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Preparation and Evaluation of Drug Miconazole nitrate (Gel Form) for Topical Delivery with the help of Deep Eutectic Mixture

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ABSTRACT
Skin is only the most sensible and larger part organ on human physique for skin administration and is primary path of topical drug delivery system.Human skin is composed of three distinct layers: the stratified, vascular, cellular epidermis; the connective tissue-rich dermis; and the hypodermis.The skin regulates the passage of various chemicals, prevents moisture loss, and helps regulate body temperature to maintain internal stability, known as homeostasis. Skin disorders affect nearly one-third of the global population, making them the fourth most common category of human diseases. For many years, the skin has been utilized to deliver drugs effectively and with limited bioavailability concerns compared to oral administration. Miconazole Nitrate, an antifungal medication, is specifically used topically for skin diseases.FTIR analysis confirmed the drug's purity and indicated no interactions between the drug and excipients. Gel formulations were assessed for drug content, pH levels, and viscosity.This study contains Pre-formulation study (i.e.Appearance and sensory properties, Melting Point determination, Solubility profile, UV-visible absorption spectra, Partition Coefficient,Fourier-transform infrared spectroscopy), here I was performed Formulation screening of carboxylic acid with choline chloride and choline bitartrate which is also known as deep eutectic solvent mixture on the basis of that the Formulation F6(A6)G2 was selected best formulation DESM for drug, after that preparation was evaluated.

KEYWORDS: Physique, Topical, Chemicals, Homeostasis, Populace, Bioavailability, Organoleptic, DESM.

INTRODUCTION

The main channel of topical drug delivery systems is within the skin, only most perceptive and largest organs on the human body for topical administration. The substantial organ in humans, the skin, is a safe and environmentally friendly way to provide medication since it avoids many of the risks associated with parenteral and oral routes.[1]

In recent decades, experts have been interested in the advantages of pores and skin. When a medicine is shipped by topical route, it passes from a topical product to a localized area that has dermal circulation all around the body and deeper tissues. [2]

Skin and pore problems affect around one-third of the world's population and are the fourth most common cause of all diseases in humans. For many years, skin has been broadly employed to

give medications that are poorly soluble and low bioavailability when taken orally throughout the world. [3]

In the year 4000 BC, Africans used minerals, phytochemicals, and cosmetic products including henna, kohl, and red ochers to treat skin conditions. Ebers Papyrus produced a book in 1500 BC that was entirely composed of papyrus paper and included information about using tiger nuts to manage wound healing. [4-7]

Types of Skin [8-9]

Human skin comprises three primary layers: the stratified, vascular, cellular epidermis; the connective tissue-rich basal dermis; and the hypodermis. Microscopic examination of the epidermis reveals distinct layers including the stratum corneum, stratum lucidum, stratum granulosum, stratum spinosum, and stratum germinativum.

Functions of skin[10-11]

Protective function, Regulation of body temperature, Formation of Vitamin D, Sensation, and Excretion.

Gels[12-13]

Gels are a modern type of dosage form that functions by encapsulating a significant amount of hydroalcoholic or aqueous liquid within a network of colloidal solid particles.Inorganic materials such as aluminum salts or manufactured or natural organic polymers can be utilized to create these particles. The type of liquid and colloidal materials employed in the composition of the gel might cause it to seem opaque or entirely clear.

Most topical gels are formulated with organic polymers such as carbomers, which impart a clear, glossy appearance and allow easy removal from the skin with water. Gels are two-phase systems, predominantly liquid-based, that exhibit a semi-solid consistency.

Types of Gels[14]

- **Single Phase Gel:** These gels are colloidal gels, where macromolecules are uniformly dispersed in a liquid phase without distinct boundaries between the dispersed macromolecules and the liquid medium.
- **Dual-Phase Gel:** Contain a gel part made up of clusters of small, separate particles, commonly known as magmas. An example is milk of magnesia or magnesia magmas.

Material and Methodology

Table 1: List of tools

S. No.	Instruments	Manufacturer
1.	UV/VIS Spectra	Shimadzu,Japan
2.	Weighing balance, (AUX220)	Shimadzu, Japan
3.	Ultrasonic Bath	PCI
4.	Vortex Mixer	Remi (SLM-VM-3000), Bangalore
5.	Melting Point determination Apparatus	Remi Equipment, Mumbai
6.	IR Spectrophotometer (FTIR)	Perkin
7.	pH Meter	Ohaus
8.	Water Bath Shaker	NSW India
9.	Magnetic Stirrer	IKA India
10.	Cooling Centrifuge	Remi Equipment, Mumbai
11.	Franz diffusion cell assembly	Orchid scientific

Table 1.1: List of substances used

S. No.	Substances	Source
1.	Methanol	Fisher Scientific India Pvt. Ltd.
2.	Potassium Dihydrogen Orthophosphate	Thomas Baker
3.	Sodium Hydroxide	Thomas Baker
4.	Ethanol	Shree Renuka Sugars Pvt. Ltd.
5.	Chloroform	Fisher Scientific India Pvt. Ltd.
6.	Choline Chloride	Tokyo Chemical Industry
7.	Choline Bitartrate	Tokyo Chemical Industry
8.	Boric Acid	Thermo Fisher Scientific India Pvt. Ltd.
9.	Benzoic Acid	Thermo Fisher Scientific India Pvt. Ltd.
10.	Citric Acid	Thermo Fisher Scientific India Pvt. Ltd.
11.	Stearic Acid	Thermo Fisher Scientific India Pvt. Ltd.
12.	Oxalic Acid	Central Drug House
13.	Succinic Acid	Vizag Chemicals
14.	Malonic Acid	ShilpaChemspec International Pvt. Ltd.
15.	Cinnemic Acid	LobaChemie Pvt. Ltd.

1. Preformulation Studies

The objective of pre-formulation studies was to explore the physical and chemical characteristics of Miconazole Nitrate. These investigations included examining parameters such as:

- Appearance and sensory properties
- Melting point determination
- UV-visible absorption spectra
- Solubility profile
- Partition coefficient
- Fourier-transform infrared spectroscopy

1.1. Appearance and sensory properties

Appearance and sensory properties of drug found to be as per literature. The appearance and sensory properties of drug were found to be as follows in table 1.2.[15]

Table 1.2: Appearance and sensory properties of Miconazole Nitrate

Sr. No.	Properties	Presumption
	Colour	White
	Odour	Odourless
	Form	Crystalline
	Taste	Slightly Unpleasant

1.2. Melting Pointdetermination

The melting point of a substance is the temperature at which its solid form transitions to liquid under standard atmospheric pressure. Determining this melting point serves as a gauge for the substance's purity, including drugs. When assessed using the capillary tube method, the melting

point of Miconazole Nitrate closely matched the known value, indicating its likely purity.as shown in table 1.3.

Table 1.3: Melting Point determination of Miconazole Nitrate

Drug	Reference	Observed
Miconazole Nitrate	179-182 ℃	177.1-178.4±0.64℃

Discussion: The melting point of Miconazole Nitrate was177.1-178.4±0.64℃ which was in the range of melting point of the pure drug. Therefore**,** drug sample was freed from any impurities.

1.3. UV-visible absorption spectra

1.3.1. Determination of absorption maxima in Methanol

Quantitative analysis of the drug was conducted using a double beam UV-visible spectrophotometer. A solution containing 10 µg/ml of Miconazole Nitrate in methanol was scanned across the wavelength range of 200-400 nm.The result of UV spectrum of Miconazole Nitrate is shown in Figure 1.

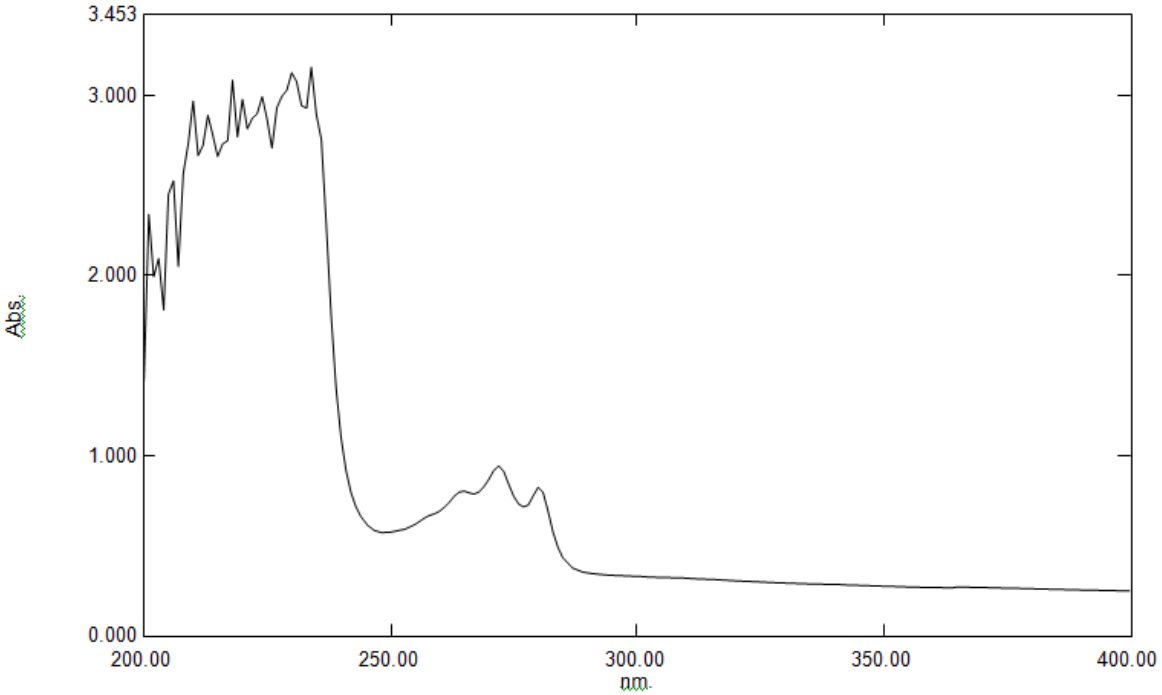

Figure 1: UV Spectra of Miconazole Nitrate in methanol

Table 1.4: Absorption maxima (λ_{max}) of Miconazole Nitrate in methanol

Name of drug	Absorption maxima (λ_{max})	
	Observed	Reference
Miconazole Nitrate	272nm	272nm

Discussion: The observed maximum wavelength of Miconazole Nitrate was 272 nm, consistent with values reported in the literature as shown in Table 1.4.[16-17]

1.3.2. Composition of standard curve of Miconazole Nitrate in methanol

Table 1.5: Calibration curve of Miconazole Nitrate in methanol (λ_{max}= 272 nm)

Sr. No.	Concentration (µg/ml)	Absorbance
1	0	0
2	20	0.198±0.001
3	40	0.381±0.001
4	60	0.545±0.001
5	80	0.737±0.060
6	100	0.943±0.003

Value is indicated as mean ± SD; n = 3

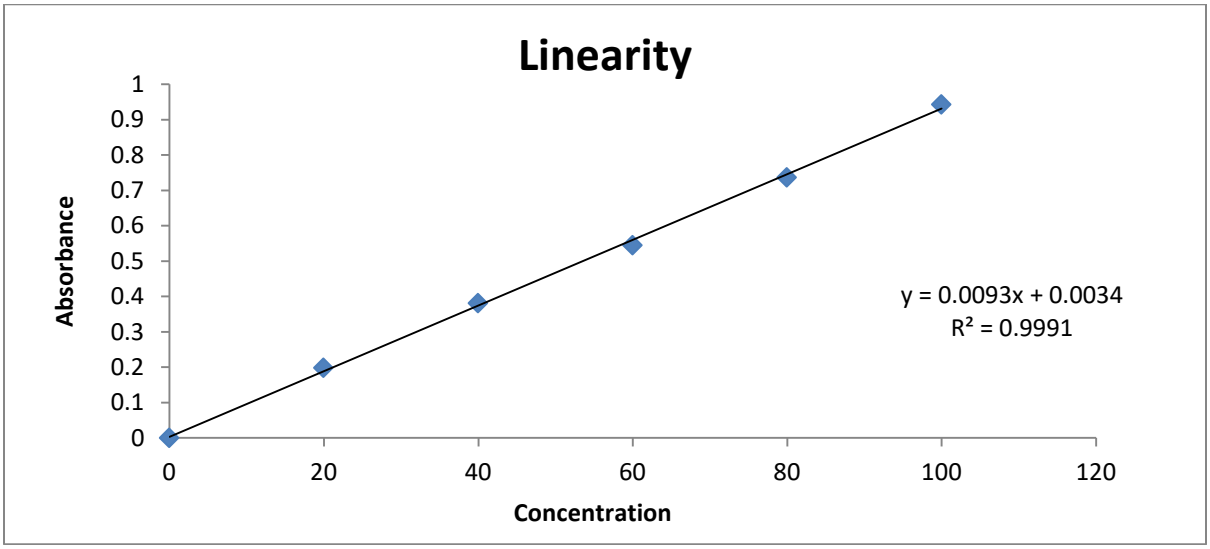

Figure 1.1: Standard calibration curve of Miconazole Nitrate in Methanol

Table 1.6: Result of regression analysis of UV method

Statistical measures	Results
λ_{max}	272 nm
Regression equation (y = mx+ c)	y = 0.009x + 0.003
Slope (m)	0.009
Intercept (C)	0.003
Correlation coefficient (R^2)	0.999

Discussion: -The calibration curve for Miconazole Nitrate was generated using concentrations ranging from 20 to 100 µg/ml in methanol. Absorbance measurements were taken at 272 nm. The resulting calibration curve, depicted in the graph above, is represented by the regression equation y = 0.009x + 0.003, with an R-squared value of 0.999, which shows good linearity as shown in table 1.6 and figure 1.1.[15]

1.4. Solubility profile

The drug's solubility in different solvents was evaluated using a UV spectrophotometer at a wavelength of 272 nm.

Table 1.7: Solubility profile of Miconazole Nitrate in different solvents

Sr. No.	Solvents	Solubility(mg/ml)	Solubility
1	Methanol	80.19±0.17	Soluble
2	Ethanol	101.48± 0.64	Freely soluble
3	Chloroform	55.44±0.11	Soluble
4	pH 7.4 Buffer	2.93±0.02	Slightly soluble
5	Water	0.14±0.01	Very Slightly soluble

Value is expressed as mean ± SD; n = 3

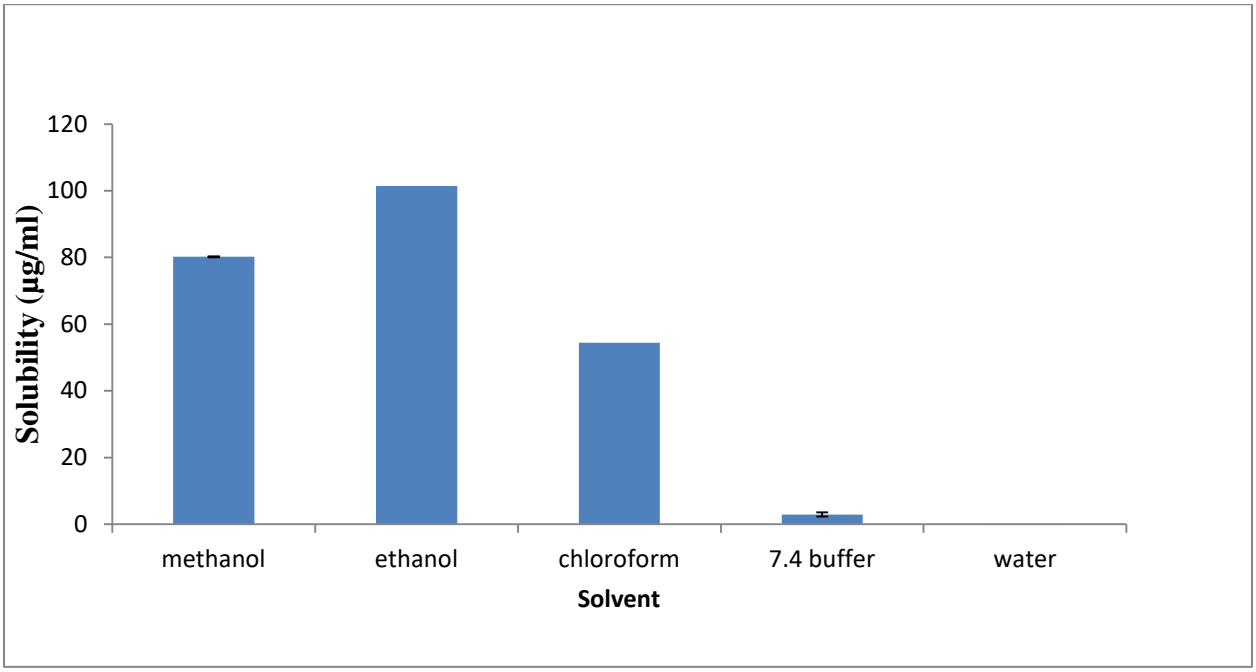

Fig. 1.2: Solubility profile of drug in different solvents

Discussion: Based on the provided information, it was evident that Miconazole Nitrate exhibited high solubility in ethanol, good solubility in methanol and chloroform, and lower solubility in pH 7.4 buffers and water (figure 1.2 and table 1.7).[18-19]

1.5. Partition coefficient

The partition coefficient of Miconazole Nitrate was determined using n-octanol and water, yielding a Log P value greater than one. This indicates that the drug has a lipophilic nature. Conversely, substances with partition coefficients less than one are considered hydrophilic. Therefore, the results confirmed that Miconazole Nitrate exhibits a lipophilic character.

Table 1.8: Partition coefficient profile of Miconazole Nitrate

Drug	Solvent system	Log P Value	Reference
Miconazole Nitrate	n-octanol: water	6.022±0.006	6.2

Value is expressed as mean ± SD; n = 3

Discussion: The partition coefficient of Miconazole Nitrate in n-octanol:water was determined to be 6.022 ± 0.006, indicating its lipophilic nature, consistent with literature findings (Table 1.8).[19-20]

1.6. Fourier-transform infrared spectroscopy analysis of pure drug and excipients

1.6.1Fourier-transform infrared spectroscopyof Miconazole Nitrate

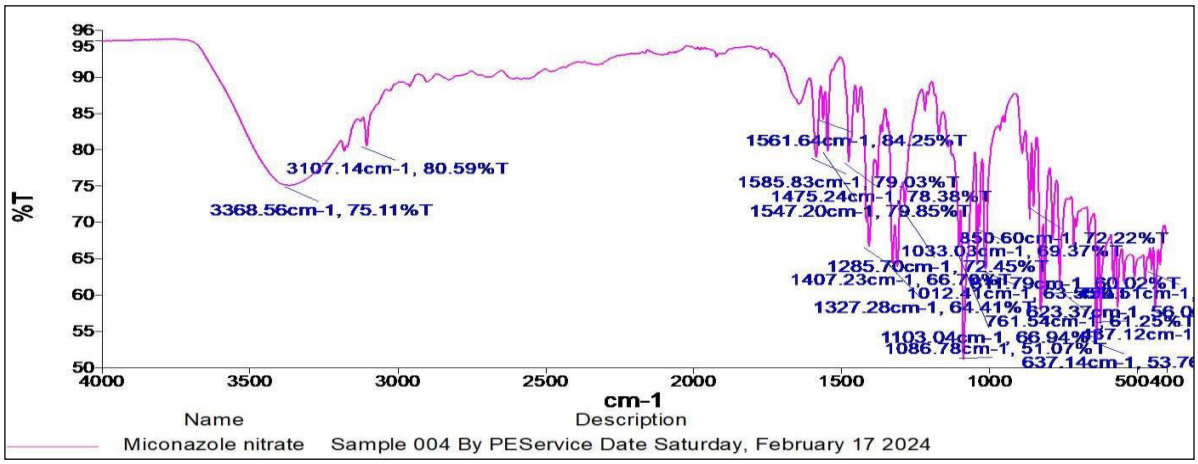

Figure 1.3: Fourier-transform infrared spectroscopyof Miconazole Nitrate

Table 1.9: Fourier-transform infrared spectroscopy interpretation of Miconazole Nitrate

Sr. No.	Characteristics Peak	Reference (cm^{-1})	Observed (cm^{-1})
1.	C=C	1589	1585.83
2.	Aromatic Amine C-N Stretching	1319.50	1327.28
3.	CHO Stretching	1038.67	1040.75
4.	=C-H Stretching	827.49	825.54
5.	C-Cl Stretching	812.92	811.79

Discussion: The FTIR spectra of Miconazole Nitrate, presented in Figure 1.3 and Table 1.9, displayed prominent absorption peaks at specific wavelengths: 1585.83 cm^{-1} (C=C stretching), 1327.28 cm^{-1} (aromatic amine C-N stretching), 1040.75 cm^{-1} (CHO stretching), 825.54 cm^{-1} (=C-H stretching), and 811.79 cm^{-1} (C-Cl stretching). These observed peaks affirm the purity and identity of Miconazole Nitrate.

1.6.2 Fourier-transform infrared spectroscopy of Choline Chloride

Figure 1.4: Fourier-transform infrared spectroscopy of Choline Chloride

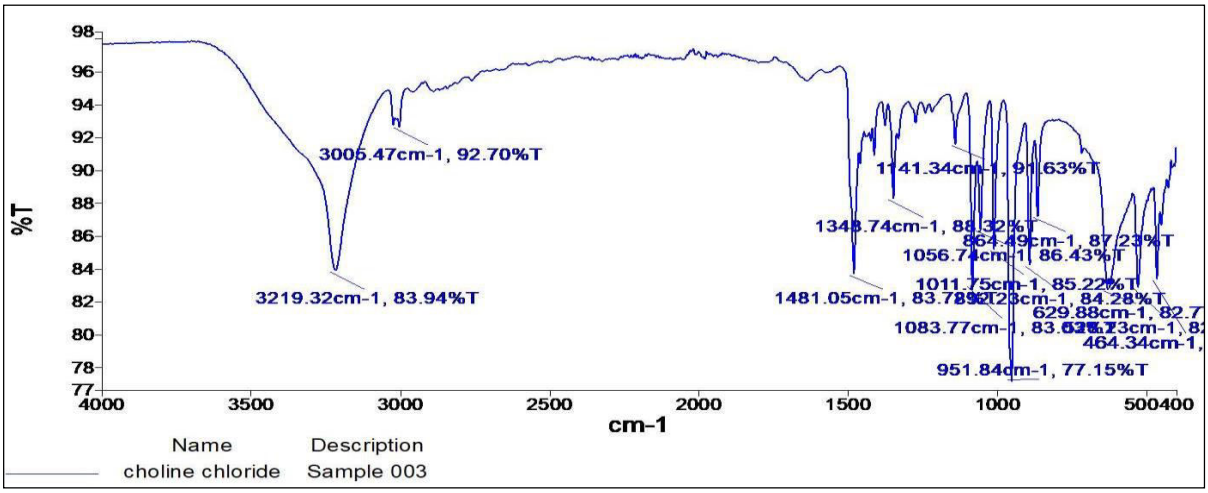

Table 1.10: Interpretation of Fourier-transform infrared spectroscopy of Choline Chloride

Functional group	**Reported peak (cm^{-1})**	**Observed peak (cm^{-1})**
C–H vibration	3024.82	3005.47
Halogenated organic compounds	1632.16	1481.05
O–H vibration	1440.65	1348.74
C=O vibration	1347.26	1141.34

Discussion: The FTIR spectra of Choline Chloride were depicted in Figure 1.4 and detailed in Table 1.10. Key IR absorption peaks observed at 3005.47 cm^{-1} (C–H vibration), 1481.05 cm^{-1} (halogenated organic compounds), 1348.74 cm^{-1} (O–H vibration), and 1141.34 cm^{-1} (C=O vibration) closely matched the reported peaks. These findings confirm the purity and authenticity of Choline Chloride.

1.6.3Fourier-transform infrared spectroscopy of Malonic acid

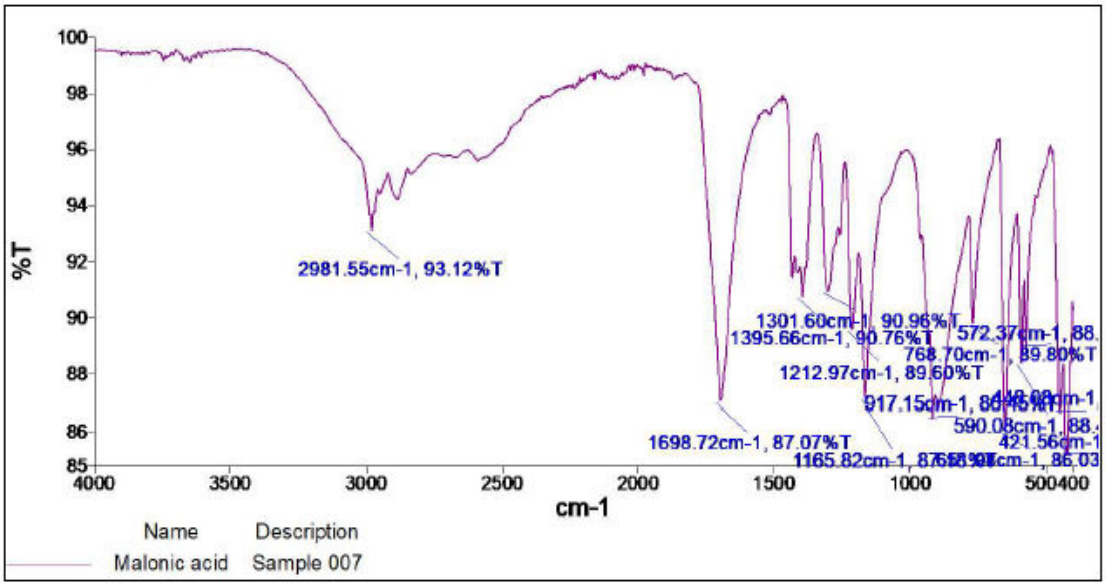

Figure 1.5: Fourier-transform infrared spectroscopy of Malonic acid

Table 1.11: Interpretation of Fourier-transform infrared spectroscopy of **Malonic acid**

Functional group	**Reported peak (cm^{-1})**	**Observed peak (cm^{-1})**
-OH Stretching	3105	2981.55
C=O Stretching	1696	1698.72
C-C aliphatic stretching	1300	1301.60
C-O	1210	1212.97

Discussion: The FTIR spectra of Malonic acid were displayed in Figure 1.5 and detailed in Table 1.11. Major IR absorption peaks observed at 2981.55 cm^{-1} (-OH stretching), 1698.72 cm^{-1} (C=O stretching), 1301.60 cm^{-1} (C-C aliphatic stretching), and 1212.97 cm^{-1} (C-O stretching) closely matched the reported peaks. These observed major peaks validate the purity and authenticity of Melonic acid. **[15, 21, 22]**

2 Evaluation of Deep Eutectic Solvent Mixture with Choline Chloride

2.1. Influence of the various carboxylic acids with Choline chloride

Physical appearance

The appearance of all DESM was shown in below the table no 1.12.

Table 1.12: Looks of DSEM with Choline Chloride at room temperature [28°C]

Sr. No.	**Formulation Name and Code**	**Looks**
1	F1	Crystal form
2	F2	Crystal form
3	F3	Crystal form
4	F4	Crystal form
5	F5	Crystal form
6	F6	Clear solution
7	F7	Crystal form
8	F8	Crystal form

Discussion: DESM using Malonic acid was transparent and clear liquid remaining other DESM were in crystal form, so they were rejected in further process.**[23]**

3. Influence of the various carboxylic acids with Choline Bitartrate

Physical appearance

The looks of all DESM was shown in below the table no 1.13.

Table 1.13: Looks of DSEM with Choline Bitartrate at room temperature [28°C]

Sr. No.	**Formulation Name and Code**	**Looks**
1	F9	Crystal form
2	F10	Crystal form
3	F11	Crystal form
4	F12	Crystal form
5	F13	Crystal form
6	F14	Crystal form

7	F15	Crystal form
8	F16	Crystal form

Discussion: All DESM with Choline bitartrate were in Crystal form at room temperature[28°C], so all formulations of DESM using choline bitartrate were rejected.[22]
Note: Due to aboveobservations**,** further process is carried out by using Malonic acid and Choline Chloride.

4.Effect of different molar ratio of Choline chloride and Malonic acid
The appearance and pH of all DESM was shown in below the table no 1.14.
4.1 Appearance and pH of DESM
Appearance of all prepared batches of the deep eutectic mixture was shown in table.

Table 1.14: Appearance and pH data of DESM of Miconazole Nitrate formulated with Malonic acid

Sr.No	Formulation Code	Appearance	pH
1	F6(A1)	Crystal form	5.13±0.020
2	F6(A2)	Crystal form	5.23±0.021
3	F6(A3)	Crystal form	5.14±0.035
4	F6(A4)	Partially clear form	5.25±0.020
5	F6(A5)	less clear form	5.45±0.020
6	F6(A6)	Clear solution	5.54±0.015
7	F6(A7)	Crystal form	5.35±0.015
8	F6(A8)	Crystal form	5.35±0.010
9	F6(A9)	Crystal form	5.25±0.030

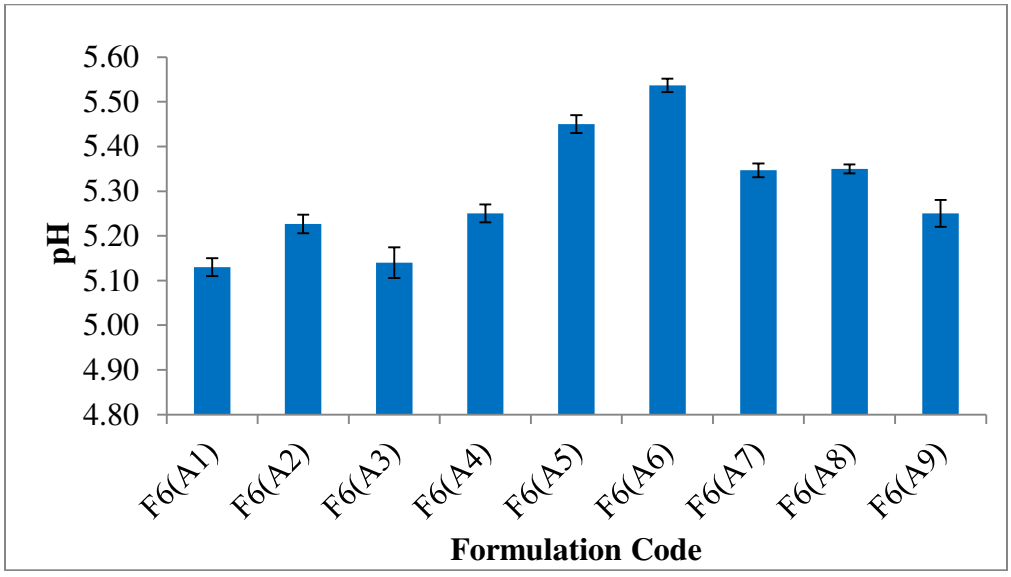

Figure 1.6: pH of Miconazole Nitrate loaded DESM in different formulation batches
Discussion: The pH values of the formulations were measured and found to be within the ranges of 5.13 ± 0.020 and 5.54 ± 0.015, as indicated in Table 1.14.

4.2 Equilibrium Solubility

The drug solubility in DESM was shown in below the table no. 1.15 and figure no 1.7.

Table 1.15: Drug Solubility of Miconazole Nitrate loaded DESM in different formulation batches

Sr. No.	Formulation Code	Solubility (mg/ml)
	Pure drug [F6(A0)]	0.014±0.01
1	F6(A1)	3.15±0.003
2	F6(A2)	3.95±0.001
3	F6(A3)	3.99±0.002
4	F6(A4)	0.639±0.003
5	F6(A5)	0.687±0.003
6	F6(A6)	0.840±0.005
7	F6(A7)	0.536±0.004
8	F6(A8)	0.198±0.002
9	F6(A9)	0.194±0.002

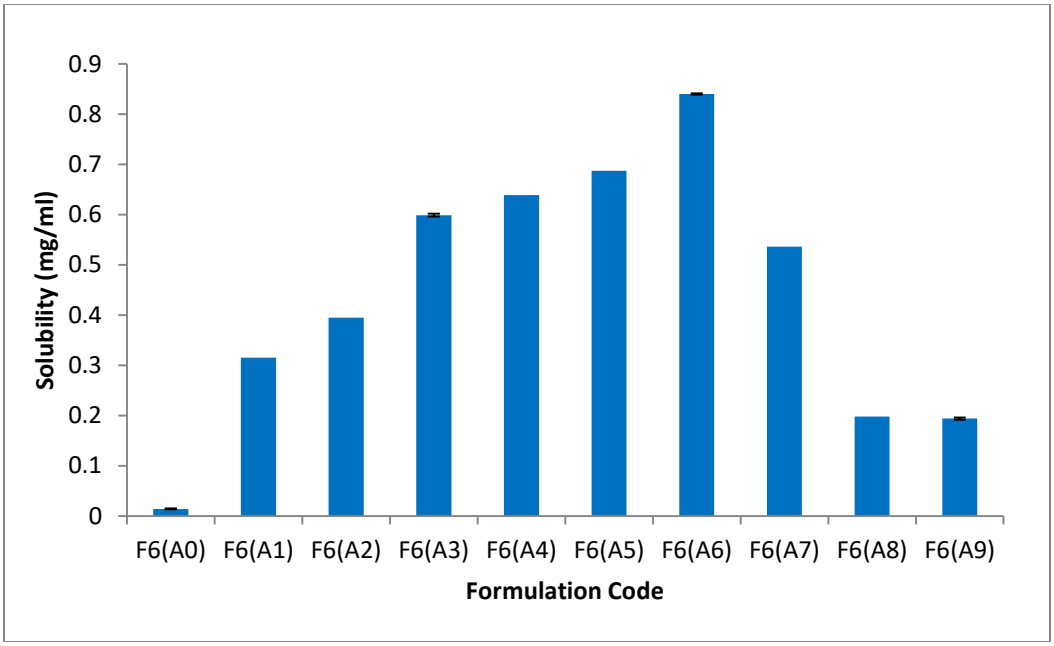

Figure 1.7: Drug Solubility of Miconazole Nitrate loaded DESM in different formulation batches.

Discussion: In table 1.15, shows that the minimum Solubility profile of Miconazole Nitrate in DESM was found to be0.014±0.01 and the maximum drug solubility was 0.840±0.005mg/ml. The maximum drug Solubility of Miconazole Nitrate was attained in formulation F6(A6) which was subjected to further process.

4.3 Drug Content

% drug content was shown in table no. 1.16 and figure no. 1.8

Table 1.16: Drug Content of Miconazole Nitrate DESM with Malonic acid

Sr. No.	Formulation Code	% Drug content
1.	F6 [A1]	27.593±0.321
2.	F6 [A2]	38.167±0.626
3.	F6 [A3]	52.778±0.962
4.	F6 [A4]	62.963±0.849
5.	F6 [A5]	82.778±0.556
6.	F6 [A6]	94.074±0.849
7.	F6 [A7]	78.704±0.849
8.	F6 [A8]	46.481±0.642
9.	F6 [A9]	26.852±0.321

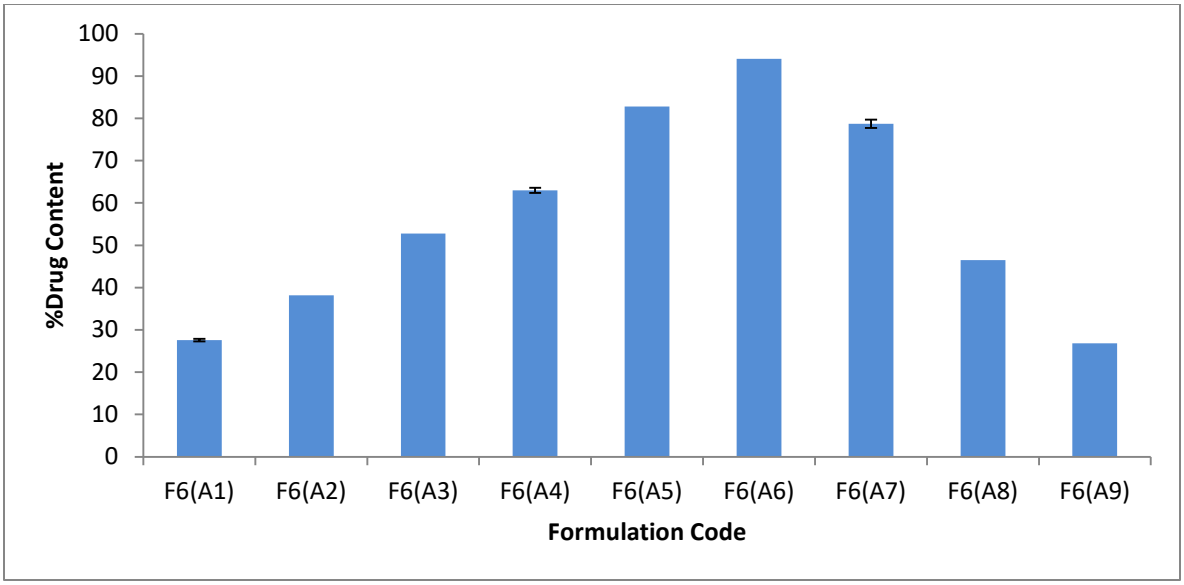

Figure 1.8: Drug Content of Miconazole Nitrate DESM with Malonic acid

Discussion: According to Table 1.16, the Miconazole Nitrate content in DESM ranged from a minimum of 26.852 ± 0.321% to a maximum of 94.074 ± 0.849%. Formulation F6 (A6) achieved the highest drug content and was selected for subsequent procedures.
According to observations the formulation F6(A6) was selected for the gel preparation.[23]

5 Evaluation of Topical Gel of Miconazole Nitrate

5.1 Appearance and pH of Topical Gel of Miconazole Nitrate

Table 1.17: Appearance and pH Data of topical gel of Miconazole Nitrate

Sr No.	Formulation Code	Appearance Of Gel	pH
1.	F6(A6) G1	Less viscous Gel Formed	5.23±0.06
2.	F6(A6) G2	Uniform Gel Formed	5.38±0.03
3.	F6(A6) G3	Sticky Gel Formed	5.85±0.05
4.	F6(A6) G4	Sticky Gel Formed	5.29±0.02

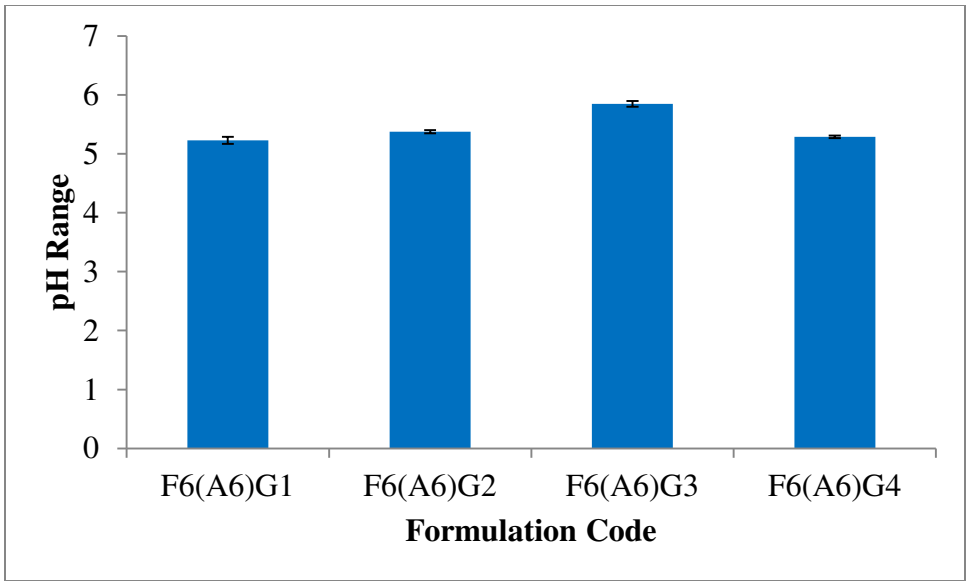

Fig 1.9: pH data of topical gel Miconazole Nitrate

Discussion: According to Table 1.17, the pH values of the Topical Gel were measured within the range of 5.23 ± 0.06 to 5.85 ± 0.05.

5.2 Drug Content

% drug content was shown in table and figure

Table 1.18: Drug Content of Miconazole Nitrate Topical Gel.

Sr. No.	Formulation Code	% Drug content
1	F6(A6)G1	88.33±0.56
2	F6(A6)G2	96.11±0.96
3	F6(A6)G3	93.89±0.56
4	F6(A6)G4	92.96±0.64

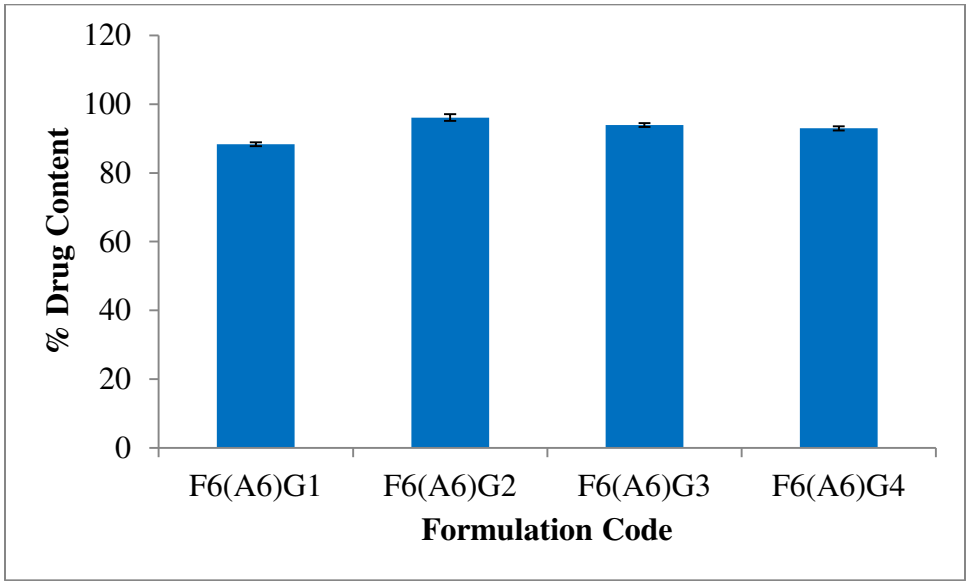

Fig1.10: Drug Content of Miconazole Nitrate topical gel

Discussion: From the table 1.18, the minimum percentage of drug content of Topical GelOf Miconazole Nitrate was detected to be 83.33±0.56 and maximum percentage of drug content was 96.11±0.96%.

5.3 Spreadability of topical Gel of Miconazole Nitrate

Table 1.19: Spreadability of Topical Gel (Miconazole Nitrate)

Sr. No.	Formulation Code	Spreadability(cm)
1	F6(A6)G1	7.83±0.015
2	F6(A6)G2	7.45±0.025
3	F6(A6)G3	7.08±0.040
4	F6(A6)G4	6.83±0.020

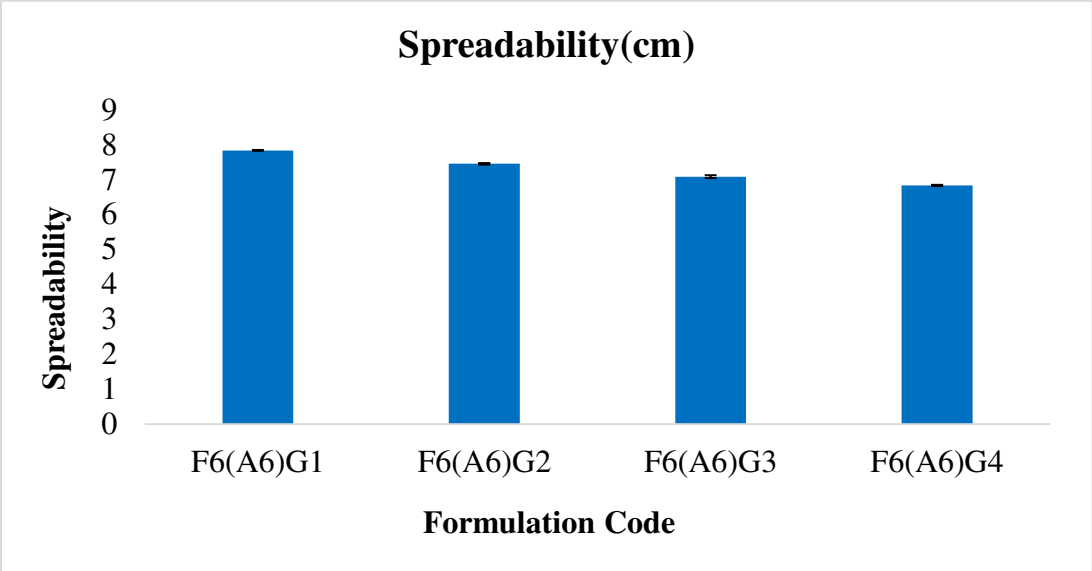

Fig 1.11: Spreadability of Topical Gel of Miconazole Nitrate

Discussion- From the Table 1.19**,** Spreadability of Topical Gel was Lies between 6.83±0.020 and 7.83±0.015.[24]

5.4 Viscosity of the Topical Gel (Miconazole Nitrate)

Table 1.20: Viscosity of topical Gel

Sr. No	Formulation Code	Viscosity(cPs)
1	F6(A6)G1	5532±1.00
2	F6(A6)G2	10640±0.58
3	F6(A6)G3	12511±1.00
4	F6(A6)G4	14453±0.58

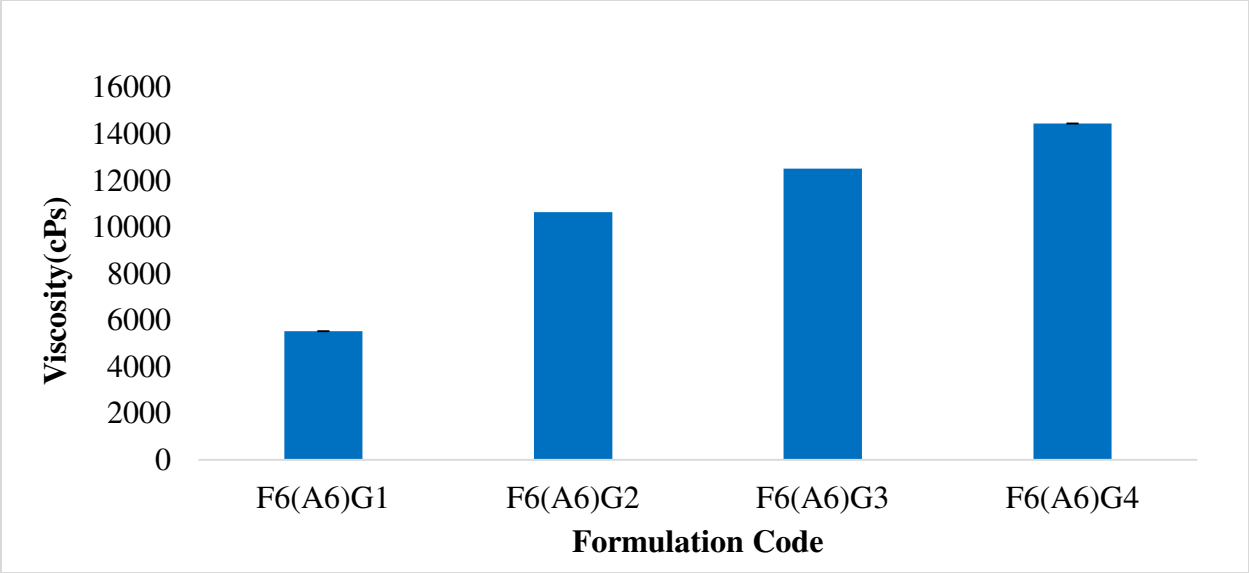

Fig 1.12: Graph of Viscosity of Topical Gel (Miconazole Nitrate)

Discussion- From the Table 1.20, the viscosity of topical gel(Miconazole Nitrate) was lies between 5532±1.00 and 14453±0.58.[25]

5.5 FTIR of Final formulation

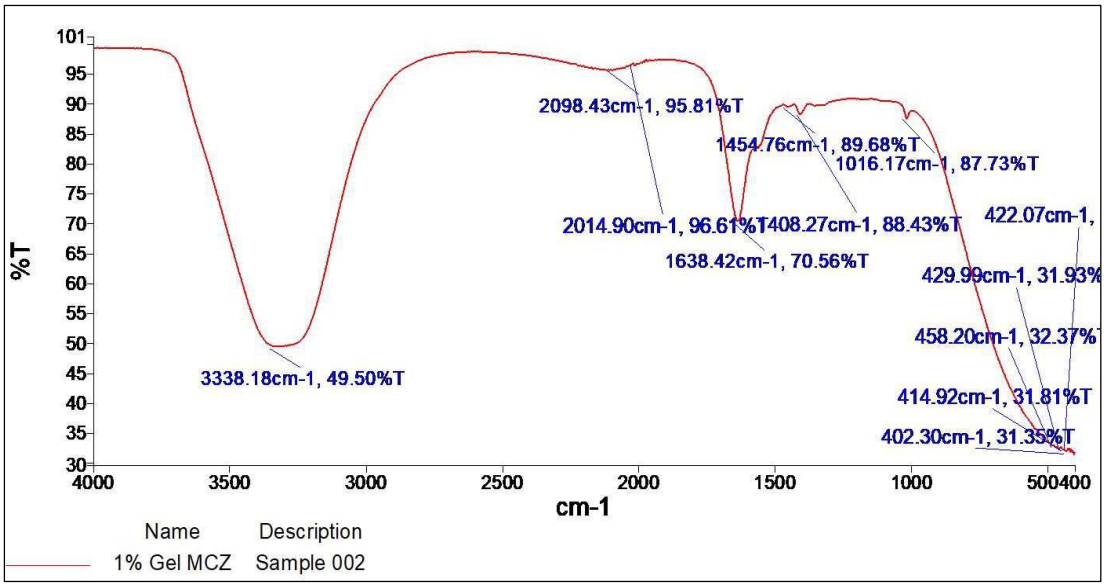

Figure 1.13: FTIR of final formulation F6(A6)G2

6.In-vitro Drug release study

The table presented the in-vitro drug release profiles of the pure drug and Formulation F6(A6)G2.

Table 1.21: In-vitro drug release profile of Topical bioavailability of Miconazole Nitrate

Time	% drug release of control gel	% drug release of formulation F6(A6)G2
0	0	0
15	5.59±0.140	10.83±0.111
30	11.94±0.056	17.98±0.085
1 hr	12.28±0.056	24.50±0.056
2 hr	13.61±0.556	34.46±0.085
3 hr	15.20±0.064	41.72±0.111
4 hr	17.19±0.085	48.98±0.085
6 hr	19.54±0.085	50.00±0.056
8 hr	20.85±0.064	62.59±0.642
10 hr	23.87±0.085	79.07±0.849
12 hr	26.85±0.085	88.89±0.556
24 hr	35.39±0.056	93.33±0.556

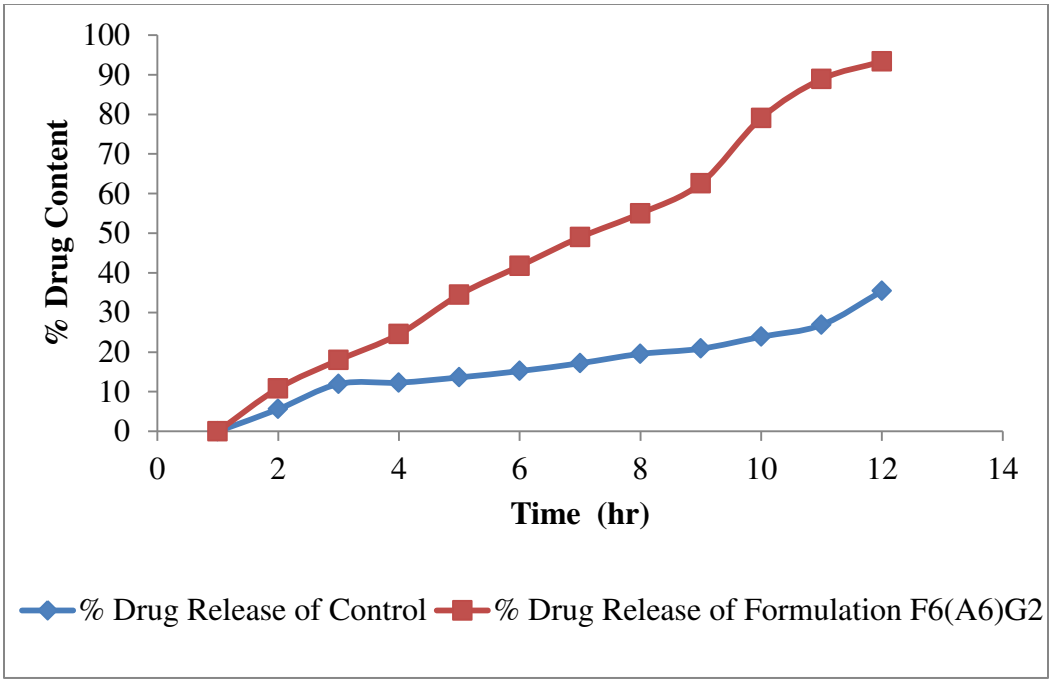

Figure 1.14: In-Vitro Drug release of Topical bioavailability of Miconazole Nitrate

Discussion: The drug release profiles of control Miconazole Nitrate and formulation F6(A6)G2, depicted in Figure 1.14, exhibited significant differences. The control drug released 35.39 ± 0.056% within 24 hours. In contrast, formulation F6(A6)G2 released 93.33 ± 0.556% within the

same timeframe in a rapid manner. Table 1.21 provided detailed in-vitro drug release data for both formulation F6(A6)G2 and the pure drug.[26]

7.In vitro release Kinetics

Below are the kinetic study data for the in-vitro drug release of formulation F6 (A6) G2.

7.1 Zero order

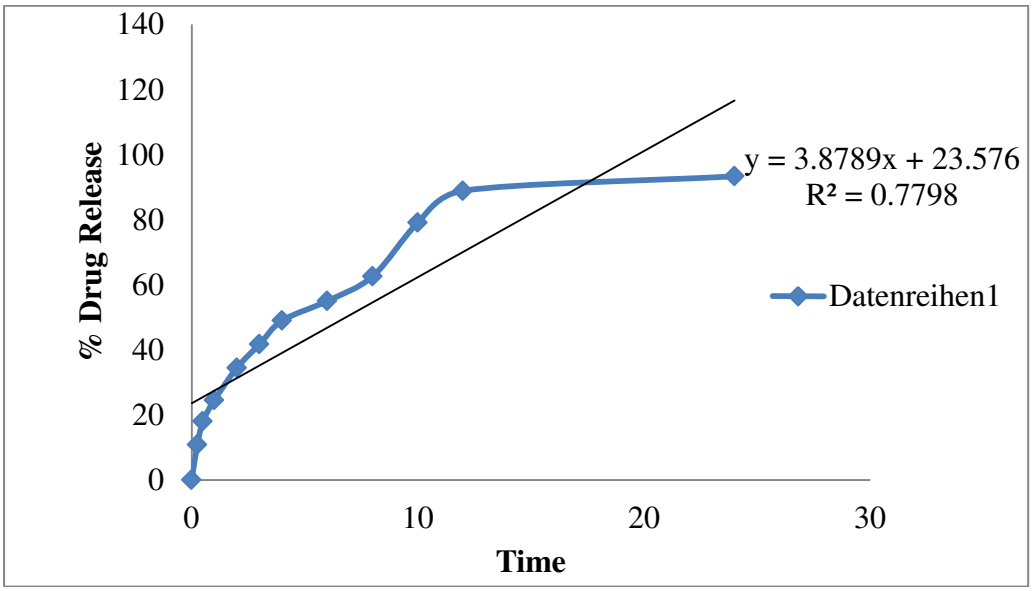

Figure 1.15: Zero order graph of formulation F6(A6)G2

7.2 First Order

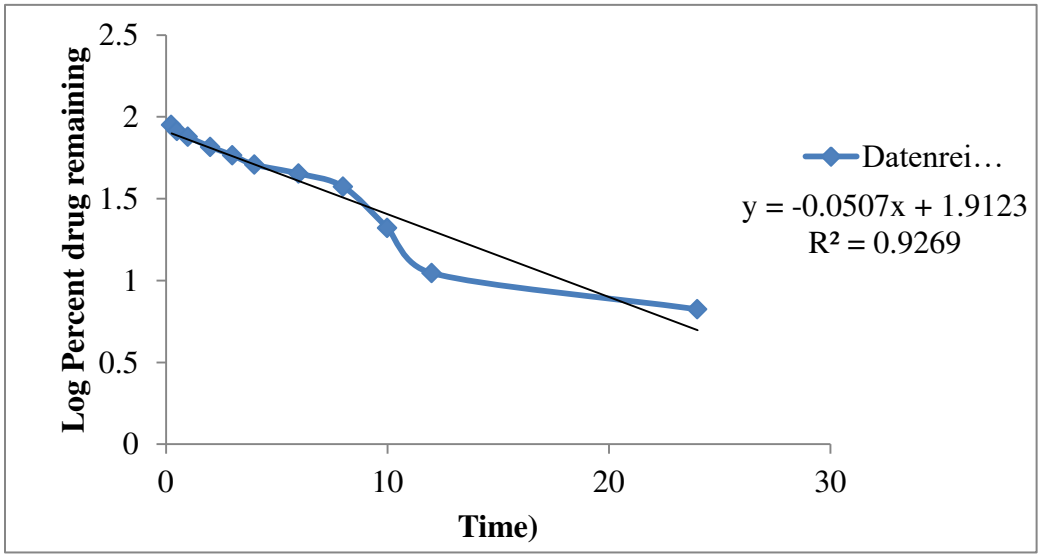

Figure 1.16: First order graph of formulation F6(A6)G2

7.3 Higuchi model

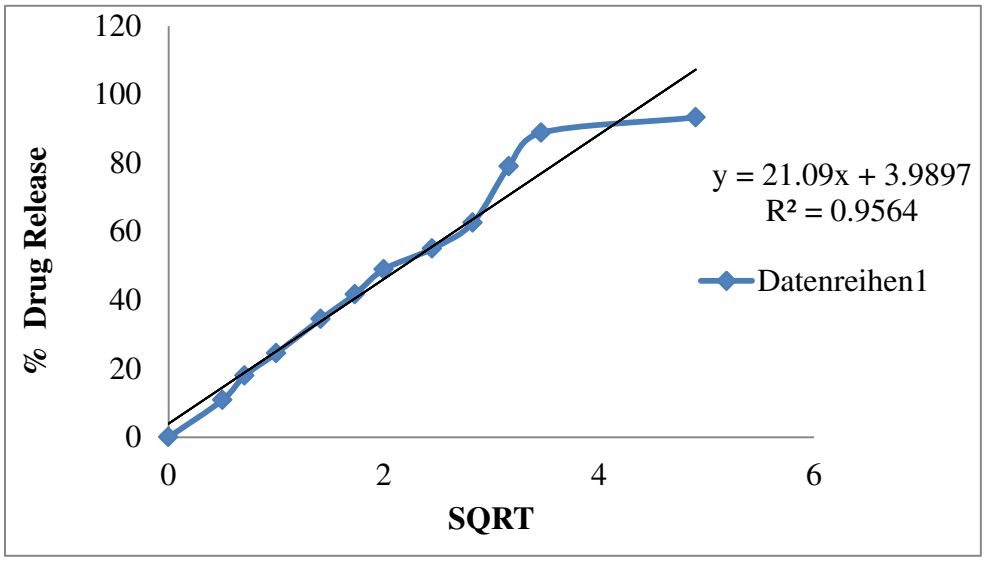

Figure 1.17: Higuchi order graph of formulation F6(A6)G2

7.4 Korsmeyerpeppas model

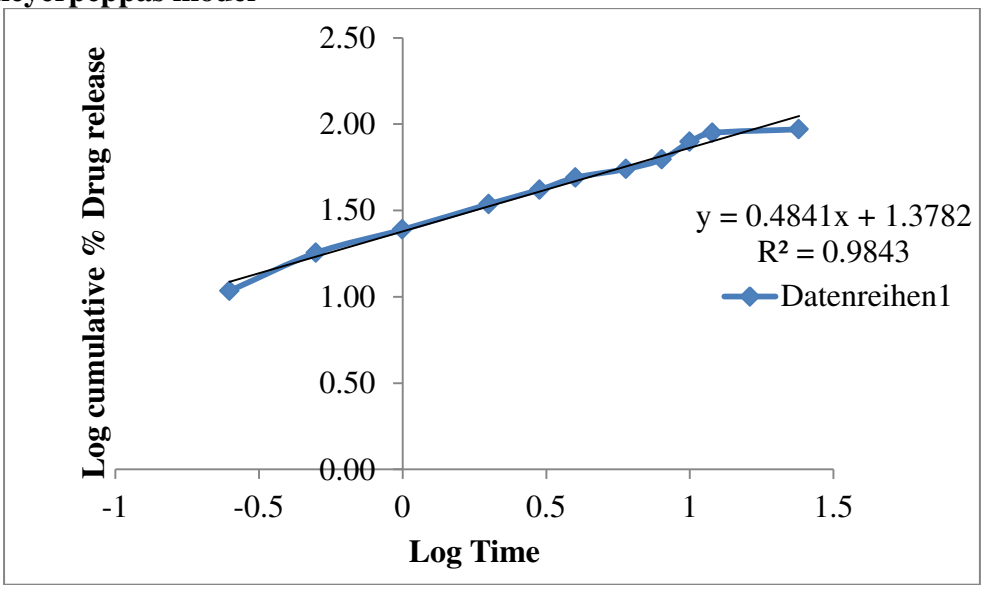

Figure 1.18: Korsmeyerpeppas graph of formulation F6(A6)G2

Table 1.22: Parameters of the kinetic equation for formulation F6(A6)G2.

Formulation	Zero order		First order		Higuchi		Korsmeyer-Peppas	
	K_0	R^2	K_0	R^2	K_0	R^2	K_0	R^2
F6(A6)G2	3.87	0.779	-0.05	0.926	21.09	0.956	0.48	0.984

Mathematical models are commonly employed to predict release mechanisms and compare release profiles. For all optimized formulations, graphs were plotted showing % drug release versus time (zero order), log percent drug remaining versus time (first order), log percent drug release versus square root of time (Higuchi plot), and log of log percent drug release versus log time (Korsmeyer and Peppas Exponential Equation). The coefficient of determination (R2) was calculated from these graphs and reported in Table 1.22 and Figures 1.15 to 1.18. Based on the R2 values, the Korsmeyer-Peppas model (R2 = 0.984) was found to best fit the release data. These results suggest that the drug was released from DESM using a sustained release mechanism.[25,26]

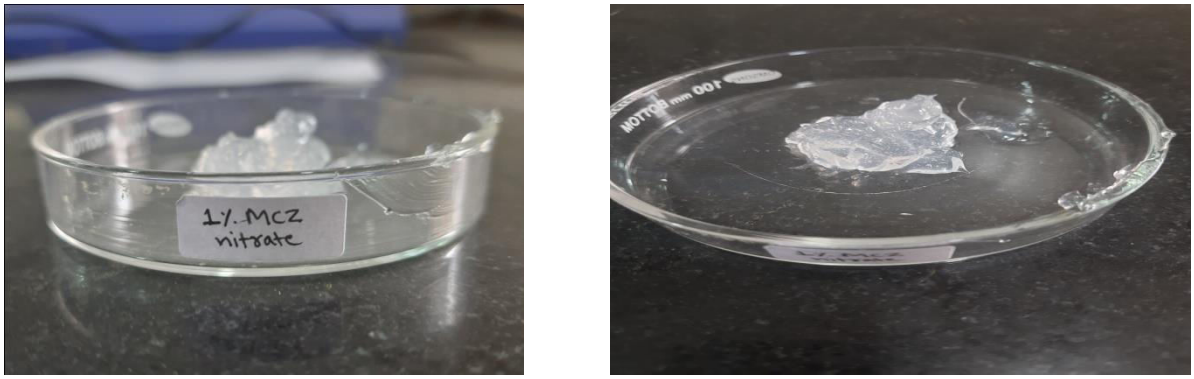

Fig 1.19: Gel Formulation

Conclusion:

An antifungal medication is called miconazole (mi KON a zole). At every chiral center, miconazole is present as a combination of R and S enantiomers.

Preformulation studies were conducted to evaluate the chemical and physical characteristics of the drug ingredient before formulating it.Miconazole's Appearance and Sensory propertiesidentified in line with medication monographs. The melting point of Miconazole was determined using the capillary method, and it closely matches the melting point specified in the reference. Specifically, the pure melting point of Miconazole was found to be within the range of 177.1 to 178.4 ± 0.64ºC.The reference chemical groups reported in the Miconazole structure were determined to be consistent with the FT-IR spectrum of the compound.

The methanol standard curves for miconazole were produced, and linear regression was used to the resulting absorbance data. Miconazole was shown to have correlation coefficients of 0.999, which is close to one, indicating high linearity. Miconazole in methanol showed a wide band at 272 nm in its UV spectra. Miconazole was determined to be pure and of good quality based on the outcomes of the preformulation study (FT-IR spectrum, UV spectrum, and melting point), and the estimation method was detected to be highly accurate, dependable, and appropriate for the development of formulations.

Miconazole is composed with Different DESM polymer concentrations were used to form the Deep Eutectic Solvent Mixture. Several formulations [F6 (A6) G1 to F6 (A6) G4] were made in order to optimize topical gel. A number of physicochemical characteristics, including viscosity, spreadability, pH, drug content, and percentage drug release, were assessed for each produced gel. The formulations F6 (A6) G1 through F6 (A6) G4 produced a smooth, well-homogeneous gel devoid of lumps. The evaluation study's findings show that the gel formulation had a smooth look, a neutral pH, a satisfactory and within-range medication content, viscosity, and spreadability.

Using a Franz diffusion cell, the in vitro drug release of optimized and commercialized formulations was investigated in phosphate buffer with a pH of 7.4. In vitro data was analyzed using the zero-order, first-order Higuchi, and Korsmeyer-Peppas models to accurately determine the rate and mechanism of drug release. Drug release from gel formulations containing DESM was shown to be considerably extended during dissolution, as compared to drug release from marketed formulations. The best model to fit the release data, according to the determination coefficients, was the Korsmeyer-Peppas Model (R2=0.984). The findings suggest that a sustained release mechanism was used to release the medication from DESM.

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