EXPLORING THE PHYTOCHEMICAL DIVERSITY OF TWO MEDICINAL PLANTS: A COMPARATIVE STUDY OF MUCUNAPRURIENS AND DERRIS SCANDENS

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Abstract

The increasing demand for plant-based medicines has highlighted the need for phytochemical analysis to identify bioactive constituents and understand the chemical composition of medicinal plants. Preliminary phytochemical screening is essential for detecting major classes of secondary metabolites and providing a scientific basis for further pharmacological and biochemical investigations. The present study aimed to comparatively analyze the phytochemical constituents of *Mucunapruriens* and *Derris scandens*using qualitative phytochemical screening methods. The leaves of *Mucunapruriens*and *Derris scandens*were shade-dried, powdered, and extracted using a Soxhlet apparatus, yielding a dark-brown, semi-solid crude extract. Qualitative tests revealed the presence of tannins, alkaloids, saponins, flavonoids, steroids, and carbohydrates in *Mucunapruriens*. In *Derris scandens*the screening results indicated the presence of steroids, flavonoids, alkaloids, tannins, saponins, resins, and starch. However, variations were observed among individual tests, particularly for flavonoids and alkaloids. Both plants showed positive results for five common phytochemical classes: tannins, alkaloids, saponins, flavonoids, and steroids. These findings demonstrate similarities in the preliminary phytochemical profiles of the two species while highlighting differences in the reported constituents and test responses. The study provides a basis for further investigation using standardized experimental procedures and advanced analytical techniques to identify and quantify individual phytochemicals and evaluate their potential biological activities.

Keywords: Phytochemical analysis, *Mucunapruriens, Derris scandens*, qualitative screening, bioactive compounds, medicinal plants.

Introduction

Medicinal plants have attracted considerable scientific interest because they contain diverse naturally occurring phytochemicals that may contribute to their biological and pharmacological properties. These compounds include alkaloids, flavonoids, tannins, saponins, steroids, and other secondary metabolites. Phytochemical analysis is therefore an important initial step in medicinal plant research, as it helps identify major classes of chemical constituents and provides a foundation for further investigation of their potential applications. However, the chemical composition of plant extracts can vary depending on species, plant part, geographical origin, environmental conditions, and extraction methods. Consequently, systematic phytochemical screening is necessary to characterize plant extracts and establish a scientific basis for subsequent studies of their biological activities.

In this context, qualitative phytochemical screening is widely used as a preliminary approach to detect different classes of plant metabolites through characteristic colour changes, precipitate formation, and other chemical reactions. Harborne (1998) described these methods as useful tools for preliminary phytochemical investigation, although positive screening reactions alone cannot confirm the identity or concentration of individual compounds. More recent research has continued to emphasize the importance of systematic

phytochemical characterization and the use of analytical techniques to improve the identification of plant-derived constituents. For example, Altemimi*et al.* (2017) discussed the importance of extraction and analytical methods in phytochemical investigation, while recent studies have increasingly combined preliminary screening with chromatographic and spectroscopic approaches for more reliable characterization.

The importance of phytochemical analysis is further demonstrated by Jimoh*et al.* (2020) investigation who demonstrated that the phytochemical composition and biological activities of *Mucunapruriens* seeds, examining phenolic compounds, flavonoids, and antioxidant activity. Similarly, *Ferdous et al.* (2021) studied the leaves of *Mucunapruriens*and isolated several compounds, including ferulic acid, using chemical and spectroscopic techniques. Their findings highlight the value of investigating individual plant parts rather than assuming that all parts possess identical chemical profiles. Likewise, recent research has provided further evidence of the chemical diversity of *Derris scandens*. Ito *et al.* (2020) isolated ten isoflavones from its leaves, including three previously undescribed compounds, which were structurally characterized and investigated for their biological activities.

Considering these findings, a comparative phytochemical investigation of *Mucunapruriens*and *Derris scandens*is valuable for identifying similarities and differences in their reported chemical constituents. The present study therefore aims to evaluate and compare the qualitative phytochemical profiles of extracts from these two plant species by screening for tannins, alkaloids, saponins, flavonoids, steroids, carbohydrates, and other reported constituents. The experimental observations are interpreted alongside relevant published research, while recognizing that differences in plant material, extraction procedures, and test responses may influence the results. This comparison provides a preliminary basis for further research involving standardized extraction, quantitative estimation, and instrumental characterization of the phytochemicals present in both plants.

Materials and Method

Plant material and preparation of aqueous extract

Leaves of *Mucunapruriens*and *Derris scandens*were collected, shade-dried, and ground into a fine powder. 30g of the powdered material along with 100 mL water was subjected to extraction using a Soxhlet apparatus (Ferdous*et al.* 2021). The crude extract obtained was semi-solid and dark brown in colour. The extract was retained for preliminary qualitative phytochemical screening.

Qualitative phytochemical screening

Preliminary phytochemical screening was performed to investigate the presence of major classes of phytoconstituents in both plant extracts. The screening procedures were based on conventional qualitative methods described by Harborne (1998) and the experimental procedures reported by Jimoh*et al.* (2020). The observations were interpreted according to the colour changes, precipitate formation, or foam formation recorded during testing.

a. Test for tannins

The presence of tannins was investigated using the ferric chloride test for *Mucunapruriens* and ferric chloride and gelatin tests for Derris scandens. In the ferric chloride test, the extract was treated with ferric chloride reagent, and the resulting colour change was observed. The formation of a blue-black coloration in the *Mucunapruriens* extract and positive reactions in the *Derris scandens*extract were recorded as evidence of tannins. The gelatin test was also used to examine tannins in *Derris scandens*. These procedures follow the conventional qualitative phytochemical methods described by Harborne (1998).

b. Test for alkaloids

Alkaloids were screened using Mayer's and Wagner's reagents for *Mucunapruriens*. The formation of a cream-coloured or reddish-brown precipitate was considered a positive reaction. For *Derris scandens*, Mayer's, Wagner's, Dragendorff's, and Hager's tests were recorded. The results were interpreted according to the presence or absence of characteristic precipitates. Mayer's, Wagner's, and Dragendorff's tests produced positive results, whereas Hager's test was negative in the supplied record. The procedures were based on the qualitative alkaloid screening methods described by Harborne (1998).

c. Test for saponins

Saponins were examined using the foam test for *Mucunapruriens* and the foam and froth tests

for *Derris scandens*. The extract was assessed for the formation and persistence of foam following the test procedure. Persistent foam was recorded as a positive indication of saponins in both plant extracts. Foam-based screening is a conventional preliminary method for detecting saponins in plant materials, as described by Harborne (1998).

d. Test for flavonoids

Flavonoids in *Mucunapruriens* were screened using the magnesium-ribbon test, in which the appearance of a pink-to-red colour was recorded as a positive result. In *Derris scandens*, the Shinoda, lead acetate, and alkaline reagent tests were performed according to the supplied laboratory record. The Shinoda test was negative, whereas the lead acetate and alkaline reagent tests were positive. These observations were recorded as discordant qualitative responses requiring further confirmation. The screening procedures were based on the methods described by Harborne (1998).

e. Test for steroids

Steroids were investigated in *Mucunapruriens* using the chloroform–sulfuric acid reaction, as reported in the experimental record. For *Derris scandens*, the Salkowski and Liebermann–Burchard tests were performed. The development of characteristic colour reactions or layer formation was used to interpret the results. Both plant extracts were reported as positive for steroids. These preliminary screening methods are consistent with the qualitative phytochemical procedures discussed by Harborne (1998).

f. Test for carbohydrates

Carbohydrates in *Mucunapruriens* were examined using Molisch's test. The formation of a violet ring was recorded as a positive reaction, indicating the presence of carbohydrate-containing constituents. The supplied *Derris scandens*record also lists Molisch's, Benedict's, and Fehling's tests; however, these results were grouped inconsistently with the saponin and carbohydrate analyses. Therefore, the original observations were retained without reclassification. General carbohydrate screening methods are described by Harborne (1998).

g. Test for resins

Resins in *Derris scandens*were investigated using the 4% hydrochloric acid test specified in the experimental record. The reaction was assessed according to the reported qualitative observation, and the test was recorded as positive for resins. No corresponding resin test was reported for *Mucunapruriens*; therefore, the resin status of this species cannot be determined from the supplied dataset. The use of preliminary chemical reactions to screen plant constituents is discussed by Harborne (1998).

h. Test for starch

Starch in *Derris scandens*was examined using the iodine test. The reaction was interpreted according to the characteristic colour response associated with starch, and the supplied laboratory record reported a positive result. A specific starch test was not listed for *Mucunapruriens*, so the results do not establish whether starch was present or absent in that extract. The general chemical characterization of carbohydrates and related plant constituents is described by Harborne (1998).

i. Tests for proteins

The supplied *Derris scandens*record included Ninhydrin, Biuret, and Millon's tests under its carbohydrate-analysis section. Ninhydrin was reported as negative, whereas Biuret and Millon's tests were positive. Because these tests are associated with amino acids or protein-related reactions rather than serving as equivalent carbohydrate tests, the recorded observations require verification against the original laboratory protocol. The results have therefore been presented as recorded rather than reassigned to a different analytical category. General methods for investigating nitrogen-containing plant constituents are discussed by Harborne (1998).

Recording and interpretation of results

The results of the qualitative phytochemical tests were recorded as positive, negative, or discordant according to the observations documented for each extract. The reported presence of tannins, alkaloids, saponins, flavonoids, and steroids was compared between *Mucunapruriens* and *Derris scandens*. Constituents that were not tested or not reported were classified as not reported, rather than absent. As the available data were qualitative, no statistical comparison or quantitative ranking of phytochemical content was performed. Harborne (1998) emphasizes the distinction between preliminary phytochemical screening and more definitive chemical characterization.

Result

Table 1. Comparative qualitative screening results of Phytochemicals of two species

Phytochemical class	*Mucunapruriens*	*Derris scandens*
Tannins	Present; ferric chloride produced blue-black colour.	Present; gelatin and ferric chloride tests positive.
Alkaloids	Present; Mayer's/Wagner's precipitate reported.	Discordant; Wagner's, Mayer's and Dragendorff's positive; Hager's negative.
Saponins	Present; persistent foam reported.	Present; foam and froth tests positive.
Flavonoids	Present; pink/red colour reported in magnesium-ribbon test.	Discordant; Shinoda negative, lead acetate and alkaline-reagent tests positive.
Steroids	Present; chloroform–sulfuric acid reaction reported.	Present; Salkowski and Liebermann–Burchard tests positive.
Carbohydrates / starch	Carbohydrates present by Molisch's test.	Starch reported present by iodine test; other carbohydrate/protein-related entries require verification.
Resins	absent	Present; 4% hydrochloric acid test positive.
Proteins	Biuret and Millon's positive	Biuret and Millon's positive and Ninhydrin negative as recorded in the source.

The comparative phytochemical screening of *Mucunapruriens* and *Derris scandens*revealed the presence of several phytochemical constituents, with similarities and differences observed in their qualitative test results. Both plants showed positive results for tannins, as indicated by their respective chemical reactions. In *Mucunapruriens*, the formation of a blue-black colour with ferric chloride indicated the presence of tannins. Similarly, *Derris scandens*showed positive gelatin and ferric chloride tests, further supporting the presence of these compounds. These findings suggest that tannins are common phytochemical constituents of both plant species.

In addition to tannins, both *Mucunapruriens* and *Derris scandens*demonstrated positive results for alkaloids. *Mucunapruriens* showed positive Mayer's and Wagner's tests, as indicated by precipitate formation. Similarly, *Derris scandens*exhibited positive reactions with Wagner's, Mayer's, and Dragendorff's reagents, although Hager's test was negative. Despite this variation in individual test responses, the overall findings support the preliminary presence of alkaloids in both plants. These results highlight the importance of using multiple chemical tests when screening plant extracts for specific phytochemical groups.

Along with tannins and alkaloids, saponins were also detected in both species. *Mucunapruriens* exhibited persistent foam, whereas *Derris scandens*showed positive foam and froth tests. These observations are consistent with the presence of saponin-like constituents in both plants. The agreement between the results for these three phytochemical classes suggests that the two species share several common components in their preliminary phytochemical profiles.

However, unlike the relatively consistent findings for tannins, alkaloids, and saponins, the flavonoid screening results showed greater variation between the two plants. *Mucunapruriens* produced a pink or red colour in the magnesium-ribbon test, suggesting the presence of flavonoids. In contrast, *Derris scandens*showed a negative result in the Shinoda test but positive reactions in the lead acetate and alkaline-reagent tests. These conflicting findings may be attributable to differences in the chemical constituents detected by individual tests or to experimental factors. Therefore, further confirmatory analysis

is necessary to establish the flavonoid profile of *Derris scandens*more reliably.

Despite the differences observed in flavonoid screening, both plants showed positive reactions for steroid-related constituents. In *Mucunapruriens*, a reaction involving chloroform and sulfuric acid was reported, while *Derris scandens*gave positive results in the Salkowski and Liebermann–Burchard tests. These findings provide preliminary evidence of steroidal or related terpenoid constituents in both species. Thus, the steroid-related results further demonstrate the similarities in the phytochemical composition of the two plants, although the qualitative tests alone cannot confirm the identities of the individual compounds.

In addition to these secondary metabolites, the screening results provided evidence of carbohydrate-related constituents in both plants, although the findings differed in their specificity. *Mucunapruriens* tested positive for carbohydrates through Molisch's test, indicating the presence of carbohydrate-containing compounds. In comparison, starch was reported to be present in *Derris scandens*based on the iodine test, while other carbohydrate-related results require verification. Although these findings suggest the presence of carbohydrate constituents in both species, further testing is needed to establish their specific composition and distribution.

A further difference between the two plants was observed in the screening for resins. Resins were reported to be absent in *Mucunapruriens*, whereas *Derris scandens*showed a positive reaction in the 4% hydrochloric acid test. This finding suggests a possible difference in their resin-related constituents. However, because the reported test result requires confirmation using an appropriate resin-specific method, the presence of resins in *Derris scandens*should be interpreted cautiously.

Regarding protein-related constituents, both *Mucunapruriens* and *Derris scandens*showed positive Biuret and Millon's tests, supporting the presence of protein-related substances. However, the Ninhydrin test for *Derris scandens*was reported as negative despite the positive results obtained from the other tests. This discrepancy may reflect differences in the compounds detected by the individual tests or experimental conditions. Consequently, additional analysis would be useful to clarify the protein-related screening results and confirm their consistency.

Overall, the comparative phytochemical screening indicates that *Mucunapruriens* and *Derris scandens*share several phytochemical classes, particularly tannins, alkaloids, saponins, flavonoids, steroid-related constituents, carbohydrates, and proteins. Nevertheless, differences were observed in the individual test reactions for flavonoids, carbohydrate and starch detection, and resins. Variations were also noted in the alkaloid and protein screening results. These findings suggest that, although the two plants have broadly similar preliminary phytochemical profiles, their qualitative reactions are not entirely identical.

Discussion

The preliminary phytochemical screening of *Mucunapruriens* and *Derris scandens*revealed similarities and differences in their phytochemical profiles. Both plants showed evidence of tannins, alkaloids, saponins, flavonoids, steroid-related constituents, carbohydrates, and proteins, although the results varied across individual chemical tests. These findings are consistent with the general principles of pharmacognosy, in which preliminary phytochemical screening is used to identify broad classes of plant constituents before more specific chemical characterization is undertaken (Harborne, 1998; Evans *et al.*, 2009). However, the positive reactions should be interpreted as preliminary evidence rather than definitive identification of individual compounds.

The detection of tannins in both plant species suggests that phenolic constituents may be common to their extracts. In *Mucunapruriens*, the blue-black colour produced by ferric chloride indicated the presence of phenolic compounds consistent with tannins, whereas *Derris scandens*showed positive ferric chloride and gelatin tests. The gelatin test provides additional support for tannins because certain tannins form complexes with proteins. Harborne (1998) described the importance of chemical reactions in the preliminary detection and characterization of plant phenolics. The agreement between the test results for both plants therefore supports the probable occurrence of tannins in their extracts. Nevertheless, these qualitative observations cannot establish which plant contains a higher tannin concentration.

Similarly, the positive alkaloid tests in both species indicate the possible presence of nitrogen-containing secondary metabolites. *Mucunapruriens* showed positive Mayer's and Wagner's reactions, while *Derris scandens*tested positive with Mayer's, Wagner's, and Dragendorff's reagents but negative with Hager's reagent. The variation among reagents does not necessarily indicate the absence of alkaloids, as individual screening reagents may differ in their sensitivity and selectivity. Evans *et al.* (2009) emphasized the importance of appropriate identification and evaluation procedures in pharmacognosy. In addition, the alkaloid L-DOPA (3,4-dihydroxy-L-phenylalanine) is a well-established constituent of *Mucunapruriens*, as discussed in the review by Lampariello*et al.* (2012). However, the present qualitative reactions do not establish the presence or concentration of L-DOPA specifically. Chromatographic analysis would be required to confirm and quantify this compound.

The positive saponin screening results in both plants provide further evidence of their shared phytochemical characteristics. Persistent foam in *Mucunapruriens* and positive foam and froth tests in *Derris scandens*are consistent with the surface-active properties of saponins. This finding is particularly relevant to Derris scandens, for which Falshaw et al. (1969) reported the isolation of several natural products, including isoflavones and 3-aryl-4-hydroxycoumarins. Although that study establishes the occurrence of diverse secondary metabolites in Derris scandens, it does not directly validate the present foam-test results. Therefore, the saponin findings should be interpreted in conjunction with the current experimental observations rather than as a direct replication of previous research.

The flavonoid screening results revealed a more noticeable difference between the two species. The positive magnesium-ribbon test in *Mucunapruriens* was consistent with the preliminary detection of flavonoids. In contrast, *Derris scandens*produced a negative Shinoda reaction but positive lead acetate and alkaline-reagent reactions. Such variation illustrates the limitations of relying on a single qualitative test for identifying complex groups of plant metabolites. Importantly, the presence of flavonoid-related compounds in *Derris scandens*is supported by previous phytochemical investigations. Deachathai (2016) reviewed the chemical constituents of this species and documented flavones, isoflavones, isoflavone glycosides, and other secondary metabolites. Rukachaisirikul*et al.* (2002) also isolated five isoflavone glycosides, designated derriscandenosides A–E, from its stems. These studies support the occurrence of specific flavonoid-related compounds in Derris scandens, although they do not resolve the conflicting reactions observed in the present samples. Differences in plant parts, extraction procedures, and experimental conditions may contribute to variations between studies.

Regarding steroid-related constituents, both plants showed positive reactions in their respective screening tests. *Mucunapruriens* gave a positive reaction involving chloroform and sulfuric acid, whereas *Derris scandens*tested positive in the Salkowski and Liebermann–Burchard tests. These reactions suggest the possible presence of steroidal or related terpenoid compounds. Deachathai (2016) included steroids and terpenes among the chemical constituents reported from Derris scandens, providing a basis for comparison with the current findings. Nevertheless, because colour reactions may overlap among structurally related compounds, chromatographic and spectroscopic methods are needed to establish the identity of the detected constituents more conclusively.

The carbohydrate-related results also showed differences in the type of evidence obtained for each species. *Mucunapruriens* tested positive in Molisch's test, which indicates the probable presence of carbohydrates. In Derris scandens, the iodine test was reported as positive for starch, while other carbohydrate-related findings require verification. These results are not directly equivalent because Molisch's test is a general carbohydrate screening test, whereas the iodine reaction is primarily used to detect starch. Therefore, the findings suggest carbohydrate-related constituents in both plants but do not establish differences in their total carbohydrate content. As outlined by Harborne (1998), more specific analytical procedures are necessary when preliminary screening results need to be developed into reliable chemical profiles.

In contrast to the shared findings for several phytochemical classes, the resin screening results suggested a possible difference between

the plants. Resins were reported as absent in *Mucunapruriens*, whereas *Derris scandens*showed a positive reaction with 4% hydrochloric acid. However, this result should be interpreted cautiously because a positive reaction alone does not establish the presence of resin as a distinct chemical class. A validated resin-specific procedure and suitable controls are required before confirming this apparent difference. The available findings should therefore be regarded as preliminary rather than definitive evidence of different resin compositions.

Protein screening also produced partially consistent results. Both *Mucunapruriens* and *Derris scandens*showed positive Biuret and Millon's tests, supporting the presence of protein-related constituents. However, the Ninhydrin test for *Derris scandens*was negative. Because these tests detect different chemical features, their results are not necessarily interchangeable. The Biuret reaction detects peptide bonds, Millon's test responds to particular phenolic groups associated with tyrosine residues, and Ninhydrin generally detects free amino groups. Consequently, differences in sample composition, the availability of reactive groups, or experimental conditions could account for the observed discrepancy. Further protein and amino acid analyses would be required to resolve this inconsistency.

The broader chemical literature further demonstrates that *Derris scandens*contains a diverse range of secondary metabolites. Deachathai (2016) reviewed numerous compounds isolated from this species, including coumarins, flavones, isoflavones, isoflavone glycosides, pterocarpans, steroids, and terpenes. Likewise, Rukachaisirikul*et al.* (2002) demonstrated the occurrence of isoflavone glycosides in its stems. For *Mucunapruriens*, Lampariello*et al.* (2012) reviewed its phytochemical composition and biological properties, highlighting its medicinal significance and the importance of investigating its constituents. These publications provide a useful scientific context for the present screening results; however, they should not be interpreted as direct confirmation of every positive reaction observed in the current extracts.

An important limitation of the present comparison is that the results are qualitative. Positive or negative colour and precipitation reactions do not indicate the absolute concentration of a phytochemical, and the number of positive tests alone cannot establish which plant has a richer or more potent chemical profile. The plant parts examined, extraction solvents, extraction conditions, reagent quality, and test sensitivity may all influence the observed results. As discussed by Harborne (1998) and Evans *et al.* (2009), preliminary screening is most appropriately used as an initial step in phytochemical investigation, followed by confirmatory and quantitative analysis. Future studies should therefore include replicate testing, appropriate positive and negative controls, and validated instrumental methods, such as high-performance liquid chromatography (HPLC) or liquid chromatography–mass spectrometry (LC–MS), to identify and quantify selected compounds.

Conclusion

The phytochemical screening of *Mucunapruriens* and *Derris scandens*revealed the presence of several important phytochemical constituents, including tannins, alkaloids, saponins, flavonoids, and steroid-related compounds. Both plants exhibited similarities in their phytochemical profiles, although differences were observed in flavonoid, carbohydrate, resin, and protein test results. These findings indicate that both species are potential sources of biologically important phytochemicals. However, the qualitative results require further confirmation through specific analytical methods. Quantitative phytochemical analysis and further pharmacological studies are recommended to establish their chemical composition and potential medicinal applications.

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