Short Research Articles

Stability of an aspirin in the aspirin+curcumin admixture at different storage conditions

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ABSTRACT

Aims: The pure stability of aspirin in the aspirin (100 μg/mL) only and aspirin (100 μg/mL) +curcumin(600 μg/mL) admixture without any ingredient under two solvents (distilled water, DW and normal saline, NS), three storage temperature(25˚C, 4˚C and -20˚C) and periods (1, 3 and 7 days) was evaluated.
Study Design: The injectable DW- and NS-aspirin containing solutions in the laboratory cap polyethylene bottle were stored and evaluated at controlled temperature (25˚C, 4˚C and -20˚C) during 7 days.
Methodology: Effects of admixture compounds, periods of storage and temperature of storage on the concentrations of active compound (aspirin) were analyzed. The concentration of aspirin in the each solution was determined by stability-indicating high-performance liquid chromatography (HPLC)-ultraviolet (UV) detection. A 1.0 mL volume of each sample was withdrawn and reconstituted with 3.0 mL of ethanol and directly inject into HPLC system immediately after filtration at 1, 3 and 7 days for analysis. The stability of the solutions was determined by calculating the percentage of the initial aspirin concentrations remaining at each test condition and periods. Stability was defined as the retention of at least 90% of the initial aspirin concentration.
Result: The concentration of aspirin of the aspirin only and aspirin+curcumin admixture solutions remained at least 90% of original without any color change or precipitation in the DW and NS solution at 4˚C and -20˚C throughout 7 day period and showed instability that decreased gradually below 90% of original concentrations after 1 day at 25˚C in the two solutions.
Conclusion: Two kinds of solutions of aspirin only and aspirin+curcumin admixture, in DW and NS, showed different stability depend on temperature of storage that means maintained stability at 4˚C and -20˚C and did not show effect of admixture of curcumin on aspirin stability during 7 days except 25˚C.

Keywords: Aspirin; Stability; Curcumin admixture; HPLC.

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1. INTRODUCTION

The chemical stability of a drug is of great importance since it becomes less effective as it undergoes degradation. Also, drug decomposition may yield toxic by-products that are harmful to the patient. Acetylsalicylic acid (ASA) decomposes rapidly in solutions of ammonium acetate or of the acetates, carbonates, citrates or hydroxides of the alkali metals. ASA is stable in dry air, but gradually hydrolyses in contact with moisture to acetic and salicylic acids. In solution with alkalis, the hydrolysis proceeds rapidly and the clear solutions formed may consist entirely of acetate and salicylate [1]. Daily Aspirin's effect on cancer has been widely studied, particularly its effect on colorectal cancer. Multiple meta-analyses and reviews have concluded that regular use of aspirin reduces the long-term risk of CRC incidence and mortality [2, 3, 4, 5]. In addition, experiments were carried out to measure the synergistic effects of a combination of aspirin with other chemopreventive agents for the anticancer benefit [6, 7, 8, 9,10]. Therefore, it is necessary to evaluate the physical and chemical stabilities of aspirin in order to determine the formulation of optimal dosage form that balances chemopreventive efficacy with safety of aspirin in combination with other agents. The purpose of this study is to provide information about the physical and chemical stability of aspirin in aspirin and curcumin of admixture under two solvents, various storage temperature and periods. Thus, the study was evaluated the stability of aspirin in the aspirin (100 μg/mL) only and aspirin (100 μg/mL) + curcumin (600 μg /mL) admixture without any ingredient under two solvents (distilled water, DW and normal saline, NS), three storage temperature (25˚C, 4˚C and -20˚C) and periods (1, 3 and 7 days)

2. MATERIALS AND METHODS

2.1 Chemicals and reagents

Aspirin was purchased from Sigma-Aldrich Co. (St. Louis, MO, USA) and Curcumin was purchased from Now Foods (Bloomingdale, USA), respectively. Acetonitrile, formic acid and ethanol were all HPLC-grade and purchased from Sigma Co. (St. Louis, MO, USA) while other reagents and solvents used were analytical grade. All aqueous solutions including the buffer for the HPLC mobile phase was prepared with water that purified by Milli-Q water purification system (Millipore, Milford, MA, USA).

2.2 Sample preparation

Solutions of the designated samples (aspirin 2.5 mg, aspirin 2.5 mg and curcumin 15 mg) and diluents (to final volume of 25 mL with normal saline and distilled water) were prepared (Table 1). At the time of preparation of each test solutions, 1 mL of samples were collected at specified time intervals; 0, 1, 3 and 7 day, and added in 15 mL falcon tubes and stored in RT(25±2℃), CT(4±2℃), and FT (-20±2℃) at until analyzed. A 1.0 mL volume of each sample was withdrawn and reconstituted with 3.0 mL of ethanol and directly inject into HPLC system immediately after filtration at 1, 3 and 7 days for analysis.

Table 1. Study protocol

Compound (μg/mL)	Period(day)	Temperature(℃)	Diluent [a]
Aspirin (100) only	1, 3, 7	-20, 4, 25	DW, NS
Aspirin (100)+Curcumin (600) admixture	1, 3, 7	-20, 4, 25	DW, NS

[a] *DW = distill water, NS = 0.9% sodium chloride solution.*

2.3 HPLC method

The concentration of aspirin in the each sample solution was determined using a stability-indicating HPLC assay method based on several references [11, 12, 13, 14, 15, 16]. The chromatographic system used in the analysis consisted of an isocratic solvent delivery pump (Model 515 pump,Waters Scientific Co., USA), an autosampler(Model Nanospace SI-2 Autosampler, Shiseido Co., Japan) and analytical column Cadenza CD-C18 (250 x 4.6 mm, 3 µm) and guard column Unison US-C18, (5 x 2 mm, 5 µm) (Imtakt Corporation, Kyoto, Japan). A variable wavelength ultraviolet detector (Model 486 Tunable Absorbance Detector, Waters Scientific Co., USA) set at 220 nm and the integration of the chromatograms (Model dsCHROM® Data module, Do-Nam instrumental Co., Seoul, Korea) were used. The mobile phase consisted of 0.1% formic acid in distill water and acetonitrile (v/v, 55/45, pH 3.3). The flow rate of mobile phase was 0.8ml/min. The method was validated for linearity, precision (inter-day and intra-day), accuracy and selectivity [17]. The experiment was repeated five times on the same day and five consecutive days to determine inter- and intra-day precisions [18]. Linearity, accuracy and precision were evaluated by determining five concentrations of aspirin in range of 6.25~100 µg/mL. Linear regression analysis of peak area and concentration yielded a good correlation coefficient ≥0.999. Inter-and intra-day precision were expressed as the percent relative standard deviation (% RSD). The accuracy was expressed as the percent ratio between the experimental and nominal concentrations for each sample.

2.4 Standard solutions

A 1 mg/mL of stock solution of aspirin was prepared by dissolving in 75% ethanol. Standard samples of aspirin were prepared by diluting the stock solution with 75% Ethanol to concentrations of 6.25, 12.5, 25, 50 and 100 µg/mL. The standard samples were assayed to repeat five times on the same day as an external standard method.

2.5 Sample analysis

Each aspirin sample solution was prepared as described. A 5 µL of sample were injected into the HPLC system, and each sample was assayed in three times a day. Effects of admixture compounds, periods of storage and temperature of storage on the concentrations of active compound (aspirin) were analyzed. The samples were visually inspected for color change and precipitate formation was evaluated on each day of analysis.

2.6 Data analysis

The stability of aspirin in the aspirin only and aspirin+curcumin admixture solutions was determined by calculating the percentage of the initial aspirin concentrations remaining at each test condition and hours. Stability was defined as the retention of at least 90% of the initial aspirin concentration.

3. RESULTS AND DISCUSSION

The linearity could be established for aspirin in the concentration range of 6.25~100 µg/mL (r^2= 0.9998, Fig.1A). Table 2 lists the percent relative standard deviation (% RSD) data obtained on analysis of the samples (n=5) on the same day and on consecutive days (n=5). As evident, the %RSD values were <3.42% and <1.43%for inter-day and intra-day results, respectively. Accuracies were 96.6~102.2% and 98.6~100.9%for inter-day and intra-day, respectively, meaning that the method was sufficiently precise and accuracies.

Table 2. Validation data and retention time (RT) under conditions of HPLC Assays

Range (µg/mL)	Validation (n=5)	RT (min)

			Inter-day	Intra-day	Aspirin	Degradation Products
Aspirin	6.25-100[a]	Precision (% RSD)	0.06~3.42	0.04~1.43	4.6	5.3
		Accuracy (%)	96.6~102.2	98.9~100.9		

[a] *Samples were diluted with 75% ethanol*

The retention time of the intact aspirin and the degradation product were about 4.6 and 5.3 minutes (Fig.1B).The aspirin undergoes hydrolysis in solutions at room temperature with the resultant degradation products being salicylic acid and acetic acid [13].

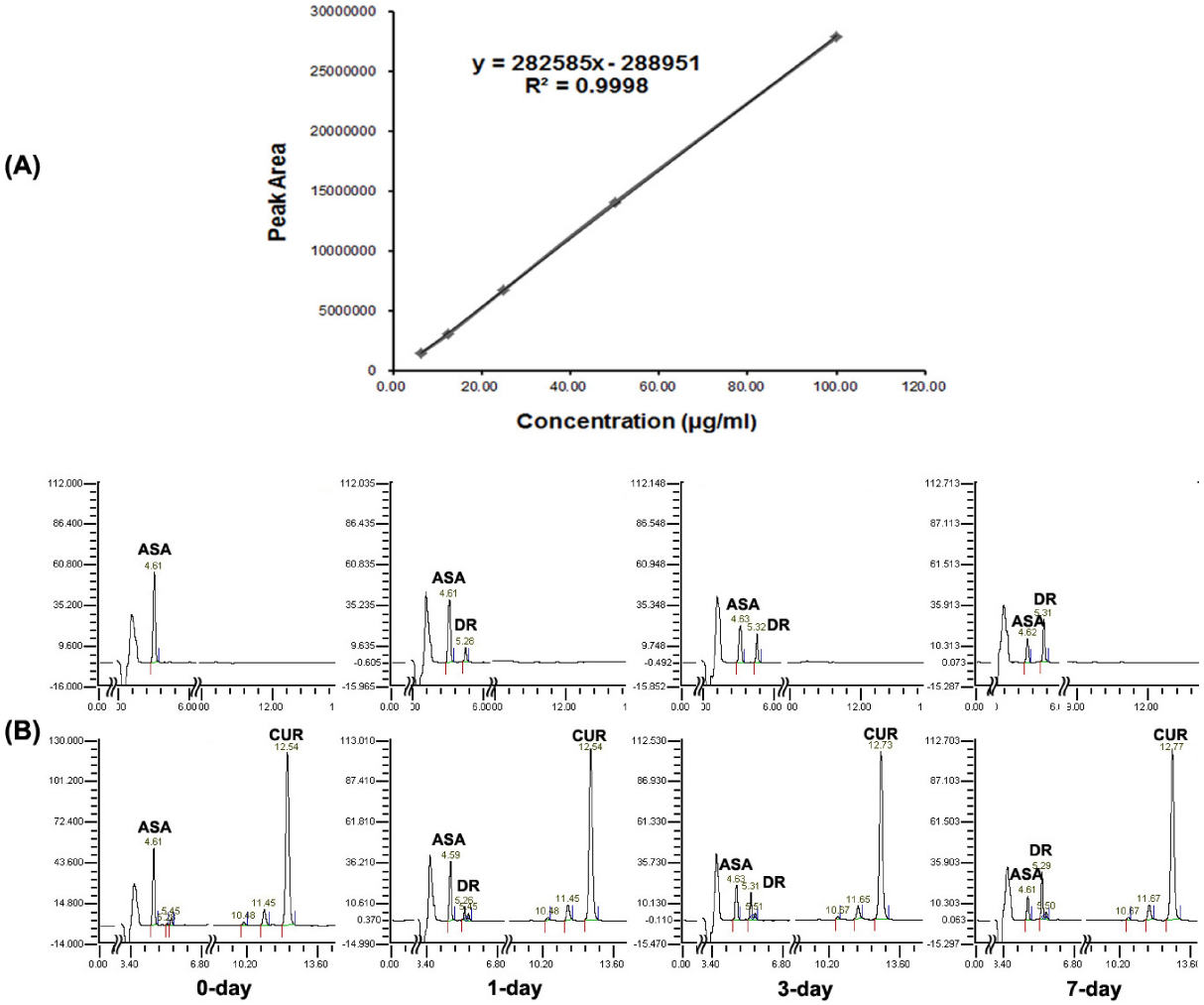

Fig. 1. (A) Calibration curve for the determination of aspirin concentrations (6.25~100 µg/mL). (B) Chromatogram of aspirin(25 µg/mL in DW) and asprin+curcumin admixture (25µg/mL+150µg/mL in DW) after 0, 1, 3 and 7 days of storage at 25℃.

ASA=aspirin, DR= degradation product and CUR= curcumin.

The initial concentration and the percentage of the remaining concentration which were observed at analytic time of each day during 7 days for each the designated samples (aspirin only and aspirin+curcumin admixture), solution (DW and NS) and storage conditions are listed in Table 3. The concentration of Aspirin decreased by a minimum of 22% of the initial concentration under RT (25 ± 2℃), 90% of the initial concentration under CT(4℃ ± 2℃) and 94% of the initial concentration under FT (-20℃ ± 2℃).

Table 3. Stability of aspirin in the aspirin only and aspirin+curcumin admixture solutions at 25, 4 and -20℃

Nominal concentration (μg/mL), Diluent [a]	Temperature (℃)	Actual concentration(μg/mL)[b]	Time (days)	% Concentration Remaining [b]
Aspirin, (25), DW	25	26.44±0.53	1	81.58±3.51
			3	56.49±1.66
			7	27.61±0.89
	4	26.84±0.97	1	90.77±3.17
			3	91.04±5.14
			7	93.94±0.19
	-20	31.01±1.45[c]	1	99.71±2.70[c]
			3	104.95±11.27[c]
			7	98.29±3.70[c]
Aspirin, (25), NS	25	21.11±0.76	1	88.71±10.04
			3	50.59±1.26
			7	22.84±0.84
	4	20.85±0.55	1	97.14±4.65
			3	93.79±2.61
			7	90.74±1.48
	-20	29.57±1.29[c]	1	94.68±0.60[c]
			3	94.64±3.08[c]
			7	94.97±1.15[c]
Aspirin + Curcumin, (25+150),DW	25	26.66±2.32	1	77.95±7.07
			3	56.54±7.03
			7	29.81±0.90
	4	23.41±1.21	1	100.83±10.38
			3	96.42±2.84
			7	96.09±6.45
	-20	30.80±4.07[c]	1	99.58±13.14[c]
			3	98.01±11.63[c]
			7	102.22±9.59[c]
Aspirin + Curcumin, (25+150),NS	25	23.19±5.16	1	87.01±11.58
			3	55.51±8.93
			7	26.46±3.33
	4	19.64±1.89	1	97.19±16.23
			3	93.68±11.60
			7	95.29±15.34
	-20	29.54±2.13[c]	1	107.62±9.34[c]
			3	96.07±8.91[c]
			7	98.98±6.50[c]

[a]DW = distill water, NS = 0.9% sodium chloride injection.

[b]Mean ± S.D.(n=7)

[c]Mean ± S.D.(n=8)

The results of this study indicate the chemical stability of aspirin solution. Therefore, the concentration of aspirin of the aspirin only and aspirin+curcumin admixture solutions remained at least 90% of

original without any color change or precipitation in the DW and NS solution at 4˚C and -20˚C throughout 7 day period and showed instability that decreased gradually below 90% of original concentrations after 1 day at 25˚C in the two solutions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHOR'S CONTRIBUTIONS

This work was carried out in collaboration between all authors. Authors JSK and HJK designed the study and wrote the protocol. Author JSK, HJK and MAK carried out the Aspirin stability testing, performed the statistical analysis and wrote the first draft of the manuscript. Authors YSP and SHK managed the literature searches and overall revision and submission. Authors read and approved the final manuscript.

CONSENT

Not applicable.

ETHICAL APPROVAL

Not applicable.

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