

Simultaneous Determination of Each Component in the Salbcain Injection

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Abstract: It has determined Sodium salicylate, Lidocaine hydrochloride and Thiamine hydro-chloride in the Salbcain injection by using an ultraviolet spectrophotometry and Kalman filter simultaneously, it has found that wavelength range for simultaneous determination were from 268.6 nm to 332.0 nm. And in this wavelength condition, this determination method for the Salbcain injection was accurate and precise (mean recovery: respectively 99.91%, 97.10% and 99.11%, coefficient of variation: respectively 0.06%, 0.99% and 0.24% of Sodium salicylate, Lidocaine hydrochloride and Thiamine hydrochloride). So it has could determinate the each component of the Salbcain injection simultaneously without chemical reagents.

Keywords: Neuralgic Drug, Salbcain Injection, Kalman Filter Method, Simultaneously Determination

1. Introduction

In many countries a lot of drugs for some diseases such as neuralgia and arthralgia which have a great impact on the disability have been developed.

It has have been preparing compound preparation, Salbcain injection which are used in treatment of every neuralgia such as the shoulder joint, lumbar pain, gonitis by acupuncture, to economize reagent chemicals, time etc. and to raise its economic effectiveness.

On the world Kalman filter-spectrophotometry was developed in 1960 and began to be applied to chemistry [1, 13-15]. On recent literature Kalman filtering method can determine multi-component compound simultaneously in white analytical system [4-12]. In medical field each component of medicine is be determined simultaneously using Kalman filtering method [2, 3].

To economize reagent chemicals and analytical time it has made Kalman filter models reflecting Ultraviolet spectra of Salbcain injection which is characterized as white analytical system. And then being examined filtering condition, it has studied to determine each component using ultraviolet spectrophotometry spectra without separation of each component.

2. Materials and Method

2.1. Materials

Materials and reagents: Sodium salicylate (official medicine), Lidocaine hydrochloride (official medicine), Thiamine hydrochloride (official medicine), Salbcain injection (standardized medicine), hydrochloric acid (analytically pure)

Apparatus: Ultraviolet spectrophotometer (UV-265, Shimadzu), analytical balance (Sartorius-werke gmbh got lingen)

2.2. Method

2.2.1. Examination of the Condition for Simultaneous Determination

Study on the linearity between concentration and absorbance of Sodium salicylate, Lidocaine hydrochloride and Thiamine hydrochloride.

First concentration series of every reference material were made. It has put dry reference components (Sodium salicylate 3 mg, Lidocaine hydrochloride 20 mg, Thiamine hydrochloride 4 mg) and some 0.1 M Hydrochloric acid solution in a measuring flask of 25 mL and then fill by this

solution till the division of a scale. Next it has measured the absorbance of the solution at the range from 200 nm to 400 nm, using 0.1 M hydrochloric acid in the reference cell.

Finally it has examined the change of absorbance according to the concentration.

Evaluation of the linear additivity in three - component mixture: It has determined extinction coefficients on the every wavelength from the saved ultraviolet spectrophotometry measuring database by the reference concentration levels of the individual substances. It has managed laboratory databases by using Microsoft Excel function. From this it has determined the steady measuring wavelength range. Nine reference mixture solutions on each 3 concentration levels were made. Then scanning at the range from 200 nm to 400 nm, with absorbance at 261.5 nm and 302.0 nm it has calculated liner additivity.

Examination of the Kalman filtering process according to the wavelength numbers: With above nine reference mixture solutions relative error between the calculation value and the real value was evaluated. Using the Kalman filtering condition on which the relative error is the minimum, it has determined each component in the nine reference mixture solution.

2.2.2. Simultaneous Determination of Each Component in the Salbcain Injection

It has taken 1 mL of the Salbcain injection exactly and put it in the 250 mL measuring flask, fill and shake by the 0.1 M hydrochloric acid till the division of a scale. Then it has measured the absorbance of the Salbcain injection sample solution at the range from 200 nm to 400 nm using 0.1 M hydrochloric acid in the reference cell. On the suitable condition it has determined each component simultaneously by Kalman filter.

3. Result and Discussion

3.1. Result

3.1.1. Examination of the Condition for Simultaneous Determination

Study on the linearity between concentration and absorbance of Sodium salicylate (S), Lidocaine hydrochloride (L) and Thiamine hydrochloride (T): It has measured the absorbance of the solution at the range from 200 nm to 400 nm, using 0.1 M hydrochloric acid in the reference cell. The relationship between concentration and absorbance is such as follows (Table 1).

Table 1. The relationship between concentration and absorbance.

№	S		L		T	
	C / ($\mu\text{g}\cdot\text{mL}^{-1}$)	$A_{302.0}$	C / ($\mu\text{g}\cdot\text{mL}^{-1}$)	$A_{261.5}$	C / ($\mu\text{g}\cdot\text{mL}^{-1}$)	$A_{244.4}$
1	12.00	0.27	80.00	0.14	16.00	0.11
2	24.00	0.41	160.00	0.27	32.00	0.20
3	36.00	0.55	240.00	0.39	48.00	0.30
4	48.00	0.69	320.00	0.50	64.00	0.39
5	60.00	0.82	400.00	0.62	80.00	0.49
formula	$A_{302.0} = 0.01 C + 0.13$		$A_{261.5} = 0.001 C + 0.03$		$A_{244.4} = 0.006 C + 0.01$	
Relative (r^2)	0.999 8		0.999 2		0.999 7	

S - Sodium salicylate, L - Lidocaine hydrochloride, T - Thiamine hydrochloride

As you can see, the linearity is satisfied that is, the linearity between concentration and absorbance of Sodium salicylate, Lidocaine hydrochloride and Thiamine hydrochloride is ensured at 12.00–60.00 $\mu\text{g}/\text{mL}$, 80.00–

400.00 $\mu\text{g}/\text{mL}$ and 16.00–80.00 $\mu\text{g}/\text{mL}$ respectively.

Evaluation of the linear additivity in three component mixture: We determined the absorbance of the solution in the reference cell (Figure 1).

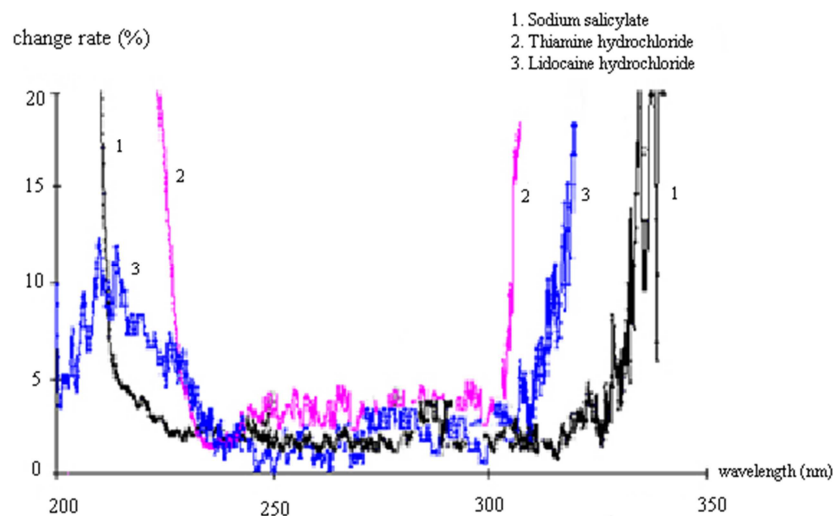


Figure 1. The change rate curve of extinction coefficient as following the wavelength.

As you can see, the alteration range is as 5% below at the 220.0 nm–332.0 nm of Sodium salicylate, 235.0 nm–340.0 nm of Lidocaine hydrochloride and 235.0 nm–332.0 nm of Thiamine hydrochloride. So it has selected 235.0 nm–332.0 nm as Simultaneous determination wavelength range. Using nine reference mixture solutions, we calculated linear additivity (Table 2).

Table 2. Evaluation of the linear additivity in three-component mixture at 261.5 nm, 302.0 nm.

№	C / ($\mu\text{g}\cdot\text{mL}^{-1}$)			A_M		A_T		Relative error (Δ)	
	S	L	T	$A_{261.5}$	$A_{302.0}$	$A_{261.5}$	$A_{302.0}$	$A_{261.5}$	$A_{302.0}$
1	28.80	88.00	17.60	0.27	0.67	0.28	0.68	-3.57%	-1.47%
2	28.80	88.00	19.20	0.30	0.66	0.29	0.68	3.45%	-2.94%
3	28.80	88.00	20.80	0.31	0.67	0.32	0.68	-3.13%	-1.47%
4	28.80	96.00	17.60	0.32	0.66	0.31	0.68	3.23%	-2.94%
5	28.80	96.00	19.20	0.28	0.65	0.27	0.68	3.70%	-4.41%
6	28.80	96.00	20.80	0.33	0.66	0.32	0.68	3.13%	-2.94%
7	28.80	104.00	17.60	0.32	0.65	0.31	0.68	3.23%	-4.41%
8	28.80	104.00	19.20	0.33	0.65	0.32	0.68	3.13%	-4.41%
9	28.80	104.00	20.80	0.33	0.65	0.34	0.68	-2.94%	-4.41%

$\Delta = (A_M - A_T) / A_T \times 100$ (%), M - measurable value, T-theoretic value

Through table 2 we confirmed linearity of three components was satisfied as relative error 5% below.

Examination of the Kalman filtering process according to the wavelength numbers: The curve of relative error between the calculation value and the real value using every nine reference mixture is as follows (Figure 2).

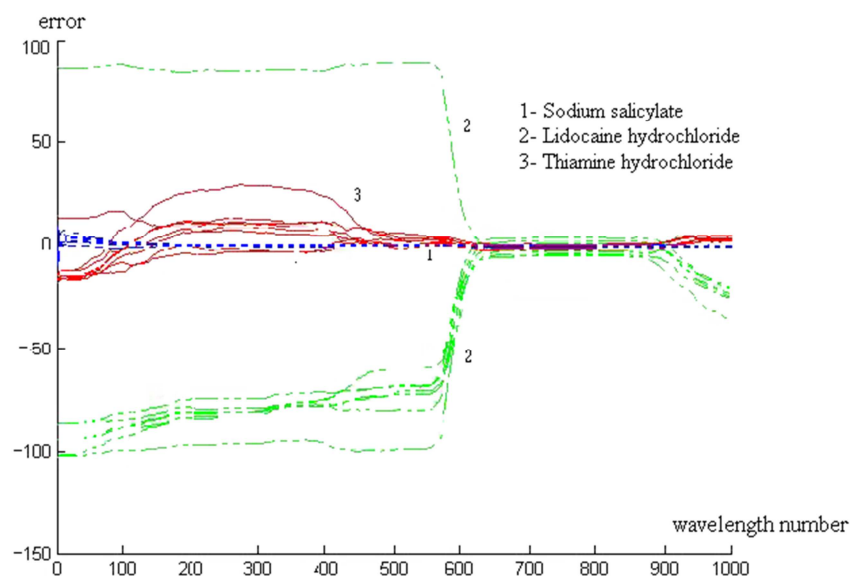


Figure 2. The curve of relative error between the calculation value and the real value.

Through above curve it has found the range on which relative error is minimum from 635 to 925. And the matching wavelength range is from 332.0 to 268.6 nm. So it has been Kalman Filter (KF) at this range.

On the suitable condition it has determined each component in nine reference mixture solutions. The result is such as table 3.

Table 3. Simultaneous determination in reference mixture by KF.

№	$C_P / (\mu\text{g}\cdot\text{mL}^{-1})$			$C_{KF} / (\mu\text{g}\cdot\text{mL}^{-1})$			Relative error (Δ)		
	S	L	T	S	L	T	S	L	T
1	28.80	88.00	17.60	29.24	89.00	17.92	1.53%	1.14%	1.82%
2	28.80	88.00	19.20	29.20	88.80	19.6	1.39%	0.91%	2.08%
3	28.80	88.00	20.80	29.16	89.10	21.28	1.25%	1.25%	2.31%
4	28.80	96.00	17.60	29.08	97.50	17.96	0.97%	1.56%	2.05%
5	28.80	96.00	19.20	29.28	97.20	19.68	1.67%	1.25%	2.50%
6	28.80	96.00	20.80	29.12	97.40	21.20	1.11%	1.46%	1.92%
7	28.80	104.00	17.60	29.16	105.50	17.96	1.25%	0.44%	2.05%
8	28.80	104.00	19.20	29.16	105.90	19.60	1.25%	1.83%	2.08%
9	28.80	104.00	20.80	29.16	105.80	21.12	1.25%	1.73%	1.54%

$\Delta = (C_{KF} - C_{add}) / C_P \times 100$ (%), P - preparation

As you can see, relative error of simultaneous determination is below 3%.

3.1.2. Simultaneous Determination of Each Component in the Salbcain Injection

Simultaneous determination of each component in the Salbcain injection.

The average recovery of Kalman Filter on the Salbcain injection is such as Table 4.

Table 4. The result of simultaneous determination of Salbcain injection by KF.

№	Amount (mL)	Dilute (d)	$C_R / (\mu\text{g}\cdot\text{mL}^{-1})$			$C_{KF} / (\mu\text{g}\cdot\text{mL}^{-1})$			Average recovery /%		
			S	L	T	S	L	T	S	L	T
1	1	250	30	40	20	29.98	38.90	19.89	99.93	97.25	99.45
2	1	250	30	40	20	29.96	38.50	19.80	99.87	96.25	99.00
3	1	250	30	40	20	29.99	38.60	19.77	99.97	96.50	98.85
4	1	250	30	40	20	29.95	39.50	19.85	99.83	98.75	99.25
5	1	250	30	40	20	29.98	38.70	19.80	99.93	96.75	99.00
average						29.97±0.02	38.83±0.40	19.82±0.05	99.91±0.06	97.10±0.99	99.11±0.24

C_R -reality concentration

Through table 4 the average recovery of Simultaneous determination of Sodium salicylate, Lidocaine hydrochloride and Thiamine hydrochloride in the Salbcain injection by Kalman Filter is respectively 99.91%, 97.10% and 99.11%. The coefficient of variation is respectively 0.06%, 0.99% and 0.24%, so reproducibility is also satisfied.

3.2. Discussion

It has determined Sodium salicylate, Lidocaine hydrochloride and Thiamine hydrochloride in the Salbcain injection by Kalman Filter.

The average recovery of every component is respectively 99.91%, 97.10%, 99.11%, coefficient of variation is respectively 0.06%, 0.99%, 0.24%. The accuracy and reproducibility of this simultaneous determination method without reagent chemicals is very satisfied.

4. Conclusions

The wavelength range for simultaneous determination of Lidocaine hydrochloride, Sodium salicylate and Thiamine hydrochloride in the Salbcain injection by Kalman Filter is from 268.6 nm to 332.0 nm.

This method for Sodium salicylate, Lidocaine hydrochloride and Thiamine hydrochloride in the Salbcain injection by Kalman Filter is satisfied as average recovery of 99.91%, 97.10% and 99.11% and coefficient of variation of 0.06%, 0.99% and 0.24%.

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