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Determination of Naphthalene Content by Gas Chromatography

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A rapid and specific gas chromatographic analytical method is developed for detection and estimation of naphthalene in a complex matrix of potentially interfering substances, using a 5% SE-30 packed column, with a run time of 20 min. The detection level is established at 10 ppm.

Key Words: Naphthalene, Gas chromatography.

INTRODUCTION

The detection and estimation of several trace components, which need to be restricted in drug substances, is a critical area in chromatographic applications[1]. Naphthalene is classified by International Agency for Research on Cancer (IARC) in group 2B under 'Agents and groups of agents', which are possibly carcinogenic to humans. The content of naphthalene has to be restricted in drug intermediates and Drug substances.

In this context, an attempt was made to develop a gas chromatographic method for the detection and determination of naphthalene and to validate this GC method. The GC method is developed for the determination of naphthalene in a sample matrix of a drug intermediate N-methyl-1-naphthalene methylamine and has been validated[1, 2].

While adopting this methodology for the determination of naphthalene in other drug intermediates or the drug substances the specificity should be verified for any interference from the sample matrix.

EXPERIMENTAL

Naphthalene GPR and toluene were procured from Merck (India) and N-methyl-1-naphthalene methylamine from Natco Pharma Ltd. (India). The gas chromatographic system (Carlo Erba, model Vega 6000 series) with FID detector, provided with data handling and integration system. Column: 5% SE-30, 2 m, 80 mesh GC packed column.

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Chromatographic conditions: Oven temperature: T_1 150°C, T_2 225°C, T_3 250°C; time: t_1 5 min, t_2 6 min, t_3 3 min; ramp rate: R_1 15°C/min, R_2 25°C/min.

[Oven temperature was programmed starting at 150°C (T_1) for 5 min (t_1) and increasing the temperature at a ramp (R_1) of 15°C per min to 225°C (T_2), stayed for 6 min (t_2) and then again with a ramp of 25°C (R_2) per min to 250°C (T_3) and stayed for 3 min (t_3).]

Injection temperature: 275°C; carrier (N_2): 180 kPa; Injection volume: 0.4 µL.

Naphthalene was taken in toluene at different concentration levels for estimation. Toluene was used as blank.

100 ppm Naphthalene solution: Accurately weighed 50 mg of naphthalene was dissolved into 50 mL of distilled water in a volumetric flask. 5 mL of the above solution was further diluted with 50 mL of toluene (0.1 mg/mL or 100 ppm).

RESULTS AND DISCUSSION

Specificity: The specificity of naphthalene with complex sample matrix is verified by injecting naphthalene standard and the sample matrix separately.

There is no potential interference of any other component peak from the sample matrix with naphthalene (Fig. 1). Although the specificity is verified with respect to the selected sample matrix, the validation is performed with synthetic preparations of naphthalene only, as it is application-specific.

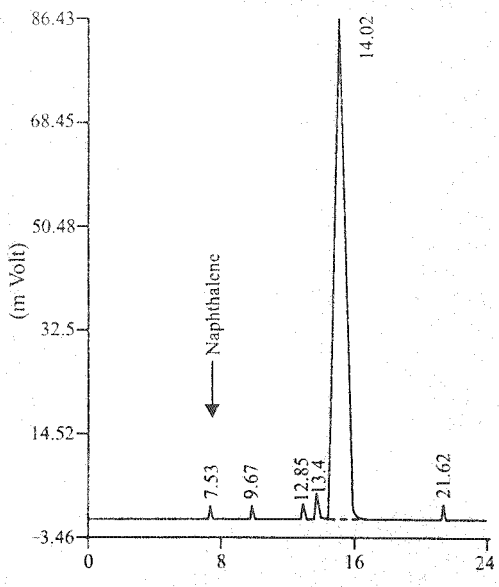

Fig. 1. Naphthalene spiked to sample matrix

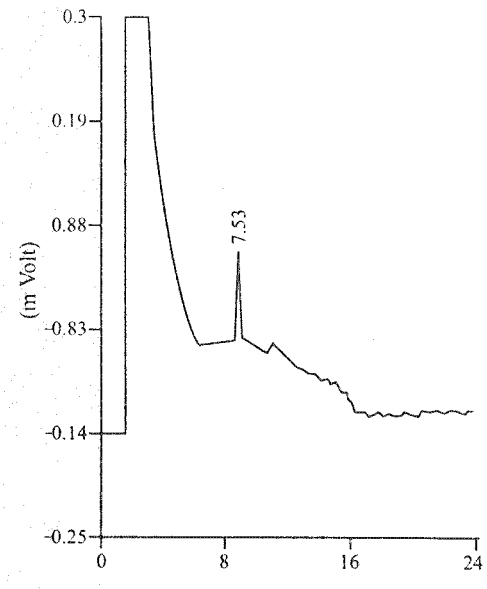

Fig. 2. Typical naphthalene precision chromatogram

Validity of the method

System suitability: The chromatographic system is deemed suitable by performing replicate injections of naphthalene at 25 ppm concentration and by calculating the % RSD (Table-1). The resulting % RSD is 5.14.

TABLE-1

S.No.	Area response
1.0	1836
2.0	1958
3.0	2085
4.0	2072
5.0	1918
6.0	2072
Average	1990
%RSD	5.14

TABLE-2

S. No.	Area response
1.0	9276
2.0	9284
3.0	9259
4.0	9301
5.0	9322
6.0	9330
Average	9295.33
%RSD	0.30

Precision: The precision is established by the analysis of synthetic naphthalene in toluene at 1000 ppm concentration six times. The % RSD obtained is about 0.30 (Table-2, Fig. 2).

Linearity: The linearity is studied over the range of 25 to 200 ppm. The peak area responses were recorded and the data (Table-3) was subjected to statistical analysis using a linear-regression by least square method. The linearity graph is in Graph-1 and the chromatograms are from Fig. 2 to Fig. 8.

The linearity chromatograms are given in Figs. 3 to Fig. 8.

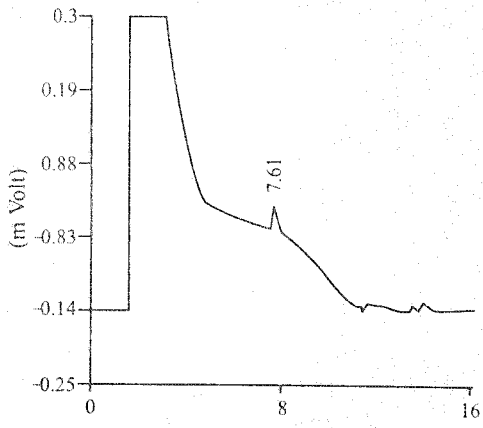

Fig. 3. Linearity at 25 ppm concentration

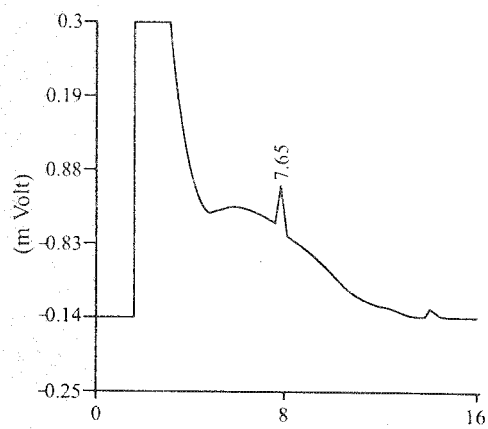

Fig. 4. Linearity at 50 ppm concentration

TABLE-3

Description	Concentration (ppm)	Area obtained
Linearity solution- 1	25	2274
Linearity solution-2	50	4864
Linearity solution-3	75	7470
Linearity solution-4	100	9315
Linearity solution-5	150	14051
Linearity solution-6	200	18746
Correlation coefficient:	0.9995	
Regression equation:	$Y = (93.0188 \times X) + 151.451$	

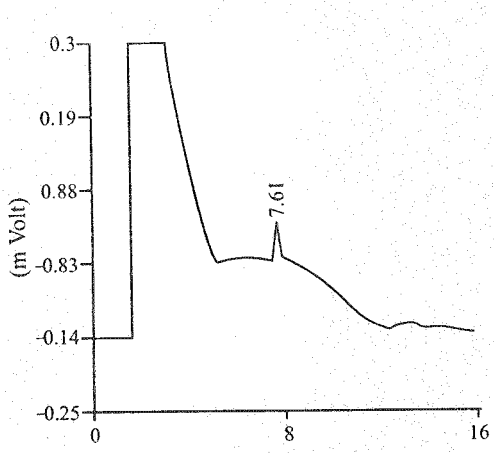

Fig. 5. Linearity at 75 ppm concentration

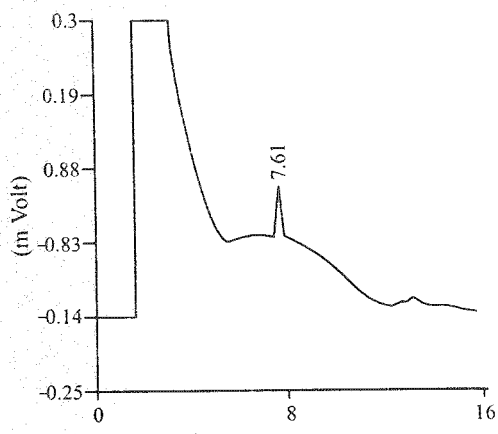

Fig. 6. Linearity at 100 ppm concentration

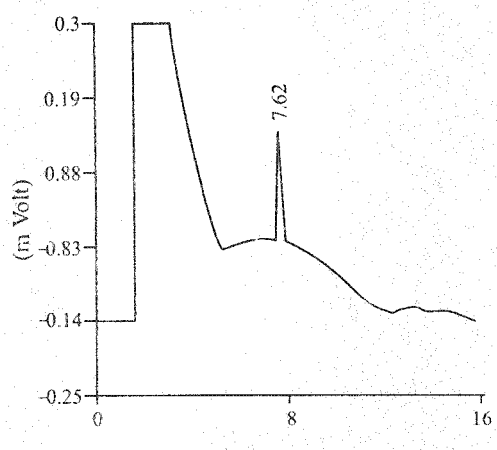

Fig. 7. Linearity at 150 ppm concentration

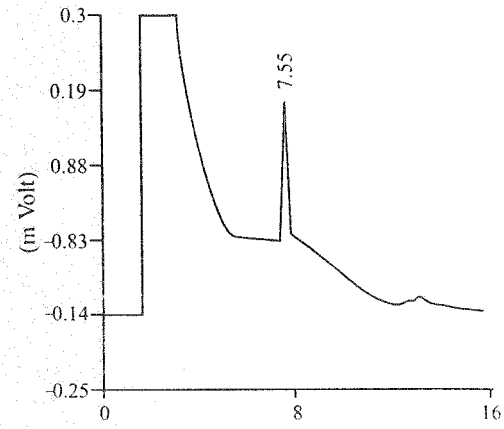

Fig. 8. Linearity at 200 ppm concentration

Accuracy (% Recovery): Recovery study is conducted at three concentration levels of 50, 100 and 150 ppm and with triplicate injections (n = 3) at each concentration level. The concentration obtained is quantified against average area of 25 ppm synthetic standard. In all the attempts, the % recoveries obtained were between 98.2 and 99.8% (Table-4).

TABLE-4

Description	50 ppm	100 ppm	150 ppm
Concn. obtained	57.28	112.68	170.93
Concn. taken	55.0	110.0	165.0
% Recovery	99.8	98.2	99.3

Average of n = 3.

Limit of detection: The detection limit is established by visual evaluation method. The detection limit obtained is 10 ppm.

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REFERENCES

1. US Department of Health and Human Resources, Food and Drug Administration, Guidance to Industry: Q2A Validation of Analytical Procedures, Center for Drag Evaluation and Research, Rockville, MD, 1994. www.fda.gov/cder/guidance/indcx.htm
2. US Department of Health and Human Resources, Food and Drug Administration, Guidance to Industry: Q2B Validation of Analytical Procedures-Methodology, Center for Drag Evaluation and Research, Rockville, MD, 1996. www.fda.gov/cder/guidance/index.htm
3. United States Pharmacopoeia: USP-28<1225>, 2005

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