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Research Article

Stability-Indicating Validated Novel RP-HPLC Method for Simultaneous Estimation of Methylparaben, Ketoconazole, and Mometasone Furoate in Topical Pharmaceutical Dosage Formulation

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A simple, specific, precise, and accurate RP-HPLC method has been developed and validated for simultaneous estimation of Methylparaben (MP), Ketoconazole (KT), and Mometasone Furoate (MF) topical pharmaceutical dosage formulation. The separation was achieved by Waters X Terra C18 column using mobile phase consisting of buffer (triethyl amine in water, pH adjusted to 6.5 with glacial acetic acid)-acetonitrile (40 : 60, v/v) at a flow rate of 1.5 mL/min and detection at 250 nm. The method showed linearity with correlation coefficient <0.9999 over the range of 0.12–15.2 μg/mL, 0.67–149.4 μg/mL, and 0.42–7.6 μg/mL for MP, KT, and MF, respectively. The mean recoveries were found to be in the range of 99.9–101.1% for all the components. The method was validated as per the ICH guidelines for linearity, limit of detection, limit of quantification, accuracy, precision, robustness and solution stability. Stability indicating capability of the developed method was established by analyzing forced degradation of samples in which spectral purity of MP, KT, and MF along with separation of degradation products from analytes peak was achieved. The method can be successfully applied for routine analysis of quantitative determination of MP, KT, and MF in pharmaceutical dosage form.

1. Introduction

Mometasone Furoate (MF), (11β, 16α)-9, 21-dichloro-11-hydroxy-16-methyl-3, 20-dioxopregna-1, 4-dien-17-yl 2-furoate (Figure 1(a)) is a topical corticosteroid; it has anti-inflammatory, antipruritic, and vasoonstrictive properties. Mometasone inhibits the action of allergic reactions, eczema, and psoriasis that cause inflammation, redness, and swelling [1, 2]. Ketoconazole (KT), an imidazole derivative, chemically 1-[4-(4-{[2-(2,4-dichlorophenyl)-2-(1H-imidazol-1-ylmethyl)-1,3-dioxolan-4-yl]methoxy}phenyl)piperazin-1-yl]ethan-1-one (Figure 1(b)) is an antifungal agent with topical and systemic action and can be incorporated into several pharmaceutical forms. As for example a ketoconazole shampoo is effective against seborrhoeic dermatitis as well as Pityriasis versicolor [3–7]. KT and MF in combined dosage form are used in the treatment of mild to moderate inflamed cutaneous mycoses with antimycotic activity.

The preservative system is an important part of semisolid formulations in preventing the deterioration of formulations from microbial contamination. Methylparaben (MP) (Figure 1(c)) and its salts are most commonly used as preservatives for many years. To establish their effectiveness throughout the shelf life of the product, the actual concentrations of preservatives must be determined, as also required by regulatory agencies [8].

The finished product release specifications should include an identification test and a content determination test with acceptance criteria and limits for each antimicrobial preservative present in the formulation [9]. The finished product self-life specification should also include an identification test and limits for the antimicrobial preservatives present [10].

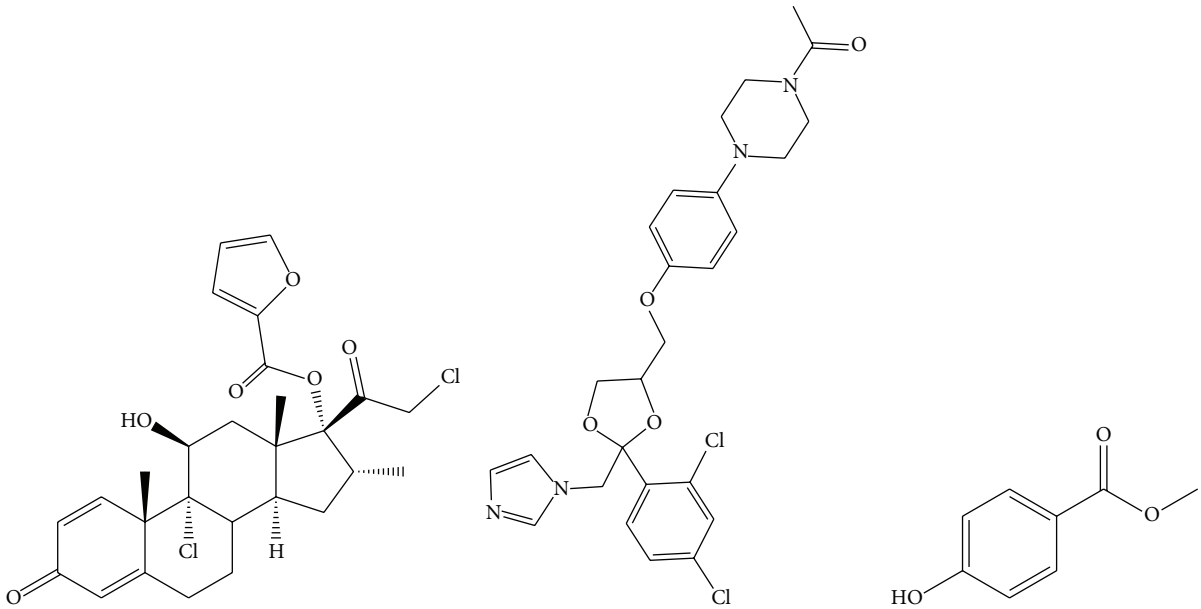

Figure 1: Chemical structure of (a) Mometasone Furoate, (b) Ketoconazole, and (c) Methylparaben.

A detailed literature survey for Mometasone Furoate, Ketoconazole, and Methylparaben revealed that determination of individual compound or combination with other drugs has been reported by high performance liquid chromatography (HPLC) [1, 2, 4, 9, 11–33], polarographic techniques [34], liquid chromatography-mass spectrometry (LCMS) [35–38], electrophoresis [39, 40], subcritical-fluid chromatography (SFC) [41], spectrophotometric techniques [42–44], and high performance thin layer chromatography (HPTLC) [45]. To the best of our knowledge, there is no stability-indicating liquid chromatographic method reported for the simultaneous estimation of Mometasone furoate, Ketoconazole, and Methylparabenin topical pharmaceutical dosage formulation.

The drug product stability guideline Q1A (R2) issued by the International Conference on Harmonisation (ICH) [46] suggests that stress studies should be carried out on a drug to establish its inherent stability characteristics, leading to identification of degradation products and, hence, supporting the suitability of the proposed analytical procedures. It also requires that analytical procedures for testing the stability of samples should be stability indicating and should be fully validated.

2. Materials and Methods

2.1. Materials and Reagents. MF and KT sample working standards were provided by Dr. Reddy's Lab, India. HPLC grade acetonitrile, triethylamine, and glacial acetic acid were used of Rankem, India. 0.22 μm nylon membrane, 0.22 μm PVDF syringe filter, and 0.22 μm Nylon syringe filter were used of Millipore, India. Water for HPLC was generated using Milli-Q Plus water purification system (Millipore, Milford, MA, USA).

2.2. Chromatographic Parameters and Equipments. All chromatographic experiments were performed on Waters Alliance HPLC system (Waters, Empower 2 software, USA), photo stability chamber (Sanyo, Leicestershire, UK), dry air oven (Cintex, Mumbai, India), XS205 dual range balance (Mettler Toledo), and cintex digital water bath were used for specificity study. All chromatographic experiments were performed in the isocratic mode. Separation was achieved on Waters X-Terra (250 × 4.6 mm, 5 μm) column as stationary phase by using mixture of buffer (0.2% v/v triethyl amine in water, pH adjusted to 6.5 with glacial acetic acid) : acetonitrile (40 : 60, v/v) as mobile phase. Other parameters such as run time 6.0 minutes, 1.5 mL/min as flow rate, injection volume of 10 μL, and column temperature of 50°C were finalized during development. MP, KT, and MF were detected at 250 nm. Mixture of acetonitrile : water, 80 : 20, v/v was used as diluent.

The stress-degraded samples and the solution stability samples were analyzed using a photo diode array (PDA) detector covering the range of 200–400 nm.

2.3. Procedure

2.3.1. Standard Solution Preparation. The stock solutions of MP (100 μg/mL), KT (1000 μg/mL), and MF (100 μg/mL) were prepared by dissolving an appropriate amount of analyte in diluent separately. Working standard solution was prepared by mixing above stock solutions of MP, KT, and MF with final concentration of 10 μg/mL, 100 μg/mL, and 5 μg/mL respectively.

2.3.2. Sample Preparation. An accurately weighed 0.5 g sample (equivalent to 10 mg of KT, 0.5 mg of MF) was taken into 100 mL volumetric flask. About 70 mL mixture of acetonitrile and water (80 : 20, v/v) was added to this volumetric flask and sonicated in an ultrasonic bath for 15 min. with intermittent shaking, diluted to the volume with acetonitrile. and mixed well. A portion of solution was filtered through 0.22 μm Nylon syringe filter.

2.3.3. Placebo Preparation. An accurately weighed 0.5 g placebo sample was taken into 100 mL volumetric flask. About 70 mL mixture of acetonitrile and water (80 : 20, v/v) was added to this and sonicated for 15 min with intermittent shaking, diluted to the volume with acetonitrile, and mixed well. A portion of solution was filtered through 0.22 μm Nylon syringe filter.

2.4. Procedure for Method Validation. The method was validated for linearity, precision, accuracy solution stability, filter compatibility, limit of detection (LOD), limit of quantification (LOQ), specificity-forced degradation studies, and robustness as per ICH guidelines.

2.4.1. System Suitability. To ensure that HPLC testing system was suitable for the intended application, the system suitability was assessed by five replicate analyses of system suitability solution (standard solution) and chromatographic parameters were evaluated. The acceptance criteria were not more than 2.0% for the RSD of the peak areas and tailing factor of the analyte peaks. The acceptance criteria were not less than 3000 for the plate count of the MP, KT and MF peaks.

2.4.2. Specificity-Forced Degradation Studies. The forced degradation studies were executed to demonstrate whether the analytical method was stability indicating and could unequivocally assess the analyte in the presence of impurities and degradation products. Combined lotion of MP, MF, and KT was stressed under thermolytic, photolytic, acid hydrolytic, base hydrolytic, and oxidative stress conditions to result in partial degradation of the drugs. All stress decomposition studies were performed at an initial drug concentration of 10, 100, and 5 μg/mL for MP, KT, and MF, respectively.

(1) Thermal Stressed Sample. For thermal stress testing, the lotion sample was placed in convection oven and exposed to heat at 75°C for 6 h.

(2) Photolytic Light Stressed Sample. For photo stress testing, the lotion sample was placed in photolytic chamber and expose to UV and visible light (1.2 million lux hours and 200 wh/m^2).

(3) Acid Degradation Sample. For acid hydrolysis, solution was prepared by dispersing and dissolving lotion sample into 15 mL mixture of acetonitrile and water (80 : 20, %v/v). Acid hydrolysis was performed by adding 1 mL of 5 N HCl and mixture was kept at 70°C on water bath for 30 minutes. The solution was neutralized with 1 mL of 5 N NaOH and further proceeded as per sample preparation.

(4) Base Degradation Sample. For base hydrolysis, solution was prepared by dispersing and dissolving lotion sample into 15 mL mixture of acetonitrile and water (80 : 20, %v/v). Base hydrolysis was performed by adding 1 mL of 0.05 N NaOH and mixture was kept at room temperature for 15 minutes. The solution was neutralized with 1 mL of 0.05 N HCl and proceeded further as per sample preparation.

(5) Peroxide Oxidation Sample. For oxidation study, solution was prepared by dispersing and dissolving lotion sample into 15 mL mixture of acetonitrile and water (80 : 20, %v/v). Oxidative study was performed by adding 1 mL of 30% v/v hydrogen peroxide (H_2O_2) and the mixture was kept at room temperature for 45 minutes. It was processed further as per sample preparation.

2.4.3. Precision. The precision of the developed method was assessed by performing repeatability and intermediate precision (interday) at an initial drug concentration of 10, 100, and 5 μg/mL for MP, KT, and MF, respectively, in one day. %RSD was calculated to determine repeatability of precision. These studies were also repeated on different days to determine interday precision.

2.4.4. Accuracy. To confirm the method's accuracy, recovery experiments were checked by standard addition method. The recovery experiments were performed in triplicate at 50, 100, and 150% concentration levels of the amount of the analytes in in-house mixture of lotion excipients (placebo).

2.4.5. Limit of Detection and Limit of Quantification. The standard solutions of MP, KT, and MF for the limit of detection (LOD) and limit of quantification (LOQ) were prepared by diluting them in mixture of acetonitrile and water (80 : 20, %v/v) sequentially. The LOD and LOQ were determined by analyzing signal-to-noise (S/N) ratio for each compound involving a series of diluted solutions until the S/N ratio yield 3 for LOD and 10 for LOQ, respectively.

2.4.6. Linearity. Six levels of calibration standard solutions were prepared from the stock solutions at concentration range 0.12–15.2 μg/mL for MP, 0.67–149.4 μg/mL for KT, and 0.42–7.6 μg/mL for MF to encompass the expected concentration in measured samples. Calibration curves were constructed by plotting areas versus concentrations of MP, KT, and MF and then subjected to least-square linear regression analysis.

2.4.7. Robustness. To determine the robustness of the method the experimental conditions were deliberately changed. The flow rate of the mobile phase (1.5 ± 0.2 mL/min), column oven temperature (50 ± 5°C), mobile phase buffer pH (6.5 ± 0.2), and acetonitrile composition (60 ± 3.5%) were varied. In each case, the %RSD values were calculated for the obtained

peak area. The number of theoretical plates and tailing factors was compared with that obtained under the optimized conditions.

2.4.8. Solution Stability. In order to demonstrate the stability of sample solutions, the solution was tested at intervals of 0, 12, 24 h by its storage at ambient temperature. The stability of solutions was appreciated by comparing assay results of peak area of MP, KT and MF.

2.4.9. Filter Compatibility. Filter compatibility was performed for nylon 0.22 μm syringe filter (Millipore) and PVDF 0.22 μm syringe filter (Millipore). To confirm the filter compatibility in the proposed method, filtration recovery experiment was carried out by sample filtration technique. Sample was filtered through both syringe filters, and percentage assay was determined and compared against centrifuged sample.

3. Results and Discussion

3.1. Method Development and Optimization. The prime objective of this study was an RP-HPLC method development for determination of Methylparaben, Ketoconazole, and Mometasone furoate in pharmaceutical dosage form and determination of assay of drug in single run which should be accurate, reproducible, robust, and stability indicating. All degradation products from stress conditions should be well separated from each other and the method should be simple to be effective in analytical research and quality control laboratory for routine use.

3.2. Mobile Phase and Chromatographic Conditions Optimization. Optimization of column selection and mobile phase selection were done simultaneously. An isocratic method was employed using buffer (0.2% v/v triethyl amine in water, pH was adjusted to 6.5 with glacial acetic acid) : acetonitrile (60 : 40 v/v) as mobile phase. X-Terra C18 (150 × 4.6 mm, 5 μ) column with flow rate 1.5 mL/min and column temperature 50°C were used in HPLC equipped with photo diode array detector. MF peak fronting was observed and peak eluted too late. To reduce run time and improve MF peak shape, an attempt was made by increasing acetonitrile composition in mobile phase, which then became buffer (0.2% v/v triethyl amine in water, pH 6.5 adjusted with glacial acetic acid) : acetonitrile (40 : 60 v/v). Due to early elution of MP peak (1.2 minute), plate count was found to be 1500. To retain the MP peak, an attempt was made by increasing column length X-Terra C18 (250 × 4.6 mm, 5 μ). MP, KT, and MF peaks eluted at RT 2.3, 3.0, and 4.6 minutes, respectively. Plate count for MP peak was more than 4000. Resolution between MP, KT was 4.8 and KT, MF was 6.5. Considering solubility of all the component mixture of acetonitrile : water, 80 : 20 %v/v was used as diluent and satisfactory recovery was achieved.

3.3. Analytical Method Validation. After satisfactory development of method, it was subjected to method validation as per ICH guideline [47].

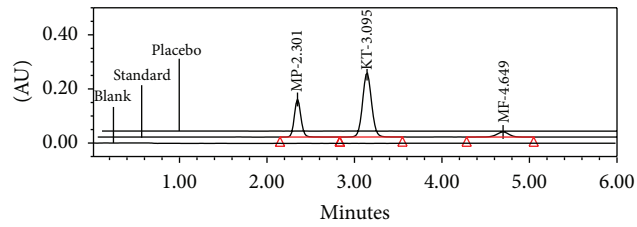

Figure 2: Typical overlay chromatogram of blank, placebo, and standards.

3.3.1. System Suitability. System suitability parameters were measured so as to verify the system, method, and column performance. The % RSD (relative standard deviation) of MP, KT and MF area count of five replicate injections (standard preparation) were 0.27, 0.17, and 0.44, respectively. Low values of % RSD of replicate injections indicate that the system is precise. The tailing factor for MF, EN, and MP peaks was 1.1, 1.0, and 1.0. The efficiency of the column was expressed as the number of theoretical plates. Results of theoretical plates for MF, KT, and MF peaks are presented in Table 1.

3.3.2. Specificity. Specificity is the ability of the method to measure the analyte response in the presence of its potential impurities [47]. Forced degradation studies were performed to demonstrate selectivity and stability indicating capability of the proposed RP-HPLC method. Figure 2 shows that there is no interference at the RT (retention time) of MP, KT and MF in presence of blank and placebo.

Force degradation studies of drug product containing MP, KT, and MF were also performed to evaluate the stability-indicating property and specificity of the proposed method. The solutions of drug product and placebo were exposed to acid hydrolysis, alkali, peroxide oxidation, thermal exposure, and photolytic exposure. KT was found sensitive to acid hydrolysis than MF. During acid hydrolysis process, about 54.1% of KT degraded and one major degradation peak was observed at 2.852 min, 8.1% of MP degraded while no degradation was observed in case of MF. MF was found to be more sensitive to base hydrolysis than KT. During base hydrolysis process, about 11.3% of MF degraded and main degradation peaks were observed at 4.911, 5.164 min, while no degradation was observed in case of KT and MP. During peroxide oxidation process, about 12.4% of KT degraded, but no significant degradation was observed for MP and MF. During photolytic degradation process, about 17.8% of KT degraded and main degradation peak was observed at 2.636 min, while no degradation was observed in case of MF and MP. No significant degradation was observed in case of thermal degradation of sample. Typical chromatograms obtained from assay of stressed lotion sample are shown in Figure 3, acid degradation (a), base degradation (b), peroxide oxidation (c), thermal exposed (d), and photo exposed (e) sample. MF, KT and MP were investigated for spectral purity in the chromatogram of all exposed samples and found spectrally pure. The purity and assay of MP, MF, and KT were unaffected by the presence of its degradation products and

Table 1: System suitability results (precision, intermediate precision, and robustness) for MP, KT, and MF.

Parameters	MP				KT				MF			
	>3000	≤2.0	≤2.0		>3000	≤2.0	≤2.0		>3000	≤2.0	≤2.0	
	N	T	%R^*	RT	N	T	%R^*	RT	N	T	%R^*	RT
Precision	4190	1.1	0.27	2.301	4270	1.0	0.17	3.095	5472	1.0	0.44	4.665
Interprecision	4452	1.1	0.22	2.306	4268	1.1	0.27	3.101	5476	1.0	0.33	4.674
1.7 mL/min flow rate	3881	1.1	0.29	2.040	3781	1.1	0.14	2.733	5007	1.0	0.83	4.137
1.3 mL/min flow rate	4923	1.1	0.22	2.637	4812	1.1	0.19	3.541	6149	1.0	0.32	5.322
55°C column temp.	4455	1.1	0.24	2.278	4365	1.1	0.31	3.058	5607	1.0	0.25	4.486
45°C column temp.	4514	1.1	0.39	2.341	4199	1.1	0.25	3.135	5580	1.0	0.61	4.844
Mobile phase pH 6.7	4289	1.1	0.29	2.302	4271	1.1	0.07	3.095	5548	1.0	1.01	4.659
Mobile phase pH 6.3	4316	1.1	0.17	2.303	4261	1.1	0.16	3.086	5565	1.0	0.56	4.644
+3.5% Acetonitrile	4422	1.1	0.35	2.271	4170	1.1	0.33	2.940	5480	1.0	1.02	4.282
−3.5% Acetonitrile	4323	1.1	0.59	2.368	4497	1.0	0.17	3.345	5641	1.0	0.69	5.242

N: plate count, T: tailing factor, R: relative standard deviation, RT: retention time, *determined on five values.

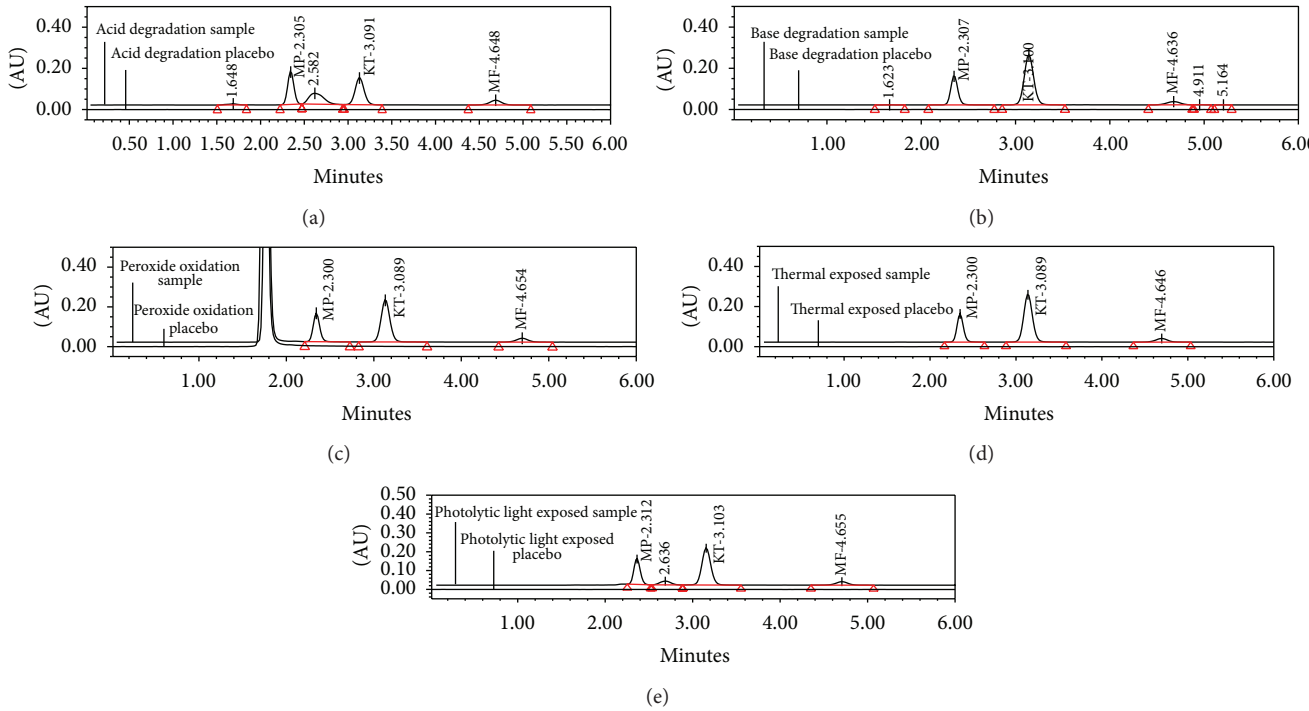

Figure 3: Typical overlay chromatograms of (a) acid degradation sample and placebo, (b) base degradation sample and placebo, (c) peroxide oxidation sample and placebo, (d) thermal exposed sample and placebo, and (e) photolytic light exposed sample and placebo.

thus confirms the stability-indicating power of the developed method. Results from forced degradation study are given in Table 2.

3.3.3. Method Precision. The Precision of assay method was evaluated by carrying out six independent determinations of 10 μg/mL of MP, 100 μg/mL of KT, and 5 μg/mL of MF lotion samples against qualified working standards. The average % assay ($n = 6$) of MP, KT, and MF were 100.5%, 99.7% and 100.2%, respectively, with RSD of below 0.8%. Low values of % RSD indicate that the method is precise. Results are presented in Table 3.

3.3.4. Intermediate Precision (Reproducibility). The purpose of this study is to demonstrate the reliability of the test results with variations. The reproducibility was checked by analyzing the samples by different analyst using different chromatographic system and column on different day. Results are presented in Table 3.

3.3.5. Accuracy. The accuracy was evaluated applying the proposed method to the analysis of the in-house mixture of cream excipients with known amount of the drug, to obtain solutions at concentrations of 5.05, 10.10, and 15.15 μg/mL for MP; 49.80, 99.60, and 149.40 μg/mL for KT; 2.53, 5.05

Table 2: Results of forced degradation study for MP, KT, and MF.

Stress conditions	MP			KT			MF		
	PA	PTH	% Deg.	PA	PTH	% Deg.	PA	PTH	% Deg.
Acidic hydrolysis (5 N HCl, 70°C, 30 mins)	0.319	1.105	8.1	0.126	1.181	54.1	0.655	1.950	ND
Alkaline hydrolysis (0.05 N NaOH, RT, 15 mins)	0.286	1.113	ND	0.173	1.141	ND	1.181	2.057	11.3
Oxidation (30% H_2O_2, RT, 45 min)	0.094	1.127	ND	0.204	1.159	12.4	0.760	2.029	ND
Thermal (At 80°C, 6 h)	0.165	1.179	ND	0.177	1.143	ND	1.286	2.216	ND
UV and visible light exposed	0.286	1.113	4.2	0.173	1.141	17.8%	1.181	2.057	ND

N.D.: no degradation, RT: room temperature, PA: purity angle, PTH: purity threshold.

Table 3: Method precision, intermediate precision result, LOD, LOQ evaluation, and linearity data for MP, KT, and MF.

Parameter	MP	KT	MF
Precision day-1 ($n = 6$) (% Assay ± SD; % RSD)	100.5 ± 0.48; 0.48	99.7 ± 0.43; 0.43	100.2 ± 0.76; 0.75
Intermediate precision day-2 ($n = 6$) (% Assay ± SD; % RSD)	100.0 ± 0.32; 0.32	100.4 ± 0.17; 0.17	101.3 ± 0.59; 0.58
LOD (μg/mL)	0.033	0.204	0.123
LOQ (μg/mL)	0.12	0.67	0.42
Linearity range (μg/mL)	0.12–15.2	0.67–149.4	0.42–7.6
Correlation coefficient	0.9999	0.9999	0.9999
Intercept (a)	1485.841	415.816	−1614.022
Slope (b)	72985.066	17217.396	35584.579
Bias at 100% response	−0.202	0.024	−0.914

Table 4: Accuracy results for MP, KT, and MF.

Active components	Amount added (μg/mL)	Amount recovered (μg/mL)	% Recovery[#] ± SD; % RSD[*]
MP	5.05	5.11	101.1 ± 0.17; 0.17
	10.10	10.19	100.9 ± 0.63; 0.62
	15.15	15.14	99.9 ± 0.12; 0.12
KT	49.8	50.37	101.1 ± 0.05; 0.05
	99.6	100.41	100.8 ± 0.25; 0.25
	149.4	149.63	100.2 ± 0.13; 0.13
MF	2.53	2.54	100.8 ± 0.62; 0.62
	5.05	5.06	99.9 ± 0.36; 0.36
	7.58	7.57	99.9 ± 0.48; 0.48

[*]Determined on three values. [#]Mean of three determinations.

and 7.58 μg/mL for MF. The accuracy was assessed from three replicate determinations and calculated as the μg/mL drug recovered from the drug matrix. The means and RSD% obtained from the recovery studies are shown in Table 4 with ranges of 99.9–101.1%, 100.2–101.1%, and 99.9–100.8% for MP, KT, and MF, respectively, demonstrating that the method is accurate within the desired range and also there is no interference due to excipients present in placebo cream sample.

3.3.6. Limit of Detection (LOD) and Limit of Quantification (LOQ). The LOD and LOQ were determined at a signal to noise ratio of 3 : 1 and 10 : 1, respectively, by injecting a series of dilute solutions with known concentrations. The limit of detection and limit of quantification values of MP, KT, and MF are reported in Table 3.

3.3.7. Linearity. Linearity was demonstrated from LOQ % to 150% of standard concentration using minimum six calibration levels of test concentration (LOQ-15.2 μg/mL for MP, LOQ-149.4 μg/mL for KT and LOQ-7.6 μg/mL for MF), which gave us a good confidence on analytical method with respect to linear range. The response was found linear for all MP, KT, and MF from LOQ to 150% of standard concentration and correlation coefficient was also found greater than 0.9999. Bias was found within ±1.0. The result of correlation coefficients, Y-intercept of the calibration curve and % bias at 100% response for MP, KT, and MF are presented in Table 3.

3.3.8. Robustness. The robustness as a measure of method capacity to remain unaffected by small, but deliberate, changes in chromatographic conditions was studied by testing influence of small changes in flow rate (±0.2 mL/min), change in column oven temperature (±5°C), mobile phase buffer pH (±0.2), and mobile phase organic composition (±3.5% acetonitrile). No significant effect was observed on system suitability parameters such as theoretical plates, tailing factor, and % RSD of MP, KT, and MF. The results are

presented in Table 1 along with system suitability parameters of precision and intermediate precision study.

3.3.9. Stability of Sample Solution. Stability of sample solution was established by storage of sample solution at ambient temperature for 24 h. The assay of MP, KT, and MF was analyzed. It was found that % labeled amounts of MP at 0, 12, and 24 hrs were 99.8, 100.5, and 99.8, respectively; % labeled amounts of KT were 98.9, 99.1, and 98.7, respectively, and % labeled amount of MF were 100.1, 100.8, and 100.1, respectively.

3.3.10. Filter Compatibility. Sample solution did not show any significant change in assay percentage with respect to centrifuged sample. It was found that % labeled amount of MP at centrifuged sample, 0.22 μm PVDF syringe filter, and 0.22 μm Nylon syringe filter were 100.5, 100.2, and 100.7, respectively; KT were 98.6, 98.4, and 98.8, respectively; and MF were 100.0, 99.5, and 100.9, respectively. In the result, difference in % assay was not more than ±1.0, which indicates that both syringe filters have a good compatibility with sample solution.

4. Conclusions

An isocratic RP-HPLC method was successfully developed for the estimation of Methylparaben, Ketoconazole, and Mometasone Furoate in topical pharmaceutical dosage form. The method validation results have proved that the method is selective, precise, accurate, linear, robust, filter compatible and stability indicating. Forced degradation data proved that the method is specific for the analytes and free from the interference of placebo/known impurities/and degradation products. The run time (6.0 min) enables rapid determination of drug. Moreover, it may be applied for determination of Methylparaben, Ketoconazole, and Mometasone Furoate in the study of content uniformity, tube homogeneity, and in-vitro release test profiling of topical dosage forms, where sample load is higher and high throughput is essential for faster delivery of results. The developed method is stability-indicating and can be used for quantifying Methylparaben, Ketoconazole, and Mometasone Furoate in topical pharmaceutical dosage forms and their combinations, that is, MP+MF, MP+KT, MF+KT, and MP+MF+KT.

Conflict of Interests

The authors declare that they do not have a direct financial relation with the commercial identity mentioned in this paper that might lead to a conflict of interests for any of the authors.

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