



Identification of Dexamethasone in Jamu Pegal Linu Distributed in Ciracas Market Using Thin Layer Chromatography (TLC) – Spectrophotodensitometry

Identifikasi Deksametason dalam Jamu Pegal Linu yang Diedarkan di Pasar Ciracas Menggunakan Kromatografi Lapis Tipis (KLT)– Spektrofotodensitometri

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Abstract

Jamu is a traditional medicinal product widely utilized for health maintenance, health promotion, and disease prevention. One notable example is jamu pegal linu, which demonstrates therapeutic efficacy in alleviating muscle and joint pain. However, the increasing prevalence of jamu consumption raises significant concerns regarding adulteration with chemical drug additives, including dexamethasone. The prolonged consumption of jamu adulterated with dexamethasone can result in severe adverse health effects, including gastric ulcers, hypersensitivity reactions, hypertension, diabetes mellitus, and hepatorenal damage, with potentially fatal outcomes. This study aims to identify the dexamethasone content in jamu pegal linu distributed in Pasar Ciracas, East Jakarta. A qualitative test was performed using Thin Layer Chromatography (TLC), with the results were evaluated by spot visualization and the comparison of Retention Factor (Rf) values. The TLC results of ten jamu pegal linu samples revealed that one sample (sample 3) exhibited a spot corresponding to the dexamethasone reference standard under UV 254 nm light. The Rf value of sample 3 (0.538) matched that of the dexamethasone standard. The test procedure proceeded with sample spot scanning, which revealed that only a single sample (sample 3) exhibited a chromatogram spectrum comparable to the dexamethasone standard, whereas the remaining samples displayed no such alignment. Identification via high performance liquid chromatography at a maximum wavelength of 254 nm revealed that the chromatographic profile of sample 3 matched that of the dexamethasone standard. This result confirms the presence of dexamethasone in sample 3. Consequently, it is concluded that one out of the ten samples tested contained dexamethasone.

Abstrak

Jamu merupakan produk obat tradisional yang banyak digunakan untuk pemeliharaan kesehatan, peningkatan kesehatan, dan pencegahan penyakit. Salah satu contoh yang umum adalah jamu pegal linu, yang memiliki khasiat terapeutik dalam meredakan nyeri otot dan sendi. Namun, meningkatnya konsumsi jamu menimbulkan kekhawatiran serius terkait adanya pemalsuan produk dengan penambahan bahan kimia obat, termasuk deksametason. Konsumsi jamu yang mengandung deksametason dalam jangka panjang dapat menyebabkan dampak kesehatan yang merugikan dan parah, seperti tukak lambung, reaksi hipersensitivitas, hipertensi, diabetes melitus, serta kerusakan hati dan ginjal, yang bahkan dapat berakibat fatal. Penelitian ini bertujuan untuk mengidentifikasi kandungan deksametason dalam jamu pegal linu yang beredar di Pasar Ciracas, Jakarta Timur. Uji kualitatif dilakukan menggunakan metode Kromatografi Lapis Tipis (KLT), dengan hasil yang dievaluasi melalui visualisasi bercak dan perbandingan nilai *Retention Factor* (Rf). Hasil KLT terhadap sepuluh sampel jamu pegal linu

menunjukkan bahwa satu sampel (sampel 3) memperlihatkan bercak yang sesuai dengan standar pembandingan deksametason di bawah sinar UV 254 nm. Nilai Rf sampel 3 (0,538) sama dengan nilai Rf standar deksametason. Prosedur pengujian dilanjutkan dengan pemindaian bercak sampel, yang menunjukkan bahwa hanya satu sampel (sampel 3) yang memiliki spektrum kromatogram serupa dengan standar deksametason, sedangkan sampel lainnya tidak menunjukkan kesesuaian tersebut. Identifikasi menggunakan *High Performance Liquid Chromatography* (HPLC) pada panjang gelombang maksimum 254 nm menunjukkan bahwa profil kromatografi sampel 3 sesuai dengan standar deksametason. Hasil ini mengonfirmasi keberadaan deksametason dalam sampel 3. Dengan demikian, disimpulkan bahwa satu dari sepuluh sampel yang diuji mengandung deksametason.

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INTRODUCTION

Traditional medicine refers to substances or concoctions derived from plants, animals, minerals, or a combination thereof, which have been used empirically for generations. To guarantee efficacy and safety, the National Agency of Drug and Food Control (BPOM) categorizes traditional medicines into three levels: Jamu (herbal medicine), Standardized Herbal Medicine (OHT), and Phytopharmaca⁷.

Despite these regulations, the safety of traditional medicines remains a critical concern. To provide rapid therapeutic effects, some packaged Jamu products are illegally mixed with chemical drug additives. While traditional herbal preparations typically exhibit a gradual therapeutic response compared to fast-acting synthetic alternatives, market competition has driven this dangerous practice. To protect the public, BPOM strictly prohibits adding chemical drug additives to traditional medicines. This illegal practice is hazardous because it occurs without controlled dosage measurements. The resulting adverse health effects include stomach ulcers, allergic reactions, hypertension, diabetes, liver and kidney damage, and even death.

According to BPOM Press Release Number HM.01.1.2.12.23.50, monitoring results from September 2022 to October 2023 identified 50 traditional medicine products containing chemical drug additives distributed across Indonesia³. Notably, dexamethasone is one of the chemical drug additive substances most frequently misused in muscle ache remedies (jamu pegal linu). Dexamethasone is a synthetic corticosteroid drug with primary glucocorticoid activity. According to the National Information Center for Drug and Food (PIONAS), it is primarily indicated to treat inflammation, allergic disorders, congenital adrenal hyperplasia, cerebral edema, and rheumatic or ocular diseases. However, its use without proper medical supervision carries a high risk of serious adverse effects, including gastric ulcers, hypersensitivity reactions, hypertension, diabetes mellitus, and hepatorenal damage, with potentially fatal outcomes⁹.

The illicit addition of chemical drug additives to traditional herbal medicine has been documented in previous studies. Research by Purwanitingsih at Cisalak Market in Depok revealed that two out of six samples of jamu pegal linu tested positive for dexamethasone¹⁷. Similarly, Ryansyah detected dexamethasone in all four samples of jamu pegal linu distributed in e-commerce marketplaces²¹. Based on evidence from various regions, this study aims to identify the presence of chemical drug additives in jamu pegal linu distributed in Ciracas Market, helping protect consumers from the risks and harmful side effects associated with dexamethasone.

METHODS

This was a descriptive laboratory study designed to identify and quantify dexamethasone content in jamu pegal linu distributed in Ciracas Market, East Jakarta. Based on reports regarding traditional medicines and health supplements containing illegal chemical drug additives (BKO), 97 brands are suspected of containing dexamethasone². To address the limitations of localized sampling and potential selection bias from a single marketplace, the scope of this study is explicitly framed as an initial exploratory surveillance of high-risk outlets. A purposive sampling method was utilized based on strict criteria: powder or capsule formulations, single-serving packaging, and direct seller recommendations. While the sample size was limited to ten representative products from Ciracas Market as a localized index, this targeted approach captures formulations most frequently associated with illegal dexamethasone adulteration. For laboratory analysis, the study performed a preliminary screening using Thin Layer Chromatography (TLC), followed by confirmatory identification and semi-quantitative/ quantitative evaluation via spectrophotodensitometry. To ensure methodological rigor, analytical validation parameters for the spectrophotodensitometric procedure—including specificity, linearity, limit of detection (LOD), and limit of quantification (LOQ) were established.

Tools and Materials

The tools and materials used in this study were as follows. Tools: aluminum foil, stirring rod, chromatographic chamber, evaporating dish, glass funnel, measuring cylinders (5, 10, and 100 mL), filter paper, silica gel 60 GF 254 TLC plates (20 x 10 cm), Erlenmeyer flask (100 mL), volumetric flasks (25 and 100 mL), Memmert oven, water bath, capillary pipette, pasteur pipette, metal spatula, CAMAG TLC scanner 3 for spectrophotodensitometry, and Mettler Toledo analytical balance. Materials: purified water, acetone, dexamethasone reference standard (purity 1, Indonesian Pharmacopoeia Reference Standard issued by BPOM), diethyl ether, dichloroethane, 96% ethanol, chloroform, methanol (pro-analysis grade), and ten of jamu pegal linu samples.

Research Procedure

1. Qualitative Test using Thin Layer Chromatography (TLC) Method

a. Preparation of the Test Solution

Approximately 500 mg of the jamu pegal linu sample was weighed and transferred into an Erlenmeyer flask. Add 25 mL of 96% ethanol was added, the mixture was shaken for 30 minutes until homogeneous, and it was filtered. The preparation of the test solution was repeated for ten samples.

b. Preparation of the Dexamethasone Standard Solution

Dexamethasone standard solution 0.1%w/v was prepared in methanol (purity 1, Indonesian Pharmacopoeia Reference Standard issued by BPOM). Approximately 100 mg of the dexamethasone reference standard was weighed, transferred into a volumetric flask, dissolve with methanol up to the 100 mL mark, and homogenized.

c. Preparation of the Mobile Phase (Eluent)

The mobile phase mixture used in this study is prepared using a Chloroform : Acetone ratio of 4 : 1.

d. Preparation of the Stationary Phase

The TLC plate (20 x 10 cm) was activated by heating it in an oven for 30 minutes at 110°C. The plate was marked with a pencil at a distance of 1 cm from both the top and bottom edges. The spotting scale for the test solution was set at 1.5 cm intervals.

e. Identification using Thin Layer Chromatography (TLC)

Each solution was spotted separately, and the TLC procedure was performed under the following conditions using stationary phase (silica gel 60 GF 254), mobile phase (Chloroform : Acetone ratio of 4 : 1), chamber the sample was saturated for 20 minutes using filter paper, development distance at 10 cm, spotting volume 5 µL, spot visualization (UV light at 254 nm). The sample labels STD1, STD2, and STD3 represent the dexamethasone standards, while S1 through S10 represent the jamu pegal linu samples.

The Retention Factor (Rf) was calculated using the following formula:

$$Rf = \frac{\text{distance traveled by the compound from the spotting origin to the center of the spot}}{\text{distance traveled by the mobile phase from the spotting origin to the solvent front}}$$

2. Spectrophotodensitometry Method

Following the TLC identification, sample spots that aligned with and exhibited the same Rf value as the reference standard were presumed to contain dexamethasone. Confirmatory testing was then conducted by scanning the spots to obtain chromatogram spectra using a spectrophotodensitometer at a wavelength of 254 nm and a scanning speed of 20 mm/s to obtain their chromatogram spectra.

Data Identification Criteria

A positive result is defined by a Thin Layer Chromatography (TLC) test showing spots that align with the reference standard (indicating suspected dexamethasone), and a confirmatory spectrophotodensitometry test showing an matching spectrum to the standard.

RESULT AND DISCUSSION

1. Qualitative Analysis of Dexamethasone

The Thin Layer Chromatography (TLC) analysis of the sample against a dexamethasone standard was conducted using a silica gel 60 GF 254 stationary phase and a mixture of Chloroform : Acetone (4:1) as the mobile phase.

The formula for calculating the Rf value is as follows:

$$Rf = \frac{\text{distance traveled by the compound from the spotting origin to the center of the spot}}{\text{distance traveled by the mobile phase from the spotting origin to the solvent front}}$$

Table 1. Rf Values of Dexamethasone Standard and Jamu Pegal Linu Samples

No.	Sample	Distance of the spot (cm)	Distance of the solvent front (cm)	Rf value
1	STD1	3.500	6.500	0.538
2	S1	-	-	-
3	S2	-	-	-
4	S3	3.500	6.500	0.538
5	STD2	3.500	6.500	0.538
6	S4	-	-	-
7	S5	-	-	-
8	S6	-	-	-
9	S7	-	-	-
10	S8	-	-	-
11	S9	-	-	-
12	S10	-	-	-
13	STD3	3.500	6.500	0.538

Information:

STD1, STD2, STD3 : dexamethasone standard

S1, S2, S3, S4, S5, S6, S7, S8, S9, S10 : jamu pegal linu samples

Based on the results presented in the table above, Sample 3 was presumptively positive because its R_f matched the dexamethasone standard under the specified chromatographic conditions. This is supported by the test results, which indicate that the sample has the same R_f value (0.538) as the dexamethasone standard.

TLC Chromatogram Visualized under UV Light at 254 nm
(Stationary Phase Silica Gel 60 GF 254; Mobile Phase Chloroform : Acetone (4:1))

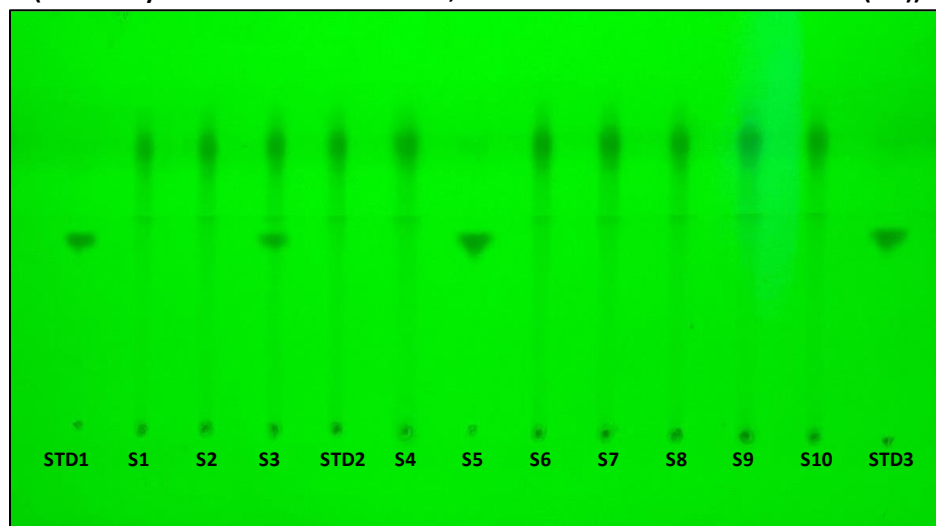


Figure 1. TLC Chromatogram Visualized under UV Light at 254 nm
(Stationary Phase Silica Gel 60 GF 254; Mobile Phase Chloroform : Acetone (4:1))

Information:

STD1, STD2, STD3 : dexamethasone standard
S1, S2, S3, S4, S5, S6, S7, S8, S9, S10 : jamu pegal linu samples

Furthermore, as shown in the TLC plate image, UV light visualization at 254 nm demonstrated that Sample 3 exhibited a matching R_f and spot position to those of the dexamethasone standard. This finding was further confirmed by spectrophotodensitometry evidence. Therefore, Sample 3 is concluded to be positive for dexamethasone.

This finding aligns with a study by Purwanitningsih & Ryansyah on monitoring adulterated products, which frequently detected dexamethasone as a hidden ingredient due to its potent anti-inflammatory effects^{17,21}. From a regulatory perspective, the presence of dexamethasone in this sample constitutes a severe violation, as BPOM strictly mandate a zero-tolerance policy for prescription-only synthetic corticosteroids in over-the-counter commercial products.

2. Spectrophotodensitometry as a Confirmation Test of Dexamethasone

Following the separation by TLC, the process was continued with spot scanning to determine the chromatogram profile of each spot that was aligned or had a similar R_f value to the dexamethasone standard.

Spectrophotodensitometry profiles of separated chromatographic spots
The scanning profiles display spots with R_f values corresponding or close to the reference standard

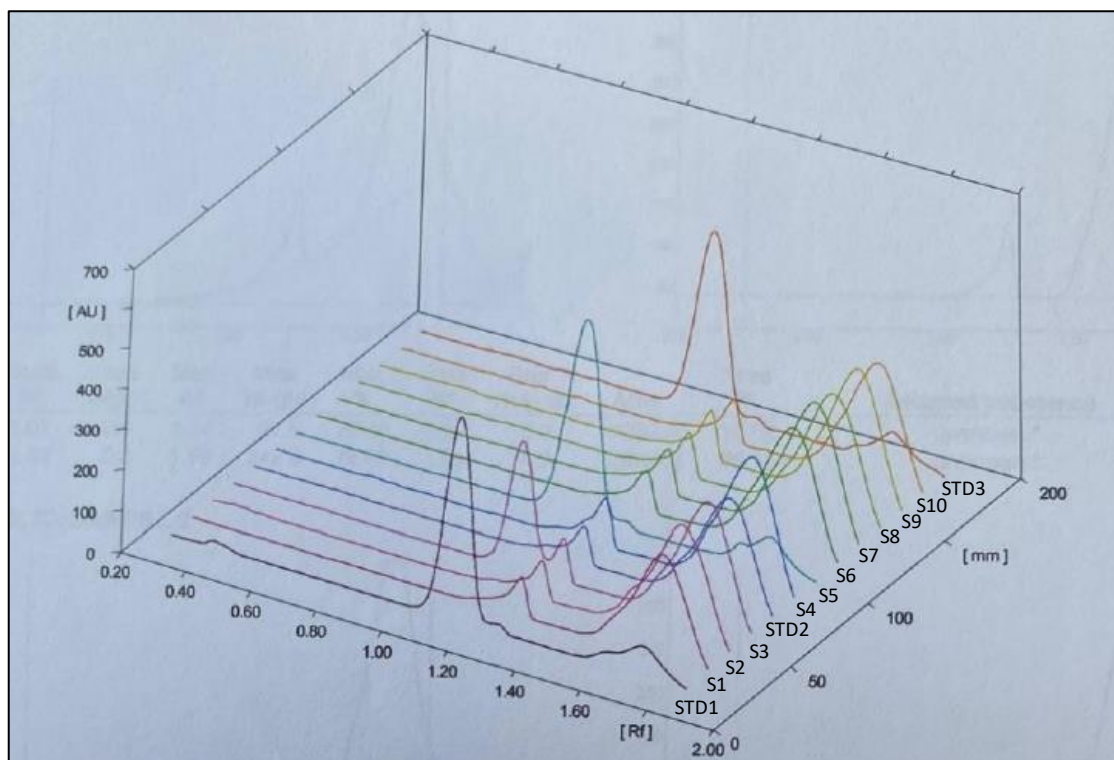


Figure 2. Spectrophotodensitometry profiles of separated chromatographic spots. The scanning profiles display spots with Rf values corresponding or close to the reference standard.

Information:

STD1, STD2, STD3 : dexamethasone standard

S1, S2, S3, S4, S5, S6, S7, S8, S9, S10 : jamu pegal linu samples

Based on the scanning results of all sample spots, Sample 3 showed a peak λ_{max} and spectral overlay consistent with the dexamethasone standard within the allowed Rf tolerance, while the other samples did not meet these identification criteria.

UV spectral overlay of all sample spots and the dexamethasone standard

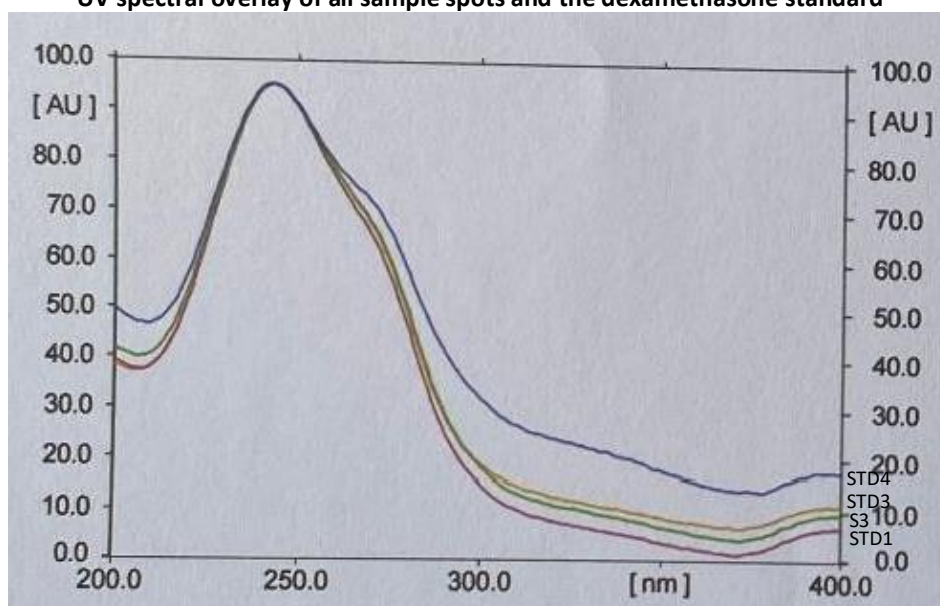


Figure 3. UV spectral overlay of all sample spots and the dexamethasone standard

Information:

STD1, STD2, STD3 : dexamethasone standard
 S3 : jamu pegal linu samples

Furthermore, visual inspection under UV light at 254 nm confirmed that the spot migration and appearance of Sample 3 matched the dexamethasone standard. This indicated that Sample 3 showed a profile consistent with dexamethasone. Thus, it can be concluded that one out of the ten samples studied (10%) was detected to contain dexamethasone under the applied analytical conditions.

The detection of dexamethasone in 10% of the surveyed samples poses significant risks regarding potential consumer exposure levels. Because consumers often take these products daily without professional medical supervision, they are vulnerable to uncontrolled chronic exposure. Such unregulated intake can lead to severe health risks, including adrenal suppression, metabolic disturbances (like Cushing's syndrome), osteoporosis, and compromised immune responses. Compared to similar surveillance studies conducted in neighboring regions where adulteration rates often fluctuate between 5% and 15%, this 10% positivity rate highlights a persistent public health challenge and underscores the urgent need for stricter market enforcement and routine post-market screening.

Limitation

This study has several limitations. First, the sample size was limited to ten samples collected exclusively from a single location, Ciracas Market, which may not represent the broader market of jamu pegal linu products, thereby limiting the generalizability of the findings regarding consumer exposure levels. Second, the analytical methods focused solely on the detection and identification of dexamethasone; consequently, other potential chemical drug additives commonly added to traditional medicines were not investigated. Lastly, this study was qualitative in nature, utilizing Thin Layer Chromatography (TLC) and spectrophotodensitometry for confirmation. While a qualitative positive result is sufficient to confirm a violation of the zero-tolerance policy for synthetic drugs set by the National Agency of Drug and Food Control (BPOM), the lack of quantification prevents an exact calculation of the adulterant's concentration. Consequently, this introduces methodological uncertainties regarding the precise magnitude of consumer exposure and limits the ability to assess the specific severity of acute or chronic health risks associated with the contaminated samples.

CONCLUSION

Of the ten jamu pegal linu samples distributed at Ciracas Market, one sample (Sample 3) tested positive for dexamethasone based on Thin Layer Chromatography (TLC) screening and spectrophotodensitometry confirmation.

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AUTHOR CONTRIBUTION STATEMENT

WKS: Writing – reviewing & editing, PI: Writing – reviewing & editing, DA: Writing – original draft.

CONFLICT OF INTEREST DECLARATION

The authors declare no conflict of interest.

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