Chapter 6B)
Formulation Development: DPK 060 Lotion

Dermal Delivery of Protein/Peptide Based Antimicrobial to Treat Secondary Infection in Psoriasis and Eczema

6B.1 Introduction

The objective of our present study was to develop and characterize a lotion-based formulation of DPK 060 for dermal delivery. Different excipients were screened thoroughly for the preparation of a lotion-based formulation of the DPK 060. The excipients were selected based on better compatibility and no analytical interference in the practice of lotion.

6B.2 Materials and Instruments

6B.2.1 Materials

Table 6B.1 List of materials

Materials & Reagents	**Manufacturers**
DPK 060	S-Biochem, Kerala, India (Custom synthesis)
Methanol (A.R. & HPLC Grade)	Spectrochem Pvt. Ltd., Mumbai
Cetyl alcohol	Loba Chemie Pvt. Ltd., India
Isopropyl myristate	Loba Chemie Pvt. Ltd., India
Ceteareth-25	MP Biomedicals Pvt. Ltd., Mumbai
Propylene Glycol (PG)	MP Biomedicals Pvt. Ltd., Mumbai
PVP K30	Sigma-Aldrich, USA
Steareth-10	Loba Chemie Pvt. Ltd., India
Propyl Paraben	Loba Chemie Pvt. Ltd., India
Methyl Paraben	Loba Chemie Pvt. Ltd., India
Sodium chloride (AR)	S.D. Fine Chemicals, Mumbai, India
Sodium hydroxide (AR)	Spectrochem Labs Ltd, Vadodara, India
Potassium chloride (AR)	Spectrochem Labs Ltd, Vadodara, India
Potassium dihydrogen phosphate (AR)	Spectrochem Labs Ltd, Vadodara, India
Sodium dihydrogen phosphate (AR)	Spectrochem Labs Ltd, Vadodara, India
Distilled water	Prepared In-house

6B.2.2 Instruments

Table 6B.2 List of instruments

Equipment	Manufacturer
Digital Weighing Balance	Shimadzu, Japan
RP-HPLC with UV Detector (gradient)	Agilent OpenLab CDS EZChrom, India
pH meter	Lab India Pvt. Ltd, Mumbai
Bath Sonicator	Remi equipments Pvt. Ltd, India
Centrifuge	Remi equipments Pvt. Ltd., India
Distillation assembly	Durga glassware, India

6B.3 Methods

6B.3.1 Preparation of DPK 060 lotion

1. The oil phase was prepared by mixing the weighed quantity of cetyl alcohol, steareth-10, ceteareth-25, and isopropyl myristate and heating at 70°C.
2. The aqueous phase was prepared by dissolving weighed quantity of DPK 060 and PVP K 30 sufficient volume of 20 mM acetate buffer pH 5.5.
3. Methylparaben and propylparaben were dissolved in an appropriate volume of 20 mM acetate buffer pH 5.5. After that, propylene glycol was added. This mixture was added to the solution obtained in step 2.
4. The remaining quantity of 20 mM acetate buffer pH 5.5 was added to the aqueous phase and heated at 70°C.
5. The heated Oil Phase was added into the heated aqueous phase and mixed with a magnetic stirrer. Further, the formed lotion formulation was cooled down to room temperature and filled in the tube. (at the same temperature).

The final composition of the DPK 060 lotion is depicted in Table 6B.3.

Table 6B.3 Optimized Batch of DPK 060 lotion

Ingredients	%Quantity (%w/w)
DPK 060 (1%)	1%
Steareth-10	0.3%
Cetyl alcohol	4%
Ceteareth-25	2.5%
Isopropyl Myristate	5%
Propyl Paraben	0.02%
Propylene Glycol	5%
PVP K30	2%
Methyl Paraben	0.1%
20 mM Acetate buffer pH 5.5	Q.S to 100 %

6B.3.2 Characterization of optimized DPK 060 lotion

6B.3.2.1 Organoleptic characteristics

The optimized DPK-060 lotion was characterized for various organoleptic examinations i.e., color, phase separation, physical appearance and homogeneity by visually. The samples were placed between the thumb and index finger, and then the homogeneity and texture characteristics of the formulated Omiganan lotion were evaluated [1].

6B.3.2.2 Assay

The DPK 060 content in the lotion was evaluated by dissolving 100 mg of DPK 060 lotion in methanol: water ratio of 8:2. The developed HPLC method was used to determine the % DPK 060 content in the lotion.

6B.3.2.3 Viscosity

The viscosity of DPK-060 lotion was determined using cone and plate rheometer (Bohlin C-VOR, Malvern Instruments Ltd., UK) at 25±1ºC. In brief, 200 mg of the sample was placed on the sample holder. After that, the spindle was lowered and kept for equilibrium for 5 min having a plate width of 20 mm and a cone

angle of 4º. Subsequently, the spindle was rotated at a shear rate of 10/s, and viscosity (Pa.S) observed was reported [2].

6B.3.2.4 Spreadability

The spreadability of DPK-060 lotion was evaluated by the previously reported method [3]. Briefly, 500 mg of sample was placed on a pre-marked circle with a 1 cm diameter on the glass plate over which a second glass plate was positioned. Subsequently, 500 g weight was applied on the upper glass plate for 5 min, and any change in diameter was noted.

6B.3.2.5 pH

The pH of DPK-060 lotion was measured using a digital pH meter (Lab India Pvt. Ltd, Mumbai).

6B.3.2.6 Thermodynamic Stability

The DPK-060 lotion was further evaluated for the temperature cycling (3 alternate cycles at 45 °C and 4 °C for 24 h) and evaluated for any sign of instability, i.e., phase separation, precipitation, and change in color [4, 5]. Moreover, the samples were further evaluated for freeze-thaw cycle (3 alternate cycles at −20 °C and 25 °C for 24 h) and centrifugation at 4000 rpm for 30 min to examine the probabilities of phase separation and texture change under stress conditions [1, 6].

6B.4 Results and Discussion

6B.4.1 Organoleptic Characteristics

Organoleptic characteristics play a critical role in dermal formulations owing to their ability to increase consumer compliance by elevating the elegance and aesthetics of a product. The developed DPk-060 lotion has a white to off-white color with a smooth texture and no signs of phase separation.

6B.4.2 Assay

The % drug content of the DPK 060 in lotion was found to be 99.65 ± 0.87 % (9.97 mg/gm).

6B.4.3 Viscosity

The viscosity of DPK 060 lotion was found to be 6.20 ± 0.192 Pa.S, lower in comparison with the developed gel-based formulations of DPK 060 i.e. free DPK 060 gel (13.10 ± 0.292 Pa.S) and DPK 060 NLC loaded gel (16.22 ± 0.451 Pa.S) (Refer Chapter 6A).

6B.4.4 Spreadability

The spreadability of DPK 060 lotion was found to be 9.49 ± 2.32 cm^2. The spreadability of DPK 060 lotion was higher than the developed gel-based formulations of DPK 060 i.e. free DPK 060 gel (6.87 ± 2.07 cm^2) and DPK 060 NLC loaded gel (7.69 ± 1.38 cm^2) (Refer Chapter 6A).

6B.4.5 pH

The pH of DPK 060 lotion was found to be 5.9 ± 0.4.

6B.4.6 Thermodynamic Stability

The optimized DPK-060 lotion did not exhibit any sign of instability i.e., creaming, phase separation, and precipitation under the applied stress conditions. Additionally, no coalescence and cracking were observed throughout the thermodynamic stability testing.

6B.5 References

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