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Review Article

A Scoping Review: Pharmacology study of *Kalanchoe pinnata*

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ABSTRACT

Kalanchoe pinnata (cocor bebek) is a medicinal plant known for its rich content of bioactive compounds, including flavonoids and saponins, which contribute to diverse pharmacological properties. This study aimed to systematically map and analyze the pharmacological activities of K. pinnata through a scoping review following the PRISMA framework, providing an evidence-based synthesis for future research and therapeutic development. Literature searches were conducted in Google Scholar for articles published between 2013 and 2024, applying predefined inclusion criteria. Twenty-five studies were identified, with most focusing on leaf extracts obtained predominantly through maceration. Ethanol emerged as the most frequently used extraction solvent, followed by aqueous and methanolic preparations. The results showed that antioxidant activity was the most reported effect (44%), followed by antibacterial (40%), antidiabetic (16%), anti-inflammatory (16%), and anticancer (16%) activities. Antioxidant and antibacterial effects were strongly associated with polar solvent extractions, likely due to high phenolic and flavonoid concentrations. Evidence for antidiabetic, anti-inflammatory, and anticancer properties, while promising, was supported by fewer studies and remains largely preclinical. These findings suggest that K. pinnata possesses considerable potential for herbal-based therapeutic product development, particularly in topical formulations targeting skin health, where its antioxidant and antibacterial properties could be synergistically applied. However, the review also highlights critical research gaps, including the need for standardized extraction protocols, exploration of non-leaf plant parts, dose–response studies, and clinical trials. Addressing these gaps will be essential to advance K. pinnata from traditional medicine into validated, evidence-based therapeutic applications.

Keywords:
Kalanchoe pinnata, Pharmacology, Bioactive compounds, Phytochemistry

INTRODUCTION

Kalanchoe pinnata (L.) Pers. or locally known as *cocor bebek*, is a medicinal plant found in tropical and subtropical regions, including Indonesia. This plant has long been used in traditional medicine to treat various health complaints, ranging from respiratory disorders, wounds, to digestive disorders. Traditionally, the leaves of *Kalanchoe pinnata* are used as an external medicine to accelerate wound healing and treat skin infections (Singh et al., 2022). However, despite its wide use in traditional medicine, more in-depth scientific research on the active components and pharmacological potential of this plant is still limited. With the development of phytochemical research, it is now known that this plant contains various bioactive compounds, such as flavonoids, saponins, tannins, and alkaloids, which have various therapeutic potentials (Liu et al., 2023).

Some of the active compounds in *Kalanchoe pinnata* have been shown to have anti-inflammatory, antimicrobial, and antioxidant activities, which make it attractive for further research in the field of medicine. Saponins, for example, are known to have antibacterial and antifungal effects, and function in accelerating the wound healing process (Patel & Patel, 2020). Flavonoids contained in *Kalanchoe pinnata* also play an important role in reducing inflammation and promoting tissue health, while alkaloids show potential as anticancer and analgesic agents (Sharma et al., 2021). However, despite promising preliminary evidence, there are still many aspects of the medical potential of this plant that need to be further explored, particularly for systemic treatment applications and the development of *Kalanchoe pinnata*-based pharmaceutical preparations.

Recent research has also shown that *Kalanchoe pinnata* extracts have the potential to be used in the treatment of inflammatory disorders and oxidative stress-related diseases. Some studies suggest that this plant can reduce inflammation in conditions such as arthritis and respiratory disorders (Liu et al., 2023). Its strong antioxidant activity also supports claims of its traditional use to fight free radical damage. Nonetheless, most of the existing studies are still limited to in vitro tests and animal experiments, so there is not enough scientific evidence to support the widespread use of *Kalanchoe pinnata* in clinical practice.

Given the great potential of *Kalanchoe pinnata*, it is important to conduct further research to explore its active compound content and evaluate its clinical effectiveness. Further research may open up opportunities for the development of herbal products or therapies based on this plant, especially in the treatment of inflammatory and infectious diseases. With the increasing interest in plant-based medicine, *Kalanchoe pinnata* has the potential to be an effective and safe alternative to modern medicine.

The aim of this study was to analyze the content of bioactive compounds in *Kalanchoe pinnata*, as well as explore its pharmacological potential through biological activity assays. This research aims to provide a deeper understanding of the mechanism of action of active compounds in this plant and identify possible therapeutic applications, in the hope of providing stronger scientific evidence regarding the medical benefits of this plant in modern medicine.

METHODS

A systematic search was conducted using Google scholar, Pubmed, Mendeley, Science direct databases, which yielded a total of 1,807 articles and 11 articles from other databases published between 2011 and 2024. To ensure comprehensive coverage, a combination of keywords was used: "*Kalanchoe pinnata*" '*Cocor bebek*', 'Antibacterial', 'Antidiabetic', and 'Anti-inflammatory'. In addition, the search was limited to articles focusing on pharmaceutical science, Cocor duck leaf research and Health. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework was adopted to guide the article selection process. The process involved three main stages, namely identification, screening, eligibility assessment and inclusion. Relevant keywords were identified by consulting previous studies, thesaurus, and experts' recommendations. The initial search yielded a total of 2740 articles. Based on the predefined inclusion and exclusion criteria detailed in Table 1. 155 articles were found eligible for further review. These criteria included literature type (journal), language (English), and field of study (Pharmacy, Pharmacology, medicine, biological sciences, pharmaceutical botany). After a rigorous review process based on inclusion and exclusion criteria, 25 articles were identified as worthy of further analysis.

Table 1. Inclusion and Exclusion Criteria

Criteria	Eligibility	Exception
Time	Minimum publication time of article is 2011	<2011
Language	Indonesian and English	Discussing other than Indonesian and English
Paper Type	Journal Articles	Proceedings articles, reviews, books, book series
Inner field database *ScienceDirect*	Pharmacy, Pharmacology, medicine, biological sciences, pharmaceutical botany	Economics, business, psychology, arts and humanities

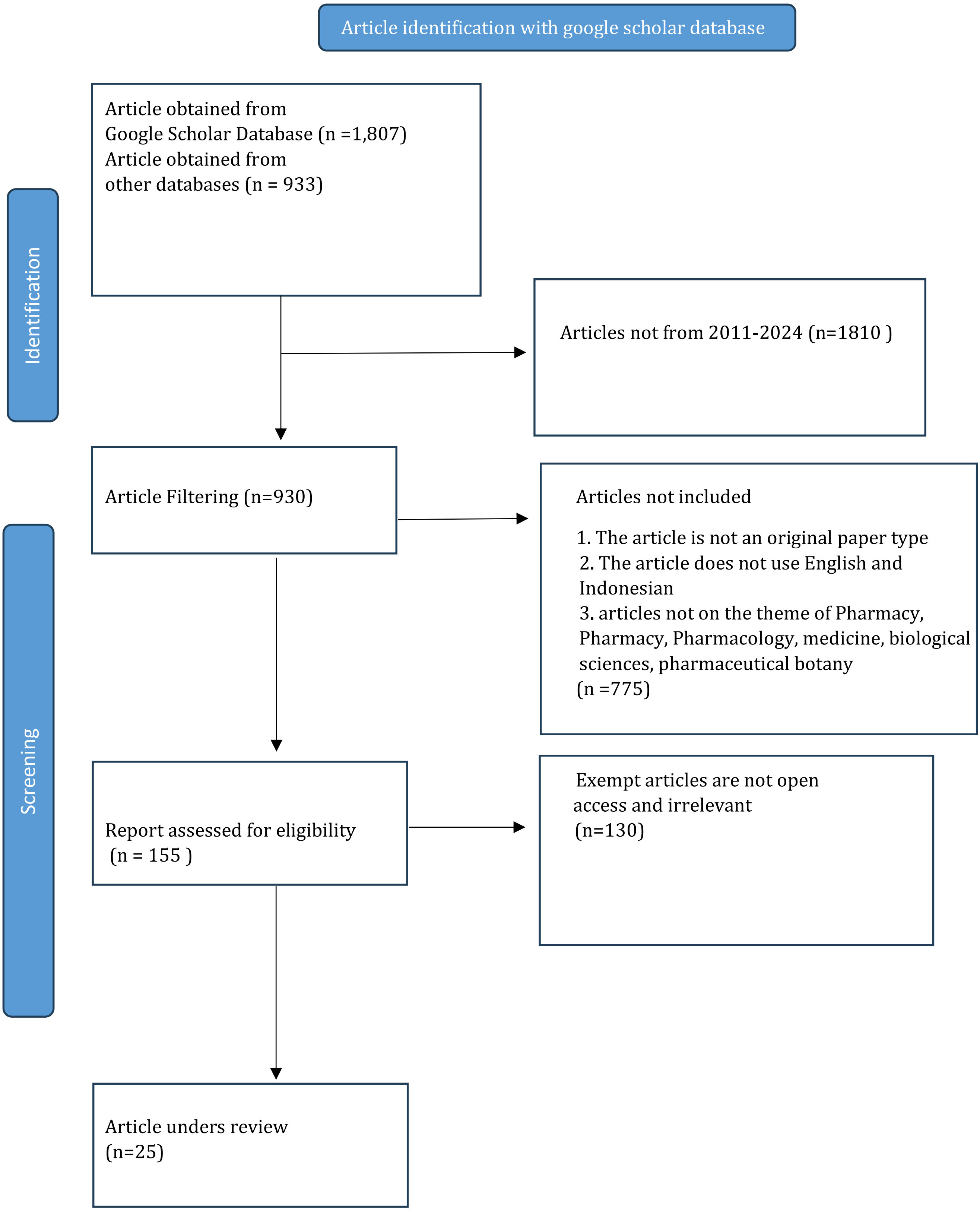

Figure 1. Data selection and extraction for SLR

RESULTS AND DISCUSSION
This section presents an analysis of the 25 selected articles, focusing on themes, participant characteristics, participant characteristics, duration, and project outcomes (summarized in Tables and Diagrams).

Table 1. Inclusion and Exclusion Criteria

No.	Author	Solvent	Sample section	Test animals	Extraction method	Pharmacological effects
1.	Maulita Cut Nuria Enny	Methanol	Leaf	*Staphylococcus aureus, Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa and Salmonella typhi*	maceration	antibacterial
2.	Ira Pufaijah Ely et al., (2020)	Ethanol 70%	Leaf	*Propionibacterium acnes*	maceration	antibacterial
3.	Kony putriani, et al., (2023)	Methanol	Leaf	*Propionibacterium acnes, Staphylococcus aureus*	maceration	antibacterial
4.	Eny Purwanitiningsih et al.,(2020)	Ethanol 70%	Leaf	*Salmonella typhi*	maceration	antibacterial
5.	Saeed,et al., (2024)	Aquadest, Methanol.	Leaf	*Brucella melitensis, Klebsiella pneumoniae, Escherichia coli, Proteus vulgaris*	maceration	antibacterial
6.	Sayantan Chatterjee et al.,(2020)	Aquadest, methanol, and N-hexane	Leaf	Not specific	Maceration	Antioxidant, anti-inflammatory
7.	Luckman Gbati et al.,(2024)	Petroleum ether, Ethanol 70%	Leaf	Not specific	Maceration	Antioxidant, anti-inflammatory
8.	Saumen Kanti Pal et al., (2020)	Methanol	Leaf	*Rattus norvegicus*	Maceration	Non-narcotic analgesic, mild anti-inflammatory
9.	Edmond J. et al.,(2021)	Aquadest, Unspecific Ethanol, Petroleum ether Ethanol	Leaf	*Rattus norvegicus*	Maceration	Antioxidant, anti-inflammatory
10.	Edilane Rodrigues Dantas de Araújoa et al., (2019)	methanol, distilled water, formic acid, ethyl acetate, acetone, propylene glycol.	Leaf	mice (*Mus musculus*), *Staphylococcus aureus or Escherichia coli*	Maceration	Antidiuretic, Antibacterial, Anti-inflammatory
11.	Justyna Stefanowicz-	Aquadest, dichloromethane	Leaf	*Staphyloccus epidermis, staphyloccus aureus*	Maceration	Anticancer, antibacterial

	Hajduk et al (2023)					
12.	Nicolas Faundes-Gandolfo et al (2024)	Ethanol 96%	Leaf	Not specific	Maceration	Anticancer, pro-apoptosis
13.	Marta Elena Hernández-Caballero et al (2022)	Methanol	Leaf	Not specific	Not mentioned	Anticancer, epigenetic regulation
14.	Justyna Stefanowicz-Hajduk et al (2022)	Aquadest	Leaf	Not specific	Maceration	Anticancer, antioxidant
15.	Kanza Saeed et al., (2024)	methanol, Aquadest	Leaf	*Yersinia pseudotuberculosis*	Conventional extraction, supercritical extraction, extraction	Antioxidant, antibacterial
16.	Edilane Rodrigues Dantas de Araújo et al.,(2018)	Aquadest	Leaf	Wistar Rat	Turbo extraction	Gastroprotective, antioxidant
17.	Jayasree Ananda,(2024)	Aquadest	Leaf	*Staphylococcus aureus, Streptococcus mutans, Candida albicans*	decoction	Antibacterial, antioxidant, anti-inflammatory
18.	Eka Nurul Qomaliyah et al., (2023)	Ethanol 96%	Leaf	Not specific	Maceration	Antioxidants
19.	Huma Rao et al.,(2024)	Methanol + distilled water	Leaf	Not specific	Maceration	Antioxidant, antibacterial
20.	Keshav Ranabhat et al.,(2022)	Ethanol 100%, methanol, formic acid, distilled water, ethyl acetate	Leaves, fruit, roots	Female Wistar rat	Soxhlet	Antioxidant, antibacterial, cytotoxic
21.	Latha ophelia george1.,et al (2018)	Aquadest, Ethanol 96%,	Leaf	Wistar Rat	Turbo extraction	Gastroprotective, antioxidant
22.	(2019)	Ethanol is not specific	Leaf	Diabetes model mice with streptozotocin	maceration	anti-diabetic
23.	Parvathy Menon PR et al.,(2024)	Ethanol 96%, distilled water, n-hexane, chloroform	Leaf	Not specific	maceration	anti-diabetic
24.	Rekha Y. Halayal, et al (2024)	Methanol	Leaf	Not specific	maceration	anti-diabetic
25.	Shashank Matthew, et al (2013)	Petroleum Ether, Ethanol 70%, Aquadest, Chloroform	Stem	Wistar albino rat	Shoxhlet extraction.	anti-diabetic

Solvent Profile

Based on the solvent usage data summarized from 25 reviewed articles, distilled water was the most frequently employed solvent, reaching 56% of total use. This reflects its high versatility and effectiveness as a polar solvent for extracting water-soluble bioactive compounds from *Kalanchoe pinnata*. Unspecified methanol followed with 40%, highlighting its common application in phytochemical studies due to its broad polarity range, allowing for the extraction of both polar and semi-polar constituents. Ethanol in concentrations of 96% and 70% (each 16%) was also widely used, attributed to its ability to dissolve phenolic compounds, flavonoids, and other pharmacologically active metabolites. Ethanol itself is considered a preferred organic solvent because of its relatively low toxicity compared to acetone and methanol, affordability, compatibility with various extraction techniques, and safety for pharmaceutical and food applications (Hakim & Saputri, 2020). Meanwhile, solvents such as petroleum ether (12%), n-hexane, chloroform, formic acid, and ethyl acetate (each 8%) were typically used for targeting non-polar or specific compounds. Less commonly used solvents, including dichloromethane, methanol 80%, propylene glycol, acetone, and ethanol 100% (each 4%), indicate their more specialized role in selective extraction processes. Overall, the solvent profile demonstrates a clear preference for polar solvents in the pharmacological studies of *Kalanchoe pinnata*.

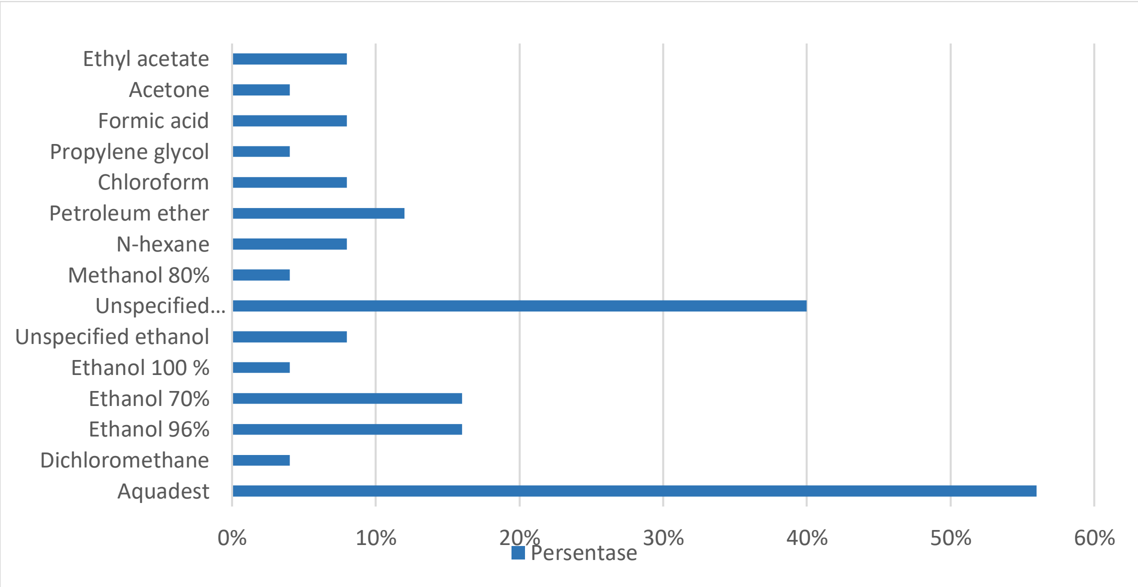

Figure 2. Solvent Profile

Based on the solvent analysis data used in 25 articles, there is a fairly diverse variation in solvent use. The most frequently used solvent is distilled water, with a frequency of 14 times (56%), indicating its popularity in research due to its multifunctional nature. Non-specific methanol is in second place with 10 times of use (40%), followed by 96% ethanol (16%) and 70% ethanol (16%) with 4 times of use and followed by petroleum ether with 3 times of use (12%) and several other solvents such as non-specific ethanol, n-hexane, Chloroform, Formic acid, Ethyl acetate which are each used 2 times (8%). Solvents such as Dichloromethane, 80% Methanol, Propylene glycol, Acetone and 100% ethanol are used with a lower percentage of around 4%.

Some Solvents such as Dichloromethane, Methanol 80%, Propylene glycol, Acetone and Ethanol 100% were used with lower percentages of around 4% each used only once, indicating their specific application in a particular study. In addition, there is a category of "Unspecified Methanol" which also appeared 10 times (40%), and "Unspecified Ethanol which appeared 2 times (8%) reflecting the presence of solvents that were not clearly identified in some studies. The total percentage reached 48%, indicating the possibility of overlapping or mixed use of solvents in one study. Overall, this solvent profile shows a tendency to use polar solvents such as ethanol and distilled water, which are commonly used to dissolve polar compounds in chemical research.

Parts of the plant Used

Among the various plant parts of *Kalanchoe pinnata* studied in pharmacological research, the leaves were by far the most frequently utilized, appearing in 24 out of 25 reviewed articles (96%). This predominance reflects the high concentration of bioactive compounds in the leaves, such as flavonoids, triterpenoids, and phenolic acids, which have been widely associated with antioxidant, anti-inflammatory, and wound-healing properties. In contrast, other plant parts such as the cortex, root, and fruit were each used only once (4%), suggesting their more specialized or targeted application in specific studies. For example, the cortex may contain unique secondary metabolites with potential antimicrobial or cytotoxic activities, while the roots may harbor alkaloids and other compounds with possible immunomodulatory effects. The fruit, although less studied, may offer nutritional value alongside pharmacological potential due to its vitamin and phenolic content. The stark difference in usage frequency underscores the central role of the leaves in *Kalanchoe pinnata* pharmacological studies, while highlighting the underexplored potential of other plant parts for future research.

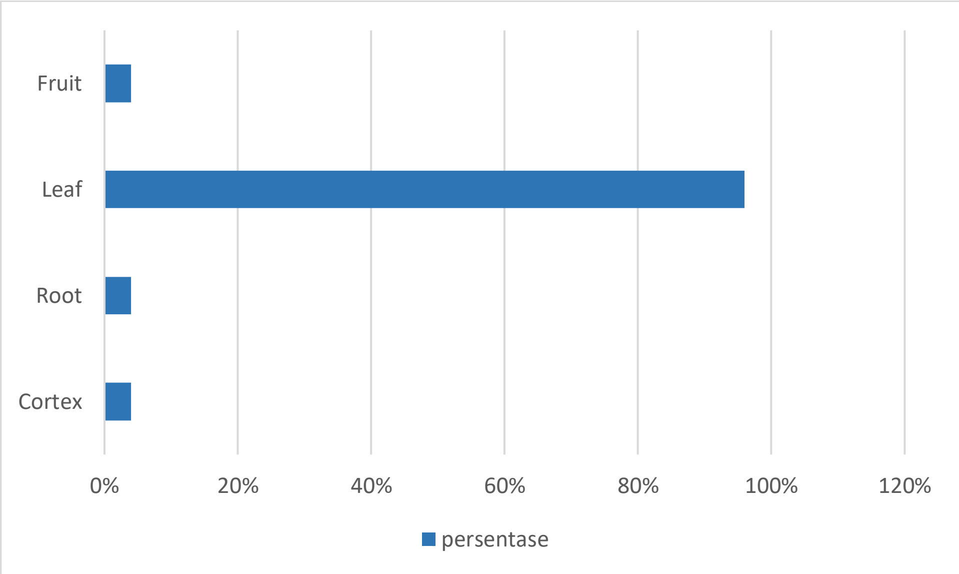

Figure 3. Profile of the parts used

Based on the analysis of 25 articles, the study used *cocor bebek* leaves as the most frequently used part with a frequency of 24 times, with a percentage reaching 96%, followed by roots and stems with 1 use each, with a percentage of 4%. This shows that *cocor bebek* leaves are the most dominant and relevant part of the plant in various studies, possibly due to their rich content of active compounds, such as flavonoids, tannins, saponins, and alkaloids, which provide various pharmacological potentials, including anti-inflammatory, antibacterial, antiviral, anticancer, wound healing, antioxidants, and immunomodulators, so that these leaves have long been used in traditional medicine for various health conditions. The popularity of these leaves also reflects their role as versatile natural ingredients in various fields, from traditional medicine to modern research. Although research on the potential of *cocor bebek* stems and roots is not as much as the leaves, several studies have identified bioactive content in both organs. The stems, with high water and polysaccharide content, have the potential to be immunomodulators and anti-inflammatories, and contain phenolic and flavonoid compounds as antioxidants. Meanwhile, the roots of *cocor bebek* are reported to contain alkaloids and triterpenoids with antibacterial and anticancer potential, as well as minerals absorbed from the soil. Further research is needed to confirm and explore the full potential of the stems and roots of *cocor bebek*, including identification of specific compounds and more in-depth biological activity tests, as well as comparison of content between plant organs.

Test Animal/Microbe Profile

Based on the data from 25 reviewed articles, the most common category reported was "None," indicating that 28% of the studies did not specify or involve any test animals or microorganisms. Among the identified test subjects, *Wistar* rats were the most frequently used (16%), reflecting their widespread application in pharmacological and toxicological research due to their stable physiology and well-documented genetic background. Several microorganisms, including *Escherichia coli*, *Propionibacterium acnes*, *Rattus norvegicus*, *Staphylococcus aureus*, and *Yersinia pseudotuberculosis*, each accounted for 8% of usage, highlighting their relevance in antimicrobial and infection-related studies. Other species such as *Mus musculus*, *Salmonella typhi*, *Staphylococcus epidermidis*, *Staphylococcus mutans*, *Bacillus subtilis*, *Brucella melitensis*, *Klebsiella pneumoniae*, *Proteus vulgaris*, and *Sprague-Dawley* rats were less frequently used (4% each), indicating more specific or targeted experimental applications. Additionally, 8% of the studies listed "Unspecified" for their test organisms, reflecting incomplete reporting or general reference to microbial groups without precise identification. This distribution shows a balanced mix of in vivo and in vitro models, with a notable emphasis on rodent models and pathogenic bacteria in the pharmacological evaluation of *Kalanchoe pinnata*.

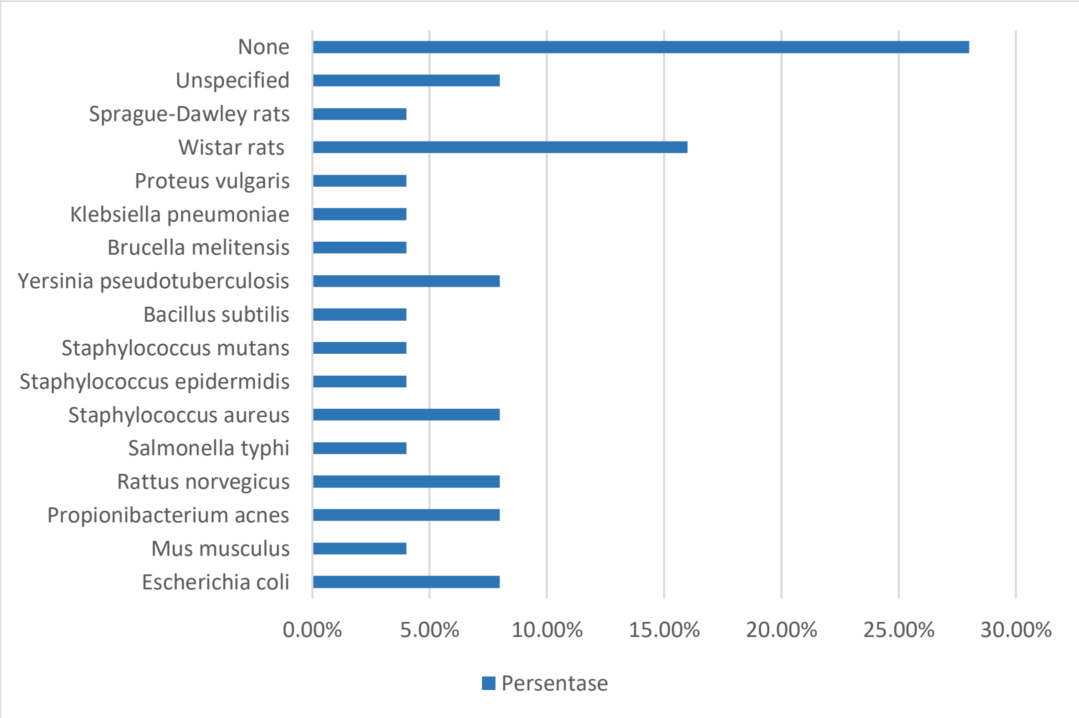

Figure 4. Test Animal/Microbe Profile

Based on data from 25 articles analyzed, the animals and test microbes used in the *Cocor bebek* study showed diverse variations. The test animals/microbes used in the scientific articles showed the diversity of organisms studied. The microorganisms tested included Gram-positive and Gram-negative bacteria, covering several species that are relevant in the context of human and animal health. The Gram-negative bacteria used included Escherichia coli, Salmonella typhi, Yersinia pseudotuberculosis, Klebsiella pneumoniae, and Proteus vulgaris. Meanwhile, the Gram-positive bacteria tested included Staphylococcus aureus, Staphylococcus epidermidis, Staphylococcus mutans, and Bacillus subtilis. In addition to bacteria, this study also involved Propionibacterium acnes, bacteria that play a role in the pathogenesis of acne, and Brucella melitensis, bacteria that cause brucellosis. The diversity of these microorganisms shows the potential for research in studying antimicrobial activity or other biological effects on a broad spectrum of bacteria.

In addition to microorganisms, this study also used experimental animals, namely mice (Mus musculus) and rats (Rattus norvegicus). There was also the use of Wistar rats and BB rats. The use of these experimental animals allows the study to examine the in vivo effects (in living organisms) of the substances or treatments being tested. The use of Wistar rats, which are a commonly used laboratory rat strain, and BB rats, which are an animal model for type 1 diabetes, indicates the focus of the study on specific physiological and pathological aspects. The presence of the categories "Not specific" and "None" indicates that in some of the compiled studies, detailed information on the test animals/microbes was not available or the study may not have involved the direct use of test organisms (e.g., in vitro studies with cells or cellular components). The percentage distribution shows that the use of Wistar rats is the most dominant (16%), followed by several microorganisms, each used in 8% of the studies, and the rest were used in 4% of the studies. As many as 28% of the studies did not mention the use of test animals/microbes

Extraction method profile

From the analysis of 25 reviewed articles, maceration emerged as the predominant extraction method, reported in 64% of the studies. This popularity can be attributed to its simplicity, cost-effectiveness, and ability to preserve thermolabile bioactive compounds such as flavonoids, tannins, and alkaloids, which are abundant in *Kalanchoe pinnata*. Turbo extraction and Soxhlet extraction were used in 8% of studies each, the former offering shorter processing times and higher efficiency, while the latter enables continuous solvent circulation for thorough compound isolation. Other techniques, including general extraction, conventional extraction, supercritical extraction, microwave-assisted extraction, and decoction, were each reported in 4% of the studies, indicating their more specialized application depending on the target compound profile. The predominance of maceration and the selective use of more advanced or specialized methods reflect a tendency towards methods that balance efficiency, cost, and preservation of active constituents in pharmacological research on *Kalanchoe pinnata*.

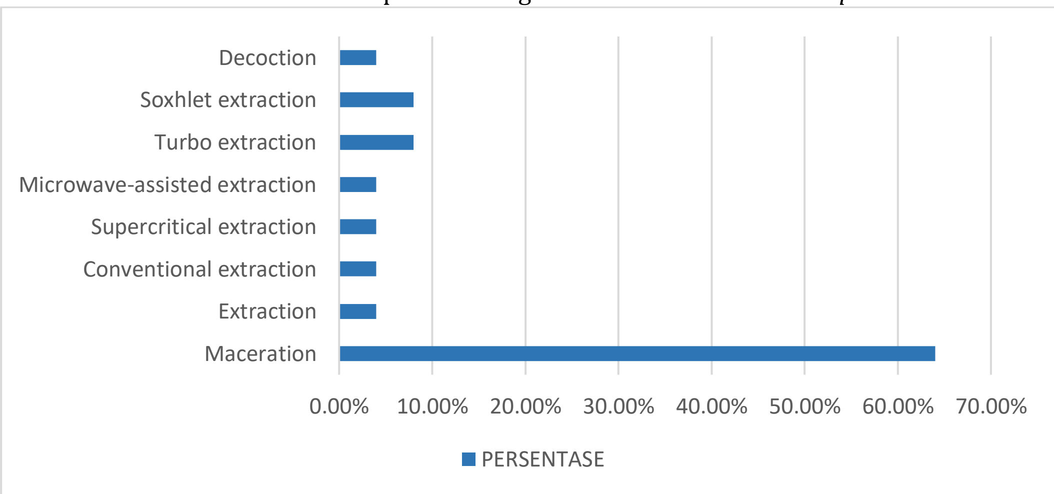

Figure 5. Extraction method

Based on the analysis of 25 research articles on leaves, the extraction method used in research related to *cocor bebek* is dominated by maceration, which covers 64% of the total methods recorded. Maceration is a relatively simple extraction method, in which plant material is soaked in a solvent at room temperature for a certain period of time. The dominance of maceration may be due to its ease of implementation, relatively low cost, and the availability of the required equipment. This method is suitable for extracting thermolabile compounds (not heat resistant) because it is carried out at room temperature. However, maceration has several disadvantages, such as lower extraction efficiency compared to more modern methods and a relatively long extraction time.

In addition to maceration, several other extraction methods were also used, although at much lower frequencies. These methods included conventional extraction (4%), supercritical extraction (4%), microwave extraction (4%), turbo extraction (8%), soxhlet (8%), and decoction (4%). The terms "extraction" and "conventional extraction" which appeared at 4% each, likely refer to maceration or other simple extraction methods due to the lack of specific information. Supercritical extraction uses solvents at supercritical conditions (temperature and pressure above their critical points) to increase extraction efficiency and selectivity. Microwave extraction uses microwaves to heat the solvent and speed up the extraction process. Turbo extraction likely refers to extraction methods that use intense stirring or agitation to increase mass transfer and extraction efficiency. Soxhlet is an extraction method in which the solvent is heated and evaporated, then condensed and repeatedly passed back over the plant material, allowing for more efficient extraction than maceration. Decoction, also known as boiling, involves boiling the plant material in water. This method is generally used to extract water-soluble and heat-resistant compounds.

The diversity of extraction methods used in *cocor bebek* research indicates an effort to optimize the recovery of bioactive compounds from plants. The selection of an appropriate extraction method depends on the nature of the compound to be extracted, the plant matrix, and practical considerations such as cost and availability of equipment. The dominance of maceration suggests that most studies may focus on the extraction of compounds that are relatively easy to extract and thermolabile. However, the use of more modern methods such as supercritical and microwave extraction suggests an interest in increasing extraction efficiency and extracting compounds that may be difficult to extract using conventional methods.

Pharmacological Effect Profile

Based on the analysis of 25 reviewed articles, *Kalanchoe pinnata* exhibits a wide range of pharmacological activities, with antioxidant (44%) and antibacterial (40%) effects being the most frequently reported. The high prevalence of antioxidant activity reflects the plant's rich content of phenolic compounds and flavonoids, which play a key role in neutralizing free radicals and reducing oxidative stress. Antibacterial properties, observed in 40% of the studies, highlight its potential in combating pathogenic microorganisms. Other notable activities include antidiabetic, anti-inflammatory, and anticancer effects (each 16%), which are often associated with modulation of glucose metabolism, suppression of inflammatory mediators, and inhibition of cancer cell proliferation, respectively. Less frequently reported effects include non-narcotic analgesic, antidiuretic, proapoptotic, epigenetic regulation, gastroprotective, and cytotoxic activities (4–8%), suggesting more specialized or targeted applications. This diversity of pharmacological actions underscores the therapeutic potential of *Kalanchoe pinnata* and supports its traditional use in various medicinal contexts.

Based on the analysis of 25 research articles on *cocor bebek*, the pharmacological effects of *cocor bebek* studied showed a broad spectrum of activities, with a major focus on antioxidant and antibacterial activities. Antioxidant effects dominated the studies (44%), indicating a great interest in the potential of *cocor bebek* in counteracting free radicals and preventing oxidative damage associated with various degenerative diseases. Antibacterial activity also received significant attention (40%), validating the traditional use of *cocor bebek* in treating bacterial infections. These findings are consistent with previous studies that identified various bioactive compounds in *cocor bebek*, such as flavonoids and alkaloids, which are known to have antioxidant and antibacterial properties.

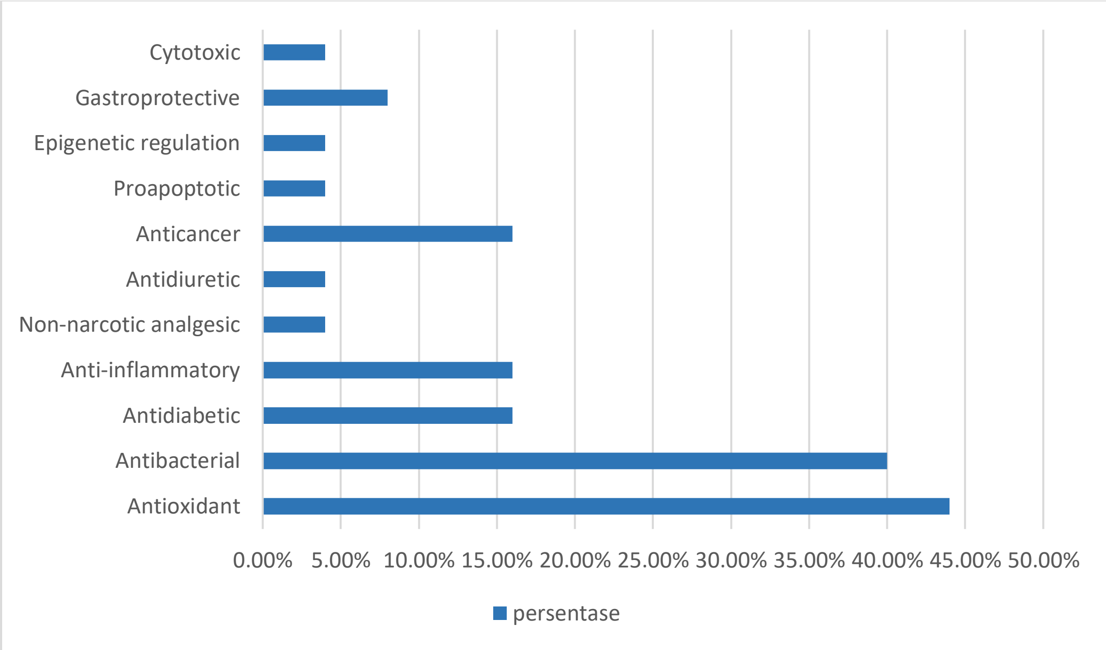

Figure 6. Pharmacological Effect Profile

In addition to these two main effects, studies have also explored the potential of *cocor bebek* in other areas, although with less frequency. Antidiabetic, anti-inflammatory, and anticancer effects were each studied in 16% of the studies. This indicates interest in the potential of *cocor bebek* in the treatment of chronic diseases such as diabetes, inflammation, and cancer. Non-narcotic analgesic, antidiuretic, proapoptotic, epigenetic regulation, gastroprotective, and cytotoxic effects were each studied in a small proportion of studies (4-8%). The presence of studies on proapoptotic and cytotoxic effects further strengthens the anticancer potential of *cocor bebek*, as these mechanisms are important in inhibiting the growth and spread of cancer cells. Studies on epigenetic regulation indicate interest in the molecular mechanisms underlying the pharmacological effects of *cocor bebek*. Meanwhile, studies on gastroprotective effects indicate the potential of *cocor bebek* in protecting the stomach from damage. The diversity of pharmacological effects studied shows the potential of *cocor bebek* as a multifunctional therapeutic agent. Although the antioxidant and antibacterial effects seem to be the main focus, further research is needed to confirm and further explore other pharmacological effects, especially through human clinical trials. These data provide a strong foundation for future research and support the traditional use of *cocor bebek* as a herbal medicine.

CONCLUSIONS

Water lily (*Kalanchoe pinnata*) has been extensively studied. Analysis of 25 research articles on water lily revealed several major trends. First, in terms of solvents, distilled water and methanol were the most frequently used solvents, reflecting a focus on the extraction of polar compounds. Second, water lily leaves were predominantly used in the studies (96%), indicating a high concentration of bioactive compounds in this part of the plant. Third, studies involved a wide range of test animals and microbes, with Wistar rats being the most common animal model and focused on testing antimicrobial activity against a variety of pathogenic bacteria. Fourth, the most frequently used extraction method was maceration (64%), likely due to its simplicity and low cost, although other methods such as soxhlet, supercritical extraction, and microwave were also explored. Finally, the pharmacological effect profile showed a major focus on antioxidant (44%) and antibacterial (40%) activities, validating the traditional use of water lily, with further exploration of antidiabetic, anti-inflammatory, anticancer, and other pharmacological effects. In conclusion, research on *cocor bebek* tends to focus on the extraction of polar compounds from leaves using maceration, to test antioxidant and antibacterial activities, as well as other therapeutic potentials in various in vitro and in vivo models.

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