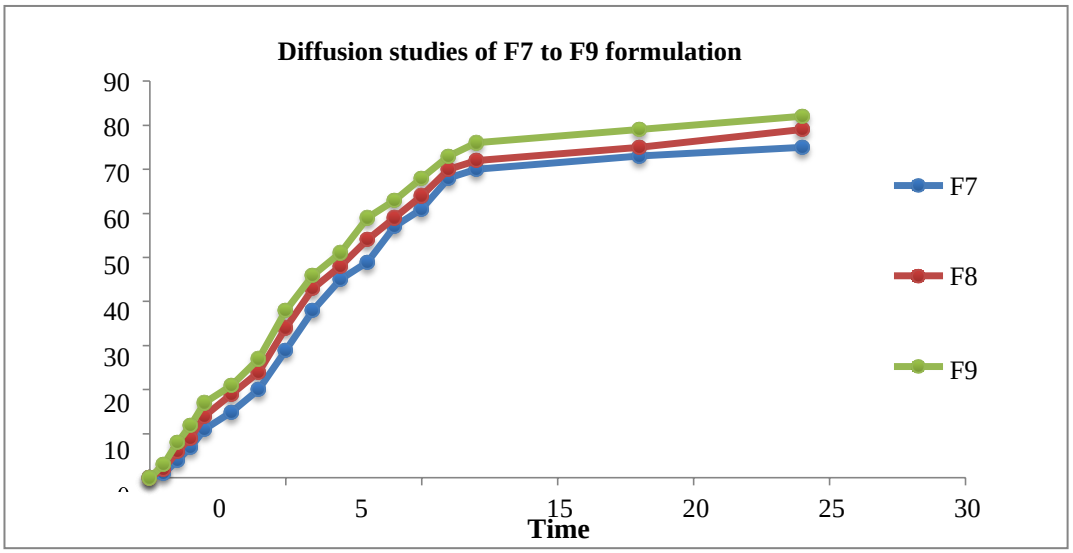

Figure No:21 Graph of *In-vitro* drug release of F7 to F9 formulations

Different Drug release kinetics models:

Table No:22 First order kinetics for *In-vitro* drug release of F1 to F3 formulation

Time (hr)	Log %Drug Remaining*		
	Formulation code		
	F1	F2	F3
0	0	0	0
0.5	1.987	1.978	1.968
1	1.978	1.959	1.944
1.5	1.959	1.934	1.908
2	1.944	1.919	1.892
3	1.892	1.875	1.833
4	1.869	1.833	1.799
5	1.833	1.806	1.763
6	1.806	1.763	1.716
7	1.756	1.724	1.672
8	1.699	1.663	1.623
9	1.663	1.633	1.568
10	1.633	1.580	1.505
11	1.580	1.531	1.477
12	1.544	1.477	1.415
18	1.505	1.415	1.301

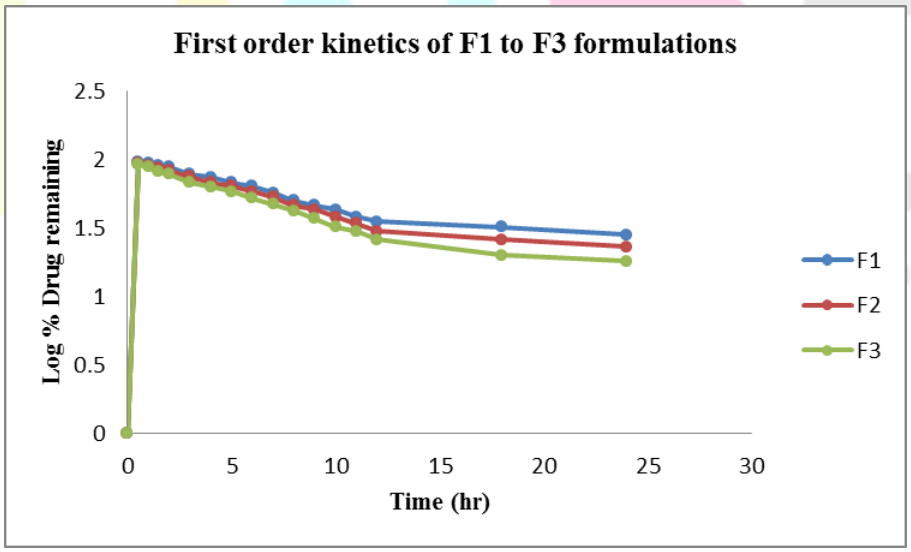

Figure No:22 Graph of First order kinetics for *In-vitro* drug release of F1 to F3 formulations.

Table No:23 First order kinetics for *In-vitro* drug release of F4 to F6 formulations.

Time (hr)	Log % Drug Remaining*		
	Formulation code		
	F4	F5	F6
0	0	0	0
0.5	1.982	1.978	1.973
1	1.964	1.954	1.940
1.5	1.949	1.929	1.934
2	1.940	1.914	1.892
3	1.908	1.875	1.881
4	1.892	1.857	1.833
5	1.869	1.820	1.806
6	1.806	1.785	1.748
7	1.778	1.732	1.699
8	1.724	1.681	1.653
9	1.643	1.633	1.580
10	1.613	1.602	1.519
11	1.556	1.544	1.462
12	1.531	1.491	1.415
18	1.477	1.415	1.362
24	1.398	1.362	1.279

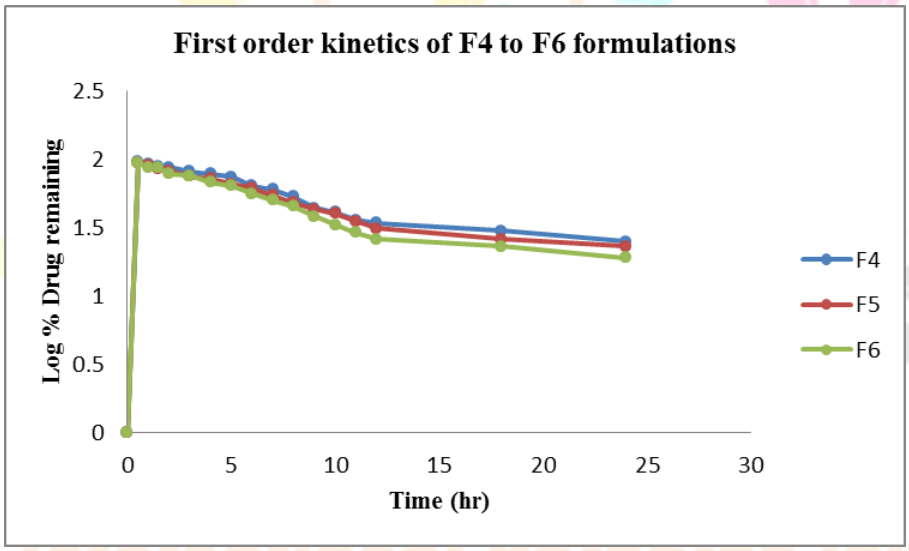

Figure No:23 Graph of First order kinetics for *In-vitro* drug release of F4 to F6 formulation

Table No:24 First order kinetics for *In-vitro* drug release of F7 to F9 formulations.

Time (hr)	Log % Drug Remaining*		
	Formulation code		
	F7	F8	F9
0	0	0	0
0.5	1.991	1.991	1.987
1	1.987	1.973	1.968
1.5	1.968	1.954	1.944
2	1.944	1.934	1.924
3	1.924	1.903	1.892
4	1.898	1.875	1.857
5	1.857	1.813	1.785
6	1.813	1.748	1.724
7	1.763	1.708	1.681
8	1.716	1.653	1.623
9	1.623	1.602	1.556
10	1.602	1.544	1.477
11	1.505	1.462	1.415
12	1.447	1.431	1.362
18	1.431	1.380	1.301
24	1.425	1.301	1.230

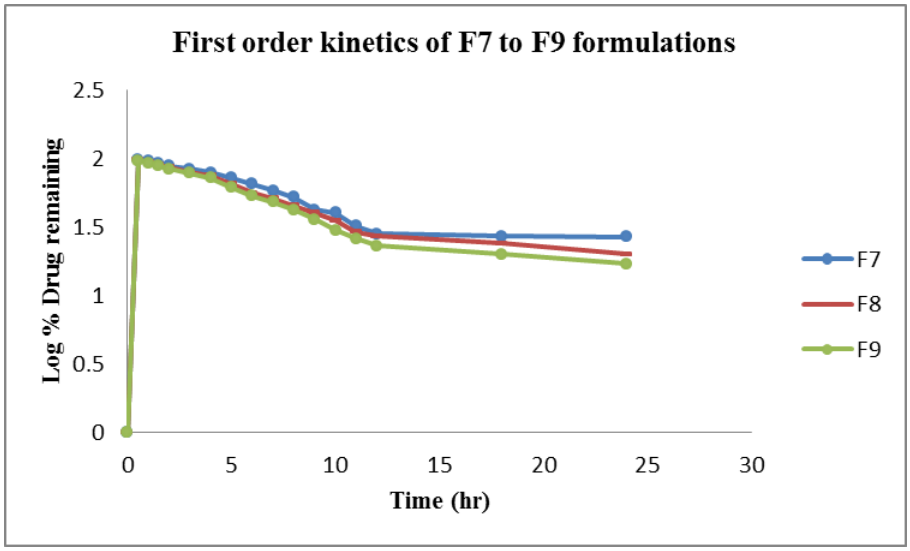

Figure No:24 Graph of First order kinetics for *In-vitro* drug release of F7 to F9 formulations

Table No:25 Higuchi's diffusion kinetics for *In-vitro* drug release of F1 to F3 formulations

√t	%Drug release		
	Formulation code		
	F1	F2	F3
0	0	0	0
0.707	3	5	7
1.000	5	9	12
1.225	9	14	19
1.414	12	17	22
1.732	22	25	32
2.000	26	32	37
2.236	32	36	42
2.449	36	42	48
2.646	43	47	53
2.828	50	54	58
3.000	54	57	63
3.162	57	62	68
3.317	62	66	70
3.464	65	70	74
4.243	68	74	80
4.899	72	77	82

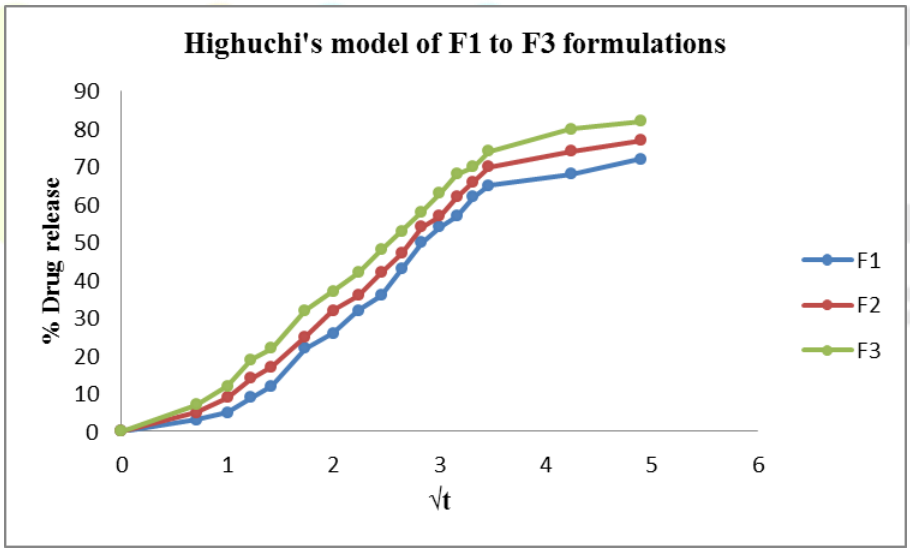

Figure No:25 Graph of Higuchi's diffusion kinetics for *In-vitro drug* release of F1 to F3 formulation

Figure No:26 Graph of Higuchi's diffusion kinetics for *In-vitro* drug release of F4 to F6 formulations.

√t	%Drug release		
	Formulation code		
	F4	F5	F6
0	0	0	0
0.707	4	5	6
1.000	8	10	13
1.225	11	15	14
1.414	13	18	22
1.732	19	25	29
2.000	22	28	32
2.236	26	34	36
2.449	36	39	44
2.646	40	46	50
2.828	47	52	55
3.000	56	57	62
3.162	59	60	67
3.317	64	65	71
3.464	66	69	74
4.243	70	74	77
4.899	75	77	81

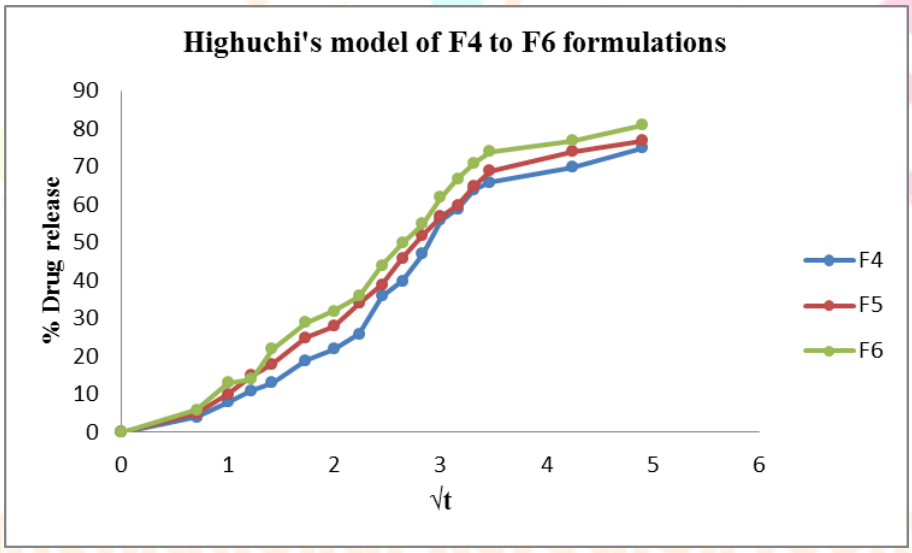

Figure No:26 Graph of Higuchi's diffusion kinetics for *In-vitro* drug release of F4 to F6 formulations.

Table No:27 Higuchi's diffusion kinetics for *In-vitro* drug release of F7 to F9 formulations.

√t	%Drug release		
	Formulation code		
	F7	F8	F9
0	0	0	0
0.707	2	2	3
1.000	3	6	7
1.225	7	10	12
1.414	12	14	16
1.732	16	20	22
2.000	21	25	28
2.236	28	35	39
2.449	35	44	47
2.646	42	49	52
2.828	48	55	58
3.000	58	60	64
3.162	60	65	70
3.317	68	71	74
3.464	72	73	77
4.243	73	76	80
4.899	76	80	83

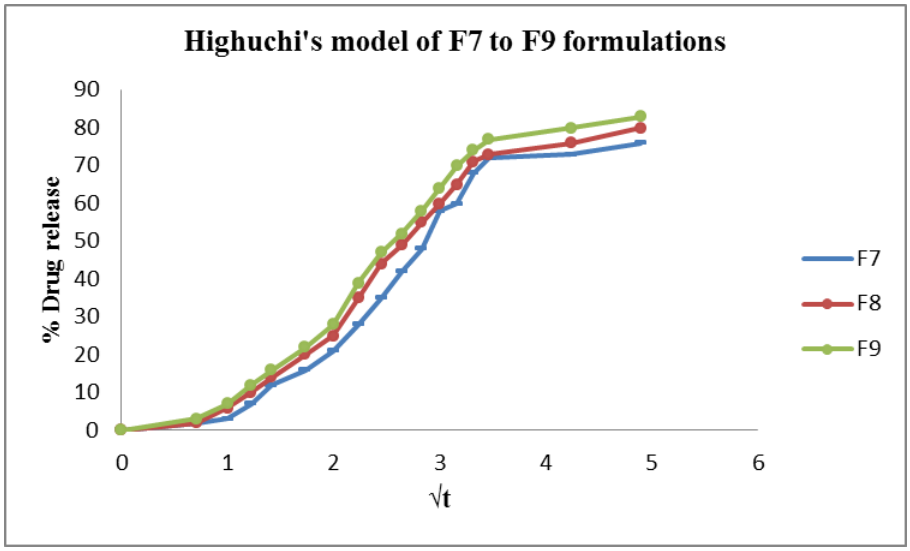

Figure No:27 Graph of Higuchi's diffusion kinetics for *In-vitro* drug release from F7 to F9 formulations.

Table No:28 Peppas model for *In-vitro* drug release of F1 to F3 formulations.

Logtime	Log % Drug release		
	Formulation code		
	F1	F2	F3
0	0	0	0
0.301	0.477	0.699	0.845
0.000	0.6990	0.9542	1.0792
0.176	0.9542	1.1461	1.2788
0.301	1.0792	1.2304	1.3424
0.477	1.3424	1.3979	1.5051
0.602	1.4150	1.5051	1.5682
0.699	1.5051	1.5563	1.6232
0.778	1.5563	1.6232	1.6812
0.845	1.6335	1.6721	1.7243
0.903	1.6990	1.7324	1.7634
0.954	1.7324	1.7559	1.7993
1.000	1.7559	1.7924	1.8325
1.041	1.7924	1.8195	1.8451
1.079	1.8129	1.8451	1.8692
1.255	1.8325	1.8692	1.9031
1.380	1.8452	1.8712	1.9051

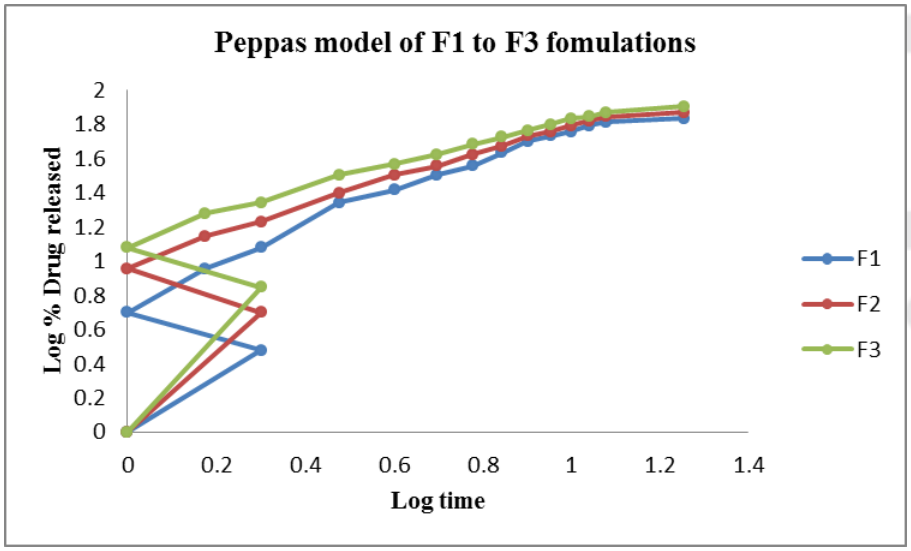

Figure No:28 Graph of Peppas model for *In-vitro* drug release of F1 to F3 formulations.

Table No:29 Peppas model for *In-vitro* drug release of F4 to F6 formulations.

Logtime	Log % Drug release		
	Formulation code		
	F4	F5	F6
0	0	0	0
0.301	0.602	0.699	0.778
0.000	0.9031	1.0000	1.1139
0.176	1.0414	1.1761	1.1461
0.301	1.1139	1.2553	1.3424
0.477	1.2788	1.3979	1.4624
0.602	1.3424	1.4472	1.5051
0.699	1.4150	1.5315	1.5563
0.778	1.5563	1.5911	1.6435
0.845	1.6021	1.6628	1.6990
0.903	1.6721	1.7160	1.7404
0.954	1.7482	1.7559	1.7924
1.000	1.7709	1.7782	1.8261
1.041	1.8062	1.8129	1.8513
1.079	1.8195	1.8388	1.8692
1.255	1.8451	1.8692	1.8865
1.380	1.8751	1.8865	1.9085

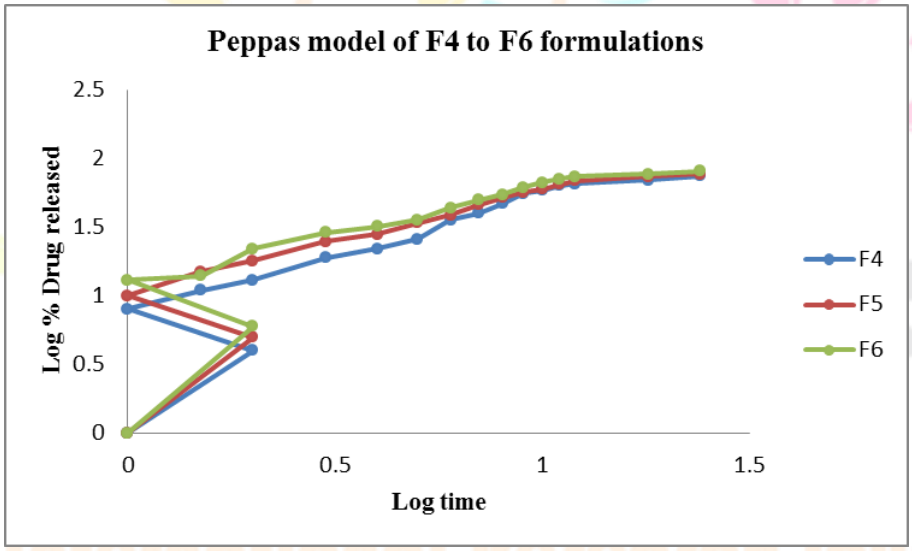

Figure No:29 Graph of Peppas model for *In-vitro* drug release of F4 to F6 formulations.

Table No:30 Peppas model for *In-vitro* drug release of F7 to F9 formulations.

Logtime	Log % Drug release		
	Formulation code		
	F7	F8	F9
0	0	0	0
0.301	0.30103	0.301	0.477121
0.000	0.477121	0.7782	0.845098
0.176	0.845098	1.0000	1.079181
0.301	1.079181	1.1461	1.20412
0.477	1.20412	1.3010	1.342423
0.602	1.322219	1.3979	1.447158
0.699	1.447158	1.5441	1.591065
0.778	1.544068	1.6435	1.672098
0.845	1.623249	1.6902	1.716003
0.903	1.681241	1.7404	1.763428
0.954	1.763428	1.7782	1.80618
1.000	1.778151	1.8129	1.845098
1.041	1.832509	1.8513	1.869232
1.079	1.857332	1.8633	1.886491
1.255	1.863323	1.8808	1.90309
1.380	1.872545	1.8965	1.9191

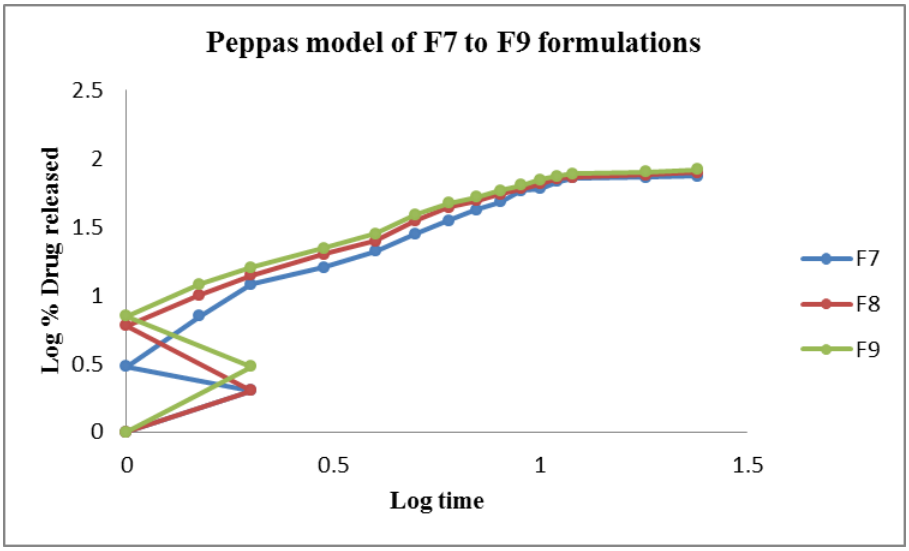

Figure No:30 Graph of Peppas model for *In-vitro* drug release of F7 to F9 formulations.

Table No:31 Regression co-efficient (R^2) values of Manjista, Nagarmotha and Madhuyasti different kinetic model.

Formulation	Zero order		First order		Higuchi	Peppas	
	R^2	n	R^2	n		R^2	n
F1	0.520	0.9101	0.076	0.9513	0.9543	0.9578	0.9796
F2	0.9201	0.704	0.052	0.9955	0.9930	0.6577	0.9915
F3	0.0043	0.9510	0.059	0.9894	0.9964	0.5810	0.9853
F4	0.8873	0.9871	0.049	0.9875	0.9646	0.6977	0.9852
F5	0.9030	0.9785	0.053	0.9802	0.9827	0.6284	0.9800
F6	0.0806	0.9724	0.061	0.9817	0.9860	0.6032	0.9810
F7	0.0720	0.9204	0.090	0.9371	0.9263	1.1233	0.9777
F8	1.0159	0.9071	0.096	0.9505	0.9463	1.0378	0.9737
F9	0.0850	0.7683	0.029	0.0253	0.9146	0.9229	0.9599

DISCUSSION

The Manjista, Nagarmotha and Madhuyasti herbal cold cream was prepared by using different grades of bases like borax, beeswax, liquid paraffin, perfume and water by using heating method.

UV spectrometric studies:

The Manjista showed maximum absorption at wavelength 270 nm, Nagarmotha showed maximum absorption at wavelength 305nm and Madhuyasti showed maximum absorption at wavelength 254 nm in phosphate buffer pH 6.8. The standard calibration curves obey Beer's law and gives linear curve and the R^2 value is not greater than 0.999.

FTIR studies:

For the compatibility studies between the drug and basess elected are subjected to FTIR and DSC studies. The IR spectrum of pure drugs and bases and physical mixtures of drug and bases (formulations) was recorded. The IR spectra of Manjista shows sharp peak at 3280 cm^{-1} due to the presence of OH group, it shows peak at 1678 cm^{-1} due to the presence of C=O groups and it shows peak at 1564cm^{-1}dueto the presence of C=C groups and it shows peak at 1282cm^{-1} due to the presence of C-O-C groups and it shows peak at 1809 cm^{-1} due to the presence of C-O-O groups. The IR spectra of Nagarmotha shows sharp peak at 3345 cm^{-1} due to the presence of OH group, it shows peak at 1696 cm^{-1} due to the presence of C=O groups and it shows peak at 1546 cm^{-1} due to the presence of C=C groups and it shows peak at 1022 cm^{-1} due to the presence of C-O-C groups and it shows peak at 2928 cm^{-1} due to the presence of CH groups. The IR spectra of Madhuyasti shows sharp peak at 3405 cm^{-1} due to the presence of OH group, it shows peak at 1605 cm^{-1} due to the presence of C=O groups and it shows peak at 1533 cm^{-1} due to the presence of C=C groups and it shows peak at 1227 cm^{-1} due to the presence of C-O-C groups and it shows peak at 2911 cm^{-1} due to the presence of CH groups.

All these similar peaks are obtained in formulation also. It indicates that pure drug functional groups peaks were present in all the formulations without changes in the peaks position.

SEM studies:
The SEM images of formulation F1, F5 and F9 reveals that the herbal cold creams are smooth in surface.
DSC studies:
DSC thermogram of pure Manjista, Nagarmotha and Madhuyasti F1, F5 and F9 formulations are shown in Figure No.13,14,15,16,17 and 18. The F1 formulation has showed an endothermic peak at 186.22^0 C, where as F5 formulation has showed a peak at 257.92^0C and F9 formulation has showed a peak at 160.12^0 C. The pure Manjista have shown an endothermic peak at 186.22^0 C, where as Nagarmotha shows peak at 254.06^0C and Madhuyasti shows peak at 157.21^0 C due to the melting point of drug but this peak is not exactly seen in drug loaded formulations this indicates the drug was uniformly distributed in formulations.
Viscosity studies:
The Viscosity of all 9 formulations was determined by Brook-field viscometer using spindle no.64 as shown in **Table No: 11, 12 and 13**. The viscosity of all 9 formulations was in the range of 49990 to 30000 cps, which indicates that the cream is easily spreadable by small amount of shear.

pH studies:
The pH of all 9 formulations was performed by pH meter and it shown in the pH range of 5.2 to 5.9 as shown in **Table No: 14**. The formulations F1, F5 and F9 shows highest pH compare to their other formulations. Change in drug concentration may leads to changes in the pH of preparations.

Irritancy studies:
Irritancy test for all the prepared formulations were performed by applying prepared herbal cold cream to the marked area on the hand. According the result, all the formulations i.e., F1 to F9 showed no sign of irritancy, erythema and edema. It indicates that the prepared herbal cold cream was safe to use.

Washability studies:
Washability test was carried out by applying a small amount of cream on the hand and then washing it with tap water. According the result, all the formulations i.e., F1 to F9 are easily washable.

Spreadability studies:
The spread ability of the three formulations that is F1, F5 and F9 were carried out and that is shown in **Table No.18**. The spread ability of F1 formulation was found that 22.8, F5 formulation was found that 15.18 and F9 formulation was found that 32.4. The F9 formulation shows good spreadability compared to other formulation. **Here the cream was applied on the skin surface in the form of smear.**

Diffusion studies:

The *in-vitro* diffusion studies of manjista, nagarmotha and madhuyasti herbal cold cream were carried out by using Franz's diffusion cell and using cellophane membrane as barrier. The result of *in-vitro* diffusion studies is shown in **Table No. 19, 20 and 21.** The cumulative percentage of drug diffusion from F1 to F9 ranges from 74% to 83%. Formulation F1, F5 and F9 shows highest percentage drug release and from the graph it shows the drug release in controlled manner compared to other formulations. The release kinetics was evaluated by making use of Zero order, First order, Higuchi's diffusion and Pappas equation.
The drug release through the manjista, nagarmotha and madhuyasti herbal cold cream follows Pappas diffusion kinetics with controlled mechanism and the 'n' values are in between 0.52 to 0.86. By fitting in Korsmeyer-Pappas equation the release kinetics follows non-Fiction Kinetics. If the 'n' values Korsmeyer-Pappas equation below 0.5, this indicates Fiction Kinetics. If the 'n' values Korsmeyer-Pappas equation is in between 0.5 to 1 this indicates non-Fiction Kinetics. Here the Manjista, Nagarmotha and Madhuyasti herbal cold creams release kinetics are fitted in Korsmeyer-Pappas equation, 'n' values are in between 0.5 to 1, so the release is following non-Fiction, diffusion-controlled kinetics. The 'n' values and R^2 values of all nine herbal cold cream formulations are mentioned in **Table No: 31**

SUMMARY

The aim of present study was to formulate and evaluate the Manjista, Nagarmotha and Madhuyasti containing herbal cold cream. To achieve this, nine formulations of herbal cold cream were prepared by using suitable base. Prepared herbal cold cream was subjected for evaluation of surface morphology, differential scanning calorimetric analysis, fourier transform infrared spectroscopy analysis, pH studies, viscosity, Skin irritation, Wash ability, Spread ability, Greasiness and *in-vitro* diffusion studies. The drug-bases compatibility was studied by using FTIR spectroscopy. The study revealed that there is no interaction between the selected drug and bases. The herbal cold creams formed have smooth surface observed in SEM. The DSC studies shows the drugs are amorphously distributed in all formulations. The *In-vitro* diffusion studies of herbal cold cream indicate that the drug was protected from being released in physiological environment of the skin. The result shown maximum amount of drug release in controlled manner. The diffusion studies follow pappas diffusion and non-Fiction kinetics.

CONCLUSION

The preformulation studies involving solubility, melting point and description of the drugs were found to become pared with the standard. Based on all above preformulation studies the drugs are suitable for making herbal cold cream. IR spectra of F1, F5 and F9 formulations shows similar peaks present in the spectra of Manjista, Nagarmotha, and Madhuyasti. The F1, F5 and F9 formulations shows good percentage yield compare to other. SEM images of F1, F5 and F9 formulations shows good results of smooth surface with very small pore size. DSC studies shows that, the drug in F1, F5 and F9 formulations is uniformly distributed and it is amorphous in nature and it shows there is no chemical reactions. All the Herbal cold cream formulations show pH in the range of 5.2 to 5.9 which is good for skin. Formulation F9 shows highest pH of 5.8. All herbal cold cream formulations were shown pH nearer to skin required. The formulations F1, F5 and F9 shows highest percentage of drug release compare to other formulations. Based on the resultant data obtained from the different evaluation parameters it can be concluded that the prepared formulations were stable and safe to use. In future, they may further be subjected for stability studies and *In-vivo* studies using human voluntaries.

REFERENCES

1. Kolarsick PA, Kolarsick MA, Goodwin C. Anatomy and physiology of the skin. Journal of the Dermatology Nurse's Association. 2011 Jul 1;3(3):203-213.
2. Lawton S. Skin 1: the structure and functions of the skin. Nur's Times. 2019 Dec; 115:30-33.
3. Janhavi Yadav Shashikant Maury A review on anti-aging activity of herbal cold cream,World Jpurnal of Pharmacy and Pharmaceutical Sciences. 2022;11(6);381-389
4. Adebayo-Tayo BC, Borode SO, Olaniyi OA. Phythosynthesis of zinc oxide nanoparticles using methanol extract of Senna alata leaf: Characterisation, optimization, antimicrobial, properties and its application in cold cream formulation. Polymers in Medicine. 2020;50(1):5-19
5. Barethiya V, Kukde A, Ashisha B, Alpana A, Gouri D. Formulation and Evaluation of Vitamine E Enriched Cold Cream with Almondoil as an International Phase. International Journal of Pharmaceutical Sciences. 2020;63(2):71-75.
6. Navindgikarn N, Kamalapurkar KA, Chavan PS. Formulation and evaluation of multipurpose herbal cream. International Journal of Current Pharmaceutical Research. 2020May;12(3); 25-30.
7. Chauhan L, Gupta S. Creams: A Review on Classification, Preparation Methods, Evaluation and its Applications. Journal of Drug Delivery and Therapeutics. 2020;10(5-s):281-9.
8. Kala SL, Palaparthi S. Formulation and invitro Evaluvation of poly herbal Anti-Aging Face Cream. World Journal of Pharmaceutical Research. 2017;6(13):713.