Determination of Salbutamol and Guaifenesin in Mixture Using Zero-Crossing Wavelength Measurement

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Abstract
A mixture of salbutamol and guaifenesin in syrup was analyzed using zero-crossing wavelength method. NaOH 0.1 N was selected as the solvent. Zero-crossing wavelength of salbutamol is 246.2 nm and guaifenesin is 270.2 nm. Results showed that the recovery of salbutamol and guaifenesin are 95.96% and 93.94%, respectively, while the coefficient of variance is 0.995% for salbutamol and 0.2087% for guaifenesin. Limit of detection of salbutamol and guaifenesin are 0.05528 ppm and 9.443 ppm, respectively, while limit of quantification are 0.18427 ppm and 31.477 ppm. We concluded that this method could be applied to determine salbutamol and guaifenesin in mixture.

Keywords: Derivative spectrophotometry, guaifenesin, salbutamol, zero-crossing

Penentuan Salbutamol dan Guaifenesin dalam Campuran Menggunakan Pengukuran Panjang Gelombang *Zero-Crossing*

Abstrak
Campuran salbutamol dan guaifenesin dalam sirup dianalisis menggunakan metode panjang gelombang *zero-crossing*. NaOH 0,1 N dipilih sebagai pelarut. Panjang gelombang *zero-crossing* salbutamol adalah 246,2 nm dan 270,2 nm guaifenesin. Hasil penelitian menunjukkan bahwa % *recovery* salbutamol dan guaifenesin adalah 95,96% dan 93,94%, sedangkan koefisien variasi adalah 0,995% untuk salbutamol dan 0,2087% untuk guaifenesin. Batas deteksi salbutamol dan guaifenesin adalah 0,05528 ppm dan 9,443 ppm, sedangkan batas kuantifikasi adalah 0,18427 ppm dan 31,477 ppm. Dapat disimpulkan bahwa metode ini bisa diterapkan untuk menentukan salbutamol dan guaifenesin dalam campuran.

Kata kunci: Guaifenesin, salbutamol, spektrofotometri derivatif, *zero-crossing*

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Introduction

Derivative spectrophotometry is a technique based on derivative spectra of a basic, zero-order spectrum.[1] The results of derivatization of function described a run of absorbance curve is called the derivative spectrum. It has found a wide application in the quantitative chemical analysis.[2] It can be used for multi component analysis, such as determination of drugs mixtures.[3]

An example of drugs in mixture are salbutamol and guaifenesin in syrup. Salbutamol in sodium hydroxide (NaOH) shows maxima absorption (λ_{max}) at 295 nm, [4] while guaifenesin is at 273 nm.[5]

This paper described application of zero-crossing wavelength ($\lambda_{zero\text{-}crossing}$) measurement to determine salbutamol and guaifenesin in syrup.

Methods

Instrument that used was ultraviolet spectrophotometer (Shimadzu 1700) and chemical glasswares. Materials that used was salbutamol and guaifenesin (BFPI), methanol, HCl 0.1 N, NaOH 0.1 N.

This research was conducted with raw materials analysis. Raw materials of salbutamol and guaifenesin were analyzed according to Indonesian Pharmacope 5th edition that included solubility test and identification reaction.[6]

Salbutamol and guaifenesin in syrup were analyzed. The steps were preparation of standard solutions, determination of λ_{max} and $\lambda_{zero\text{-}crossing}$, preparation of standard curve at each $\lambda_{zero\text{-}crossing}$, made a series of concentration from standard solution, the validation of analytical method, and then salbutamol and guaifenesin in syrup were determinated.

Salbutamol standard solutions 1000 ppm was made by weighing accurately 0.01 g of salbutamol and dissolving it in ethanol 10 mL. A diluted solution of 100 ppm was prepared by pipetting 1 mL of the solution and diluting it with NaOH 0.1 N into 10 mL. Guaifenesin standard solution 1000 ppm was made by weighing accurately 0.01 g of guaifenesin and dissolved it in ethanol 10 mL.

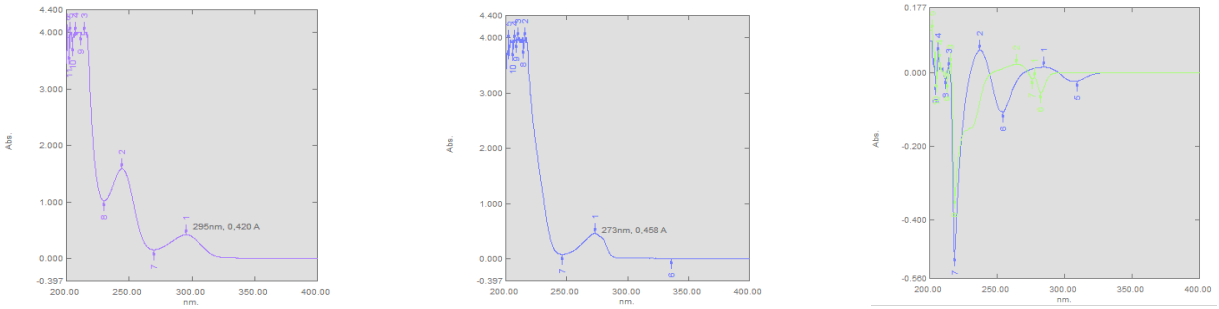
Determination of λ_{max} and $\lambda_{zero\text{-}crossing}$ of salbutamol and guaifenesin were obtained by deriving the absorbance of the normal spectra towards the wavelength ($dA/d\lambda$).[7]

Salbutamol and guaifenesin standard curves were obtained by measure ($dA/d\lambda$) of the series of standard solutions at $\lambda_{zero\text{-}crossing}$ of the other compounds.[7] Linear regression equations were calculated.

The concentration series of salbutamol standard solution were 0.2; 0.4; 0.6; 0.8; 1.0; 1.2; and 1.4 ppm. It was made from salbutamol standard solution 1000 ppm. The series concentrations of guaifenesin standard solution were 9, 18, 27, 36, 45, 54, and 63 ppm. The series concentrations were made from standard solution of guaifenesin 1000 ppm.

Table 1 Identification of Salbutamol and Guaifenesin[6]

Parameter	Salbutamol		Guaifenesin	
	Reference	Result	Reference	Result
Physical appearance	White crystalline powder	White crystalline powder	White crystalline powder	White crystalline powder
Solubility	Slightly soluble in water, soluble in ethanol	Slightly soluble in water, soluble in ethanol	Soluble in water, ethanol and chloroform	Soluble in water, ethanol and chloroform
Identification	UV absorbance in HCl 0.1 N shows maximum as given by salbutamol BPFI	Fulfilled the requirement	UV absorbance in chloroform shows maximum as given by guaifenesin BPFI	Fulfilled the requirement



(a) (b) (c)

Figure 1 UV Spectrum of Salbutamol (a) and Guaifenesin (b), UV First Derivative Spectrum of Salbutamol (Blue) and Guaifenesin (Yellow) (c)

salbutamol and guaifenesin (80%, 100%, 120%)[9] then dissolved into sugar solution. All concentrations of each compound were calculated using linear regression equation to obtain accuracy and precision. LOD and LOQ were calculated by measuring the absorbance of blank solution.[8]

Salbutamol and guaifenesin in syrup were determined by weighing accurately mixture of salbutamol (4 ppm), guaifenesin (18 ppm), and syrup then measured its absorbance at $\lambda_{zero\text{-}crossing}$.

Results

Salbutamol and guaifenesin were analyzed by according to Indonesian Pharmacope 5th edition. Table 1 shows the result of salbutamol identification.[6]

Ultraviolet spectrum of salbutamol and guaifenesin are showed in Figure 1a and 1b. The first derivative spectrum of salbutamol and guaiafenesin showed in Figure 1c. Salbutamol and guaifenesin standard curve were obtained by measuring (dA/dλ) of the series of standard solutions at $\lambda_{zero\text{-}crossing}$ of the other compounds. The calibration curve of salbutamol and guaifenesin showed in Table 3.

Discussions

Salbutamol shows maxima at 295 nm in NaOH[4] (A= 0.420), while guaifenesin is at 273 nm[5] (A= 0.458) (Figure 1a and 1b). Zero-crossing wavelength of salbutamol is 246.2 nm and guaifenesin is 270.2 nm (Figure 1c).

Linearity of the calibration curves (Table 3 and 4) is presented by the linear regression equation and coefficient of correlation (r).[8] Linear regression of salbutamol is y=0.219x+0.006 (r=0.993), while for salbutamol is y=0.012x+0.022 (r=0.997). Results of salbutamol and guaifenesin analysis are written in Table 5. Accuracy of the method was determined by calculating % recovery[8] and the result was 95.96% (salbutamol) and 93.94% (guaifenesin).

The method precision was determined

Table 3 Calibration Curve of Salbutamol and Guaienesin

Concentration of salbutamol (mg/L) (X)	Absorbance of salbutamol (Y)	Concentration of guaifenesin (mg/L) (X)	Absorbance of guaifenesin (Y)
0.2	0.050	9	0.119
0.4	0.099	18	0.264
0.6	0.138	27	0.365
0.8	0.181	36	0.458
1.0	0.217	45	0.591
1.2	0.259	54	0.700
1.4	0.326	63	0.798

Table 4 Analysis of Salbutamol and Guaifenesin in Syrup

Parameters	Salbutamol	Guaifenesin
Concentration (mg/mL)	2.3059	91.238
Recovery (%)	95.96	93.94
Error (%)	1.69	1.27

by calculating coefficient of variance[8] and the result was 0.995% for salbutamol and 0.2087% for guaifenesin.

Conclusions

Zero-crossing derivative method could be applied to determine salbutamol and guaifenesin in mixture. Limit of detection of salbutamol and guaifenesin are 0.05528 ppm and 9.443 ppm, respectively, while limit of quantification are 0.18427 ppm and 31.477 ppm.

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