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ANALYSIS OF DANGEROUS DRUG CHEMICALS (BKO) CONTENT IN JAMU USING KCKT: A REVIEW STUDY IN VARIOUS AREAS OF INDONESIA

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Abstract

The rampant abuse of illegal medicinal chemicals (BKOs) in Indonesian traditional herbal medicine has raised serious concerns, with a recent study using HPLC/HPLC analysis on ten studies revealing the content of hazardous substances such as diclofenac sodium (reaching 297,123 mg/L), dexamethasone (exceeding the safe limit), as well as antalgin and sibutramin HCl in several products in circulation. These findings emphasize the need for strict measures, ranging from strict supervision, public education, to legal action, to protect consumers while ensuring herbal medicine remains a safe and sustainable traditional medicine option for future generations.

Keywords: ***BKO, HPLC, Herbal Medicine***

INTRODUCTION

Based on historical records in traditional manuscripts such as the Serat Centhini and the Balinese Lontar Usada, jamu has been an integral part of Indonesia's traditional medicine system since the kingdom era. As a valuable cultural heritage, jamu is formulated from various natural components including plant parts such as rhizomes, leaves, fruits, and tree bark. These traditional concoctions have been passed down through generations and believed to have therapeutic benefits for maintaining health, treating diseases, and increasing vitality. Regulatoryly, the Indonesian Food and Drug Authority (BPOM) defines jamu as a traditional Indonesian medicinal preparation that must meet safety, efficacy, and quality standards in accordance with Good Traditional Medicine Manufacturing Practices (CPOTB). However, the phenomenon of misuse of Chemical Drugs (BKO) in jamu products has shown an alarming increase, caused by both deliberate adulteration practices to accelerate pharmacological effects and accidental contamination during the manufacturing process.(Mega Kusuma et al., 2020). Chemical Medicinal Substances (BKO) are key components in pharmaceutical products that function to diagnose, treat, prevent, or restore health. These compounds can be derived from natural sources, such as plants or microbes, or synthesized in laboratories. They work in the body in various ways, such as blocking certain enzymes, binding to cell receptors, or modifying biological processes. For example, paracetamol works as an analgesic and antipyretic by inhibiting the cyclooxygenase enzyme in the brain.

To ensure their safety and efficacy, these substances must meet strict standards for purity, toxicity, and effectiveness. In drug formulations, excipients such as fillers, binders, or solvents are often added to enhance absorption and maintain the stability of the drug preparation. To create safe and efficacious drugs for patients, a thorough understanding of the chemical properties, pharmacokinetic processes, and pharmacodynamic mechanisms of a compound is crucial.(J Canney, 2017). Chemical Drugs (BKO) are active components in pharmaceutical preparations that function as therapy. However, their misuse in traditional products such as unregistered herbal medicines (jamu) has the potential to pose health risks. Ideally, traditional medicines in Indonesia use only natural ingredients such as herbal extracts, but illegal practices such as the addition of dangerous BKOs such as paracetamol, phenylbutazone, dexamethasone, or sildenafil are often carried out to achieve immediate effects. Consuming BKOs without medical supervision can trigger adverse effects, such as hepatotoxicity, kidney disorders, addiction, or hypersensitivity reactions. Therefore, accurate and sensitive analytical methods, such as High-Performance Liquid Chromatography (HPLC), are needed to detect BKO contamination in herbal medicines.(Rahmadani et al., 2023).

High-Performance Liquid Chromatography (HPLC) is a highly effective analytical technique for the separation, identification, and quantification of compounds in complex mixtures. Its working principle is based on the interaction between a liquid mobile phase and a stationary phase in a column. This method is widely used because it has superior sensitivity and selectivity, even capable of detecting compounds at minimal levels. In the HPLC process, the sample is injected into the column at high pressure, then its components will separate based on different retention times, depending on the degree of their interaction with the stationary phase. For OLC analysis, UV-Vis detectors or PDA (Photodiode Array) are commonly used because many pharmaceutical compounds contain chromophore groups that can absorb UV radiation or visible light.(Li et al., 2020). Various scientific studies in Indonesia have proven that High-Performance Liquid Chromatography (HPLC) techniques are highly effective in identifying risky Chemical Drugs (BKO) such as methamphetamine, sibutramine, and dexamethasone in illegal herbal products. These compounds are often found in herbal slimming, pain-relieving, and stamina-boosting medicines. Academic research and findings from the Indonesian Food and Drug Authority (BPOM) reveal that BKO abuse remains rampant, particularly in unregistered products circulating in traditional markets. Validation of the HPLC method is carried out using analytical parameters including linearity, accuracy, precision, LOD (limit of detection), and LOQ (limit of quantification) to ensure the reliability of the results. The crucial role of HPLC lies not only in monitoring the safety of herbal medicines, but also in supporting regulatory enforcement and oversight by health authorities.(Bayes et al., 2022).

METHOD

Data and information were obtained through this literature review. Various written materials, including books, journals, articles, and other documents available in the library, were used as sources. Some of the keywords searched included the BKO method, Jamu, and KCKT. To facilitate understanding, the data was then summarized, systematically organized, and presented in tabular form. After the introduction is completed, the author will write the results and discussion. The discussion includes an in-depth analysis of the research findings. Next, the title, abstract, and conclusion will be compiled in accordance with applicable writing guidelines.

RESULTS AND DISCUSSION

This study uses 10 journals by comparing each journal with other journals.

Table 1.Results of a Review of 10 Journals Analyzing BKO on Herbal Medicine Using KCKT

No	Researcher Name	Title & Year	Research methods	Results	Conclusion
1.	(Setyowati et al., 2022)	Analysis of the Chemical Content of Sodium Diclofenac in Herbal Medicines for Aches and Pains Circulating in Pekalongan Regency Using the High Performance Liquid Chromatography (KCKT) Method in 2022	Qualitative	The test results showed that samples B, D, E, F, and K had an Rf value of 0.65 cm, while sample G recorded a slightly higher Rf value of 0.68 cm. Further analysis using the High Performance Liquid Chromatography (HPLC) technique revealed the diclofenac sodium content in each 7 gram package as follows: sample B (3 mg), D (0.69 mg), E (2.11 mg), F (1.18 mg), G (1.55 mg), and K (3.20 mg).	Here is a paraphrase of the paragraph: Research revealed that of the 14 samples of herbal medicine for aches and pains found in Pekalongan Regency, 6 samples were found to contain sodium diclofenac.
2.	(Maryam and Suhaenah, 2023)	Chemical Analysis of Sodium Drug Ingredients in Gout Herbal Preparations	Qualitative	The analysis of nine gout herbal medicine samples revealed that all samples contained diclofenac sodium, with retention times that were in	Laboratory test results showed that all herbal products analyzed contained sodium diclofenac as a chemical drug, so they

		Circulating in Timika City, 2023		accordance with the standards for this compound. The identified diclofenac sodium levels varied in each sample, namely: sample A (4.135 mg/L), B (36.300 mg/L), C (18.530 mg/L), E (40.991 mg/L), F (77.165 mg/L), G (93.109 mg/L), H (52.700 mg/L), and I (297.123 mg/L).	did not meet the safety criteria for consumption by the public.
3.	(Nugraha et al., 2024)	Analysis of Paracetamol Chemical Ingredients in Traditional Herbal Medicine Preparations Brand X Produced in Surakarta Using the HPLC Method, 2024	Quantitative	The research results confirmed the presence of paracetamol in traditional herbal medicines sold in Surakarta. This confirmation was based on the conformity of the sample retention times with the paracetamol standard. Data showed sample retention times in the first replication were 2.640–3.464 minutes, in the second replication 0.421–3.381 minutes, and in the third replication 2.372–3.439 minutes, while the standard paracetamol retention time was in the range of 3.296–3.348 minutes.	Research using the HPLC method successfully detected the presence of paracetamol compounds in traditional herbal medicine products brand X circulating in the Surakarta area.
4.	(Arifah, Permatasari and Artini, 2023)	The Use of the HPCL Method in the Analysis of Depot Herbal Medicine Containing Antalgin, 2023	Quantitative	Analysis of the herbal medicine samples for aches and pains identified antalgin content of 14.87% in sample C, a finding that should not have occurred considering that regulations prohibit the use of Chemical Drugs (BKO) in herbal medicine products.	Based on the research results, it was found that the herbal product contained 14.87% antalgin, which is a violation of the provisions of Article 196 of Law Number 36 of 2009.
5.	(Budiarti et al., 2018)	Chemical Analysis of Dexamethasone in Herbal Medicine for Aches and Pains Using High-Performance Liquid Chromatography,	Quantitative	Based on tabulated data, the dexamethasone content in traditional medicine for aches and pains showed an average value of 100.19% with a coefficient of variation (RSD) of 0.25%, indicating that the analytical technique applied had met the	Content analysis shows that the herbal medicine for aches and pains contains dexamethasone with an average concentration of 100.18%.

		2018		validity criteria for determining the levels of the compound.	
6.	(Husna, Rahmadani and Byna, 2021)	Analysis Of Sodium Diclofenac In Herbal Medicine For Pain In The City Of Banjarbaru Using High Performance Liquid Chromatography (HPLC), 2021	Qualitative and Quantitative	The study showed that of the six samples analyzed, sample 2 recorded the largest diclofenac sodium area, namely 560,823, with a concentration of 5.448 mg/g. Sample 3 had a similar area value, namely 560,823. On the other hand, sample 4 had an area of 214,770 and a diclofenac sodium content of 2.086 mg/g. Meanwhile, sample 1 recorded an area of 160,327 with a diclofenac sodium content of 1.558 mg/g.	Three of the six samples of pain-relieving herbal medicine in Banjarbaru were detected to contain sodium diclofenac, namely sample 1 (1.558 mg/g), sample 2 (5.448 mg/g), and sample 3 (2.086 mg/g).
7.	(Anugrah, Dewi and Subekti, 2016)	Analysis of Phenolphthalein Content in Slimming Herbal Medicine, 2016	Qualitative and Quantitative	Based on an inspection of the BPOM's official website, of the ten samples studied, only sample E was registered as having a distribution permit. Laboratory test results, including color reactions, HPLC chromatography analysis, and UV-Vis spectrophotometry, confirmed the presence of phenolphthalein in sample F at a concentration of 47.133 ± 0.0058%.	Long-term consumption of phenolphthalein can increase the risk of developing cancer and potentially cause genetic mutations in DNA.
8.	(Vera Nanda, Yopi and Pratiwi, 2021)	Validation and Determination of Curcumin Levels in Jamu Gendong Kunyit Asam Using High-Performance Liquid Chromatography Method, 2021	Qualitative and Quantitative	Analysis showed that sample C had the highest curcumin content (58.0346 µg/mL), while sample A had the lowest (18.5766 µg/mL). In 100 mL, the contents were 1.85766 mg, 1.88188 mg, and 5.80346 mg, respectively.	The analysis concluded that the curcumin levels in samples A, B, and C varied between 0.0186 and 0.0580 mg/mL. This means that each 100 mL serving contains approximately 1.86 mg to 5.80 mg of curcumin.
9.	(Anuillah, Suarantika and Fakih, 2024)	Identification of Allopurinol and Dexamethasone Chemical Drugs in Gout Herbal Medicine at Tanjungsari Market Using	Qualitative and Quantitative	Analysis showed that herbal medicine B contained 103.571% dexamethasone and 0.025% allopurinol. Meanwhile, herbal medicine C contained a higher dexamethasone	This study concluded that of the four gout herbal medicine samples taken from Tanjungsari Market, Sumedang, West Java, only two samples (B and C) were detected to contain the chemical

		Thin Layer Chromatography (TLC) and High Performance Liquid Chromatography (HPLC) Methods, 2024		content of 127.442%, but its allopurinol content showed a negative value of -0.004%.	drugs allopurinol and dexamethasone.
10.	(Triyasmono, Safitri and Ni'mah, 2015)	Validation of the Method and Analysis of Determining Sibutramine HCl Levels in Slimming Herbal Medicine with Reverse Phase HPLC, 2015	Quantitative	The analysis revealed that brand A herbal medicine capsules contained 15.39 mg of sibutramine HCl per unit, while brand B contained 12.83 mg per capsule. These results indicate a violation of traditional medicine regulations under Indonesian Minister of Health Regulation No. 007 of 2012.	Laboratory examination of two brands of slimming herbal medicine revealed sibutramine HCl content of 15.39 mg/capsule in product A and 12.83 mg/capsule in product B.

This study presents a systematic review of ten studies examining the content of hazardous Chemical Pharmaceutical Substances (OCS) in herbal medicines (jamu) in various regions in Indonesia using High-Performance Liquid Chromatography (HPLC). The results indicate that the addition of OCS to herbal medicines is no longer random, but has become a worrying and widespread pattern in several regions, including Pekalongan, Timika, Surakarta, Banjarbaru, and Sumedang. The types of OCS frequently detected include diclofenac sodium, paracetamol, antalgin (metampyrone), dexamethasone, phenolphthalein, allopurinol, and sibutramine HCl. The illegal use of these chemicals in herbal medicines clearly violates regulations and has the potential to endanger public health. Diclofenac sodium, a non-steroidal anti-inflammatory drug, is the most commonly found OCD in herbal medicine. Research by Setyowati et al. (2022) and Maryam & Suhaenah (2023) revealed that nearly all herbal medicine samples for aches and pains and gout contained this compound at varying levels. One sample from Timika even showed a content of 297.123 mg/L, far exceeding the safe limit. Furthermore, paracetamol was also detected in traditional herbal medicine brand X in Surakarta, with a retention time that met the standard, indicating the presence of illegal additives to enhance the pain-relieving effect.

Several studies have also found antalgin (metampyrone) in depot herbal medicine at very high levels, reaching 14.87%. This is very dangerous because antalgin can cause serious side effects such as agranulocytosis if used without medical supervision. Furthermore, dexamethasone, a potent corticosteroid, was detected at very high levels (127.442%) in several herbal medicine samples. This compound is often abused for its immediate effects such as increased stamina and pain relief, but long-term use can trigger hormonal disorders, decreased immunity, and even Cushing's syndrome. Two other studies revealed the presence of phenolphthalein and sibutramine HCl in herbal slimming medicines. Phenolphthalein, previously used as a laxative, has been banned due to its potential carcinogenicity and the potential for causing genetic mutations. Meanwhile, sibutramine HCl, an appetite suppressant with a risk of cardiovascular problems, was found at concentrations of 12.83 to 15.39 mg per capsule. These findings indicate that herbal slimming medicines are among the most vulnerable to abuse due to their frequent promises of instant results to consumers. All reviewed studies used the HPLC method, which has proven accurate and sensitive in detecting BKO even at low concentrations. Several studies also validated the method through linearity, accuracy, precision, LOD, and LOQ parameters, ensuring scientifically reliable results. This method is crucial for authorities such as the BPOM (Indonesian Food and Drug Authority) in identifying and prosecuting the distribution of illegal herbal medicines. Overall, this review confirms that many herbal medicines on the market still contain dangerous BKO. These findings serve as a warning to the government, manufacturers, and the public to increase monitoring, education, and law enforcement against illegal products. Without serious action, the practice of mixing BKO in herbal medicines will continue and has the potential to cause serious public health problems in the future.

CONCLUSION

A recent study analyzing 10 studies on herbal medicine (jamu) in Indonesia revealed alarming facts: many products were found to be mixed with illegal chemical drugs (BKO) such as sodium diclofenac, antalgin, and dexamethasone at dangerous levels—some even reaching 297.123 mg/L for sodium diclofenac and 14.87% for antalgin. Consumption of these substances can trigger hormonal disorders, organ damage, and even cancer, while people believe they are consuming safe, natural herbal medicine. This situation requires immediate action through strict supervision using modern methods such as HPLC, comprehensive public education, and strict law enforcement against perpetrators, so that traditional herbal medicine can continue to be relied upon as a safe medicinal heritage for future generations.

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