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Qualitative Phytochemical Screening of Medicinal Plants Used by Partido Albularyo in Camarines Sur, Philippines

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Abstract

Ethnobotanical use value can guide the selection of medicinal plants for laboratory phytochemical documentation. This study characterized the qualitative phytochemical profiles of 33 medicinal plants selected from an ethnobotanical dataset in Camarines Sur, Philippines. Plant materials were extracted by 72-h cold maceration in ethanol (1:10, w/v), and extracts were screened for alkaloids, flavonoids, glycosides, phenolics, phytosterols, phlobatannins, steroids, terpenoids, and saponins using established pharmacognostic reactions. Reaction intensities were recorded as absent, trace, moderate, or abundant. Prevalence was summarized with 95% Wilson confidence intervals; phytochemical richness and an ordinal screening index were calculated; Cochran's Q and Friedman tests characterized overall variation across assay classes; and Spearman correlation related published use value to screening metrics. Alkaloids, flavonoids, phenolics, and saponins were detected in all 33 taxa. Phytosterols occurred in 93.9%, phlobatannins in 84.8%, steroids in 48.5%, terpenoids in 27.3%, and glycosides in 18.2%. Overall distributional tests were significant (Cochran Q = 151.59, df = 8, $p < 0.001$; Friedman $\chi^2(8) = 184.02$, $p < 0.001$; Kendall W = 0.70). Mean phytochemical richness was 6.73 ± 0.98 classes per taxon, and the mean screening index was 12.52 ± 2.71. *Coleus amboinicus* reacted positively for all nine classes and, together with *Moringa oleifera*, attained the highest screening index (18/27). Published use value was positively associated with richness (Spearman $\rho = 0.54$, $p = 0.0010$) and the screening index ($\rho = 0.61$, $p < 0.001$). The findings provide a structured qualitative chemical-class profile of ethnobotanically important medicinal plants used in Partido District.

Subject Areas

Medicinal Chemistry

Keywords

Medicinal Plants, Phytochemical Screening, Ethnobotany, Partido Albularyo, Camarines Sur

1. Introduction

Medicinal plants remain important components of traditional and complementary health practices and continue to influence natural-product discovery. Global evidence documents sustained use of traditional and complementary medicine, while contemporary drug discovery continues to obtain chemical scaffolds, leads, and mechanistic hypotheses from natural products [1]-[3]. Ethnobotanical knowledge provides a practical basis for identifying culturally important taxa for chemical investigation and has long informed natural-product research strategies [4]-[6]. The growing use of herbal medicines has also increased attention to documentation, quality, and monitoring within traditional and complementary health systems [7].

The Philippines combines high biological diversity with extensive local knowledge of plant-based remedies. Ethnobotanical studies from Philippine communities have documented medicinal species, preparation practices, and quantitative indices such as use value and informant consensus [8]-[10]. In Partido District and the broader Camarines Sur setting, studies have documented Albularyo cultural beliefs, traditional-healing practices, and the wider cultural and religious landscape of the province [11]-[13]. Cerio (2024) documented 153 medicinal plant species from 60 families used by Partido Albularyo and quantified their ethnobotanical importance using use value (UV), informant consensus factor, and fidelity level [14]. The published study specifically identified plants with higher use values as important candidates for pharmacological and chemical investigation [14].

Qualitative phytochemical screening provides a rapid laboratory approach for detecting broad classes of plant secondary metabolites through characteristic color, precipitation, layer, and foam reactions. Classical pharmacognostic procedures are routinely used to screen for alkaloids, flavonoids, glycosides, phenolic compounds, phytosterols, phlobatannins, steroids, terpenoids, and saponins [15] [16]. Extraction conditions influence the compounds recovered from plant material, and ethanol is widely used because it extracts metabolites across a relatively broad polarity range [17] [18]. The phytochemical classes evaluated in qualitative screening include structurally and biologically important groups such as flavonoids and other phenolics [19]-[21], saponins [22] [23], and phytosterols [24]. Plant-derived secondary metabolites also remain important in antimicrobial research [25]. These tests therefore provide a useful first chemical-class profile for organizing subsequent natural-products research.

Accordingly, this study aimed to characterize the qualitative phytochemical profile of medicinal plants selected from the published Partido Albularyo use-value dataset of Cerio (2024). Specifically, it sought to (i) determine the presence and relative reaction intensity of nine phytochemical classes in ethanolic plant extracts; (ii) summarize class-level prevalence with confidence intervals and taxon-level phytochemical richness; (iii) calculate an ordinal screening index from the observed reaction scores; and (iv) examine the association of published ethnobotanical use value with phytochemical richness and the screening index.

2. Materials and Methods

2.1. Study Design and Plant Selection Based on Published Use Value

This laboratory-based qualitative phytochemical study examined medicinal plants used in traditional healing in Partido District, Camarines Sur. Plant selection was based on the ethnobotanical inventory of Cerio (2024), which documented 153 medicinal species used by Partido Albularyo and reported use value (UV), informant consensus factor, and fidelity level [14]. The 33 taxa included in the present analysis were selected from the published ethnobotanical list using their reported UVs to guide laboratory prioritization. Their published UVs ranged from 0.036 to 0.664. This ethnobotany-guided selection links the laboratory screening directly with the documented cultural importance of medicinal plants in the study area [6] [10] [14] [26] [27].

2.2. Plant Collection, Preparation, and Ethanol Extraction

Plant materials were collected from locations within the fourth legislative district of Camarines Sur. Healthy and visibly undamaged plant parts were placed in individually labeled resealable bags and transported to the laboratory. Samples were rinsed with distilled water to remove adhering debris, shade-dried at room temperature, and ground to a fine powder. For extraction, powdered material was combined with analytical-grade ethanol at a plant-to-solvent ratio of 1:10 (w/v) and cold-macerated for 72 h with occasional stirring. The macerate was filtered through a Büchner funnel lined with filter paper, and the ethanolic filtrate was concentrated under reduced pressure using a rotary evaporator at 40˚C. Concentrated extracts were stored in closed containers until qualitative testing. Ethanol maceration and reduced-pressure concentration are widely used for broad recovery of plant secondary metabolites [17] [18].

2.3. Qualitative Phytochemical Tests

Nine phytochemical classes were screened using established pharmacognostic color, precipitation, layer, and foam reactions [15] [16] [28]-[34]. The procedures were applied to concentrated ethanolic extracts, except for the phlobatannin assay, for which an aqueous filtrate of powdered plant material was prepared. Reactions were read from the characteristic endpoint specified for each test and recorded on an ordinal scale as absent (−), trace (+), moderate (++), or abundant (+++).

2.3.1. Alkaloids: Mayer's Test

Approximately 2 mL of crude ethanolic extract was mixed with 2 mL of 1% hydrochloric acid and gently warmed. After cooling, Mayer's reagent (potassium mercuric iodide solution) was added dropwise along the wall of the test tube. Formation of a creamy white to pale-yellow precipitate or distinct turbidity was recorded as a positive alkaloid reaction [16] [28] [31] [33].

2.3.2. Flavonoids: Shinoda Test

A 2 mL aliquot of crude extract was placed in a test tube and a few small fragments of magnesium ribbon or magnesium turnings were added. Concentrated hydrochloric acid was then added dropwise. Development of a pink, scarlet, red, orange-red, or magenta coloration within several minutes was recorded as a positive flavonoid reaction [15] [29] [32]-[34].

2.3.3. Glycosides: Liebermann Reaction

Crude extract (2 mL) was mixed with 2 mL of chloroform and 2 mL of glacial acetic acid. The mixture was cooled in an ice bath, after which concentrated sulfuric acid was carefully introduced along the side of the tube. A violet-to-blue-to-green color transition was recorded as a positive reaction for the glycosidic constituents screened by this procedure [16] [32]-[34].

2.3.4. Phenolic Compounds: Ferric Chloride Test

Approximately 50 mg of concentrated extract was dissolved in 5 mL of distilled water. Three to four drops of neutral 5% ferric chloride solution were added and the mixture was observed immediately. Development of a dark green, bluish-green, or blue-black coloration was recorded as a positive reaction for phenolic compounds [15] [16] [28]-[30].

2.3.5. Phytosterols: Liebermann-Burchard Test

Approximately 50 mg of extract was dissolved in 2 mL of acetic anhydride. One to two drops of concentrated sulfuric acid were then added carefully along the inner wall of the test tube. Development of a blue-green to green coloration was recorded as a positive phytosterol reaction in the Liebermann-Burchard test [15] [16] [30] [33].

2.3.6. Phlobatannins

An aqueous filtrate was prepared by dispersing powdered plant material in distilled water, shaking thoroughly, and filtering. Approximately 2 mL of the filtrate was treated with 1% aqueous hydrochloric acid and heated to boiling. Formation of a red precipitate was recorded as a positive phlobatannin reaction [28] [31] [32] [34].

2.3.7. Steroids

Crude extract was mixed with 2 mL of chloroform, and concentrated sulfuric acid was carefully added along the side of the tube. Formation of a red coloration in the lower chloroform layer was recorded as a positive steroid reaction. A second color reaction was performed using a separate aliquot of crude extract mixed with 2 mL of chloroform followed by 2 mL each of concentrated sulfuric acid and acetic acid; development of a greenish coloration supported a positive steroid result [15] [16] [28] [33] [34].

2.3.8. Terpenoids

Crude extract was dissolved in 2 mL of chloroform and the solvent was evaporated to dryness. Concentrated sulfuric acid (2 mL) was added to the residue and the mixture was heated for approximately 2 min. Development of a greyish coloration was recorded as a positive terpenoid reaction [28] [30] [32]-[34].

2.3.9. Saponins: Foam Test

Approximately 50 mg of extract was diluted with distilled water to a final volume of 20 mL in a graduated cylinder and shaken vigorously for 15 min. Formation of a stable, persistent foam layer of approximately 2 cm was recorded as a positive saponin reaction [16] [28]-[31] [34].

2.4. Taxonomic Name Standardization

Botanical nomenclature was standardized against the World Checklist of Vascular Plants and Plants of the World Online [35] [36]. The names used for oregano, tubong usa, lemonsito, and rosas de hapon were *Coleus amboinicus*, *Hellenia speciosa*, *Citrus* × *microcarpa*, and *Chrysanthemum* × *morifolium*, respectively. Pandan was retained at genus level as *Pandanus* sp.

2.5. Statistical Characterization of the Qualitative Matrix

Reaction categories were encoded for statistical summarization as − = 0, + = 1, ++ = 2, and +++ = 3. For each phytochemical class, the proportion of positive taxa (score > 0) was reported with a 95% Wilson score confidence interval [37]. The complete ordinal distribution was retained to summarize reaction intensity. Per-taxon phytochemical richness was defined as the number of positive classes (0 - 9), and an ordinal screening index was calculated as the sum of the nine reaction scores (0 - 27).

Cochran's Q test was used as a global distributional test for binary presence/absence across the nine assay classes [38]. The Friedman test was applied to the ordinal reaction scores, with Kendall's W reported as the corresponding concordance/effect-size measure [39]. Spearman rank correlation was used to examine the association of published UV with phytochemical richness and the ordinal screening index. Statistical significance was evaluated at $\alpha = 0.05$.

2.6. Ethical Considerations

No new interviews or interventions involving human or animal participants were conducted. Plant selection was based on the published ethnobotanical dataset of Cerio (2024) [14], with the local context of Partido Albularyo healing practices described in related studies [11] [12]. The study workflow is shown in **Figure 1**.

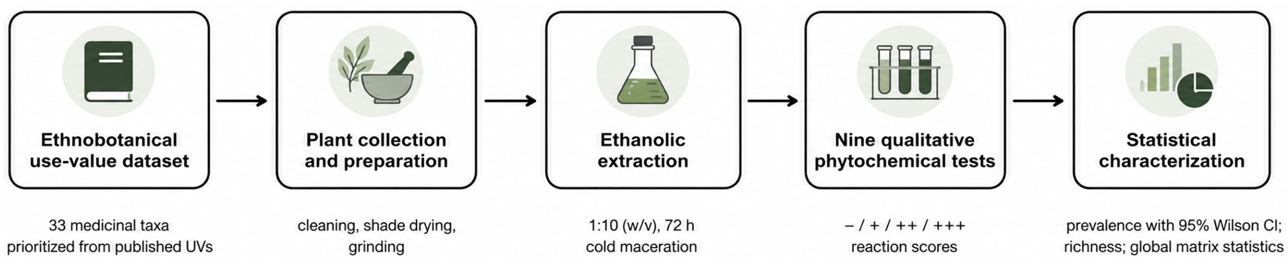

Figure 1. Study workflow from published ethnobotanical use values to plant preparation, ethanolic extraction, qualitative phytochemical screening, and statistical characterization.

3. Results

3.1. Study Materials and Plant-Part Distribution

The study included 33 medicinal taxa, all with use values reported by Cerio (2024) [14]. Leaves were the dominant sampled material (27/33, 81.8%); roots accounted for 3/33 (9.1%), and bark, fruit, and stem each accounted for one taxon (3.0%). Published UVs ranged from 0.036 to 0.664. Table 1 summarizes the plant material, published use value, phytochemical richness, and ordinal screening index.

Table 1. Medicinal plants selected using the ethnobotanical use values reported by Cerio (2024) [14] and their qualitative screening metrics.

Local and scientific name	Part used	Published UV [14]	Richness (0 - 9)	Screening index (0 - 27)
Alom (*Melanolepis multiglandulosa*)	Leaf	0.036	5	9
Anunang (*Cordia dichotoma*)	Leaf	0.236	6	13
Aritana (*Kalanchoe pinnata*)	Leaf	0.040	6	11
Artamesa (*Artemisia vulgaris*)	Leaf	0.664	7	13
Avocado (*Persea americana*)	Leaf	0.104	6	12
Bag-angan (*Eleusine indica*)	Leaf	0.100	7	12
Balingbing (*Averrhoa carambola*)	Leaf	0.044	7	12
Banaba (*Lagerstroemia speciosa*)	Leaf	0.112	7	15
Bayawas (*Psidium guajava*)	Leaf	0.204	8	17
Guyabano (*Annona muricata*)	Leaf	0.112	8	15
Herba buena (*Mentha arvensis*)	Leaf	0.084	7	15
Kalunggay (*Moringa oleifera*)	Leaf	0.160	8	18
Kayo (*Ceiba pentandra*)	Bark	0.040	5	9
Lada (*Capsicum frutescens*)	Fruit	0.044	7	11
Lagundi (*Vitex negundo*)	Leaf	0.152	7	15
Lakad bulan (*Blumea balsamifera*)	Leaf	0.592	7	16
Layang gayo (*Zingiber officinale*)	Root	0.124	8	14
Lemonsito (*Citrus* × *microcarpa*)	Leaf	0.196	7	14
Madre kakaw (*Gliricidia sepium*)	Leaf	0.044	6	14

Continued

Mangga (*Mangifera indica*)	Leaf	0.048	6	10
Niyog-niyog (*Ficus pseudopalma*)	Leaf	0.056	6	10
Oregano (*Coleus amboinicus*)	Leaf	0.376	9	18
Pandan (*Pandanus* sp.)	Leaf	0.048	6	10
Rosas de hapon (*Chrysanthemum* × *morifolium*)	Leaf	0.080	6	9
Santol (*Sandoricum koetjape*)	Leaf	0.112	5	8
Serpentina (*Rauvolfia serpentina*)	Leaf	0.060	7	14
Suro suro (*Peperomia pellucida*)	Leaf	0.144	6	10
Tamahilan (*Curcuma zedoaria*)	Root	0.076	8	12
Tanglad (*Cymbopogon citratus*)	Leaf	0.228	7	11
Tawa tawa (*Euphorbia hirta*)	Leaf	0.188	8	14
Tubang sulog (*Jatropha gossypiifolia*)	Leaf	0.056	7	12
Tubong usa (*Hellenia speciosa*)	Stem	0.052	6	11
Turog-turog (*Mimosa pudica*)	Root	0.040	6	9

3.2. Prevalence and Reaction-Intensity Distribution by Phytochemical Class

Alkaloids, flavonoids, phenolics, and saponins were detected in all 33 ethanolic extracts. Phytosterols were detected in 31 taxa (93.9%; 95% CI 80.4 - 98.3%) and phlobatannins in 28 (84.8%; 95% CI 69.1 - 93.3%). Steroids were detected in 16 taxa (48.5%; 95% CI 32.5 - 64.8%), terpenoids in 9 (27.3%; 95% CI 15.1 - 44.2%), and glycosides in 6 (18.2%; 95% CI 8.6 - 34.4%). For each of the four universally detected classes, the 95% Wilson interval was 89.6 - 100.0%. Table 2 presents the complete rating distributions and Figure 2 displays positive prevalence with confidence intervals.

Table 2. Phytochemical-class prevalence, 95% Wilson confidence intervals, and ordinal reaction distributions.

Class	Positive n/33	Prevalence (%)	95% CI (%)	Absent	Trace +	Moderate ++	Abundant +++	Mean score
Alkaloids	33/33	100.0	89.6 - 100.0	0	6	20	7	2.03
Flavonoids	33/33	100.0	89.6 - 100.0	0	4	24	5	2.03
Glycosides	6/33	18.2	8.6 - 34.4	27	6	0	0	0.18
Phenolics	33/33	100.0	89.6 - 100.0	0	2	19	12	2.30
Phytosterols	31/33	93.9	80.4 - 98.3	2	22	8	1	1.24
Phlobatannins	28/33	84.8	69.1 - 93.3	5	10	9	9	1.67
Steroids	16/33	48.5	32.5 - 64.8	17	15	1	0	0.52
Terpenoids	9/33	27.3	15.1 - 44.2	24	9	0	0	0.27
Saponins	33/33	100.0	89.6 - 100.0	0	4	16	13	2.27

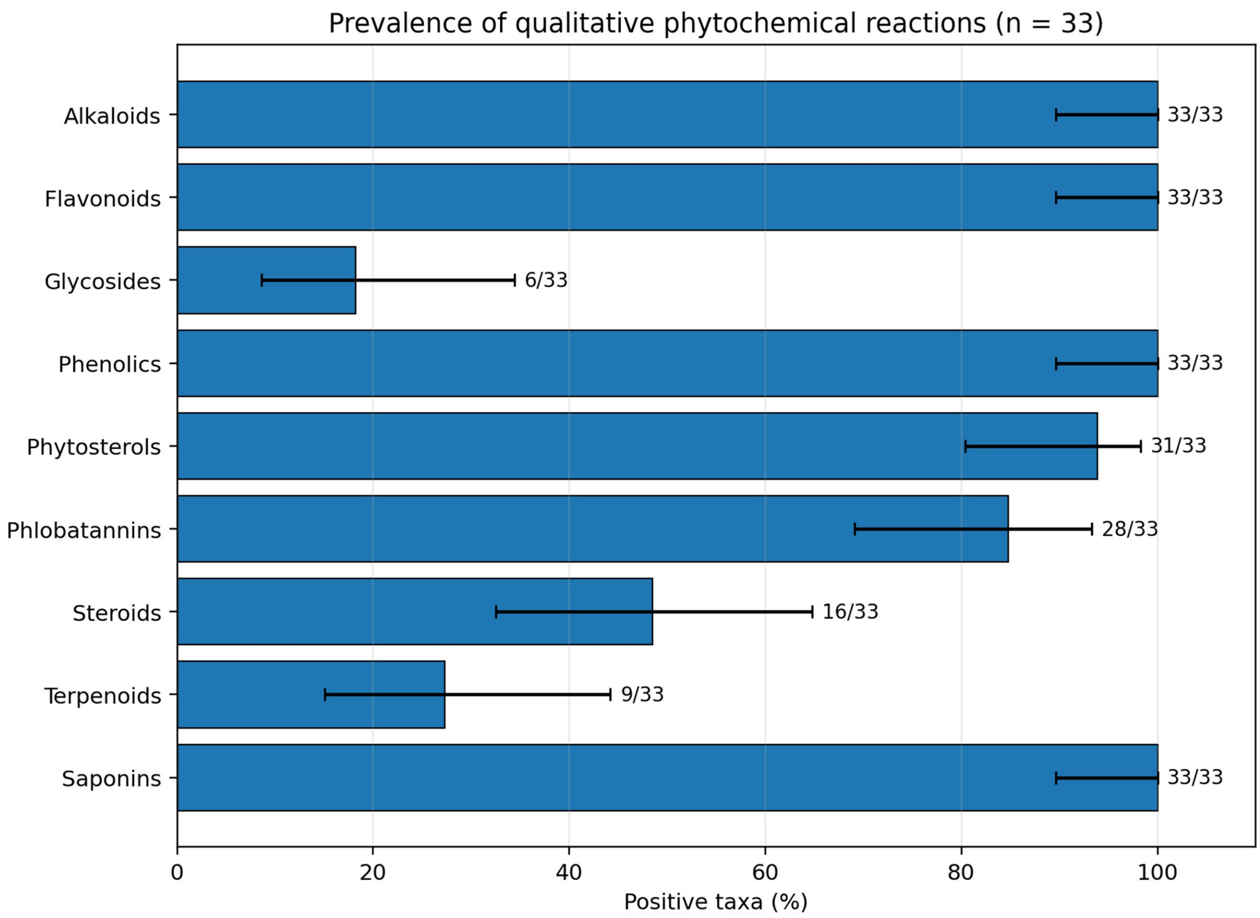

Figure 2. Positive prevalence of nine phytochemical classes across 33 medicinal plant extracts. Error bars show 95% Wilson score confidence intervals; labels show the number of positive taxa out of 33.

3.3. Matrix-Level Statistical Characterization

The qualitative screening matrix showed an uneven distribution of reactions across the nine assay classes. Cochran's Q for binary presence/absence was 151.59 (df = 8, $p < 0.001$). For the ordinal reaction scores, Friedman $\chi^2(8) = 184.02$ ($p < 0.001$), with Kendall W = 0.70. Mean ordinal scores were 2.30/3 for phenolics, 2.27 for saponins, 2.03 for alkaloids and flavonoids, 1.67 for phlobatannins, 1.24 for phytosterols, 0.52 for steroids, 0.27 for terpenoids, and 0.18 for glycosides.

3.4. Taxon-Level Phytochemical Richness and Screening Index

Phytochemical richness averaged 6.73 ± 0.98 classes per taxon, with a median of 7, interquartile range 6 - 7, and range 5 - 9. The ordinal screening index averaged 12.52 ± 2.71 (median 12; IQR 10 - 14; range 8 - 18). Oregano (*Coleus amboinicus*) reacted positively in all nine screened classes and had an index of 18/27. *Moringa oleifera* also scored 18/27 across eight positive classes, followed by *Psidium guajava* (17/27, eight classes) and *Blumea balsamifera* (16/27, seven classes). Figure 3 presents the complete score matrix.

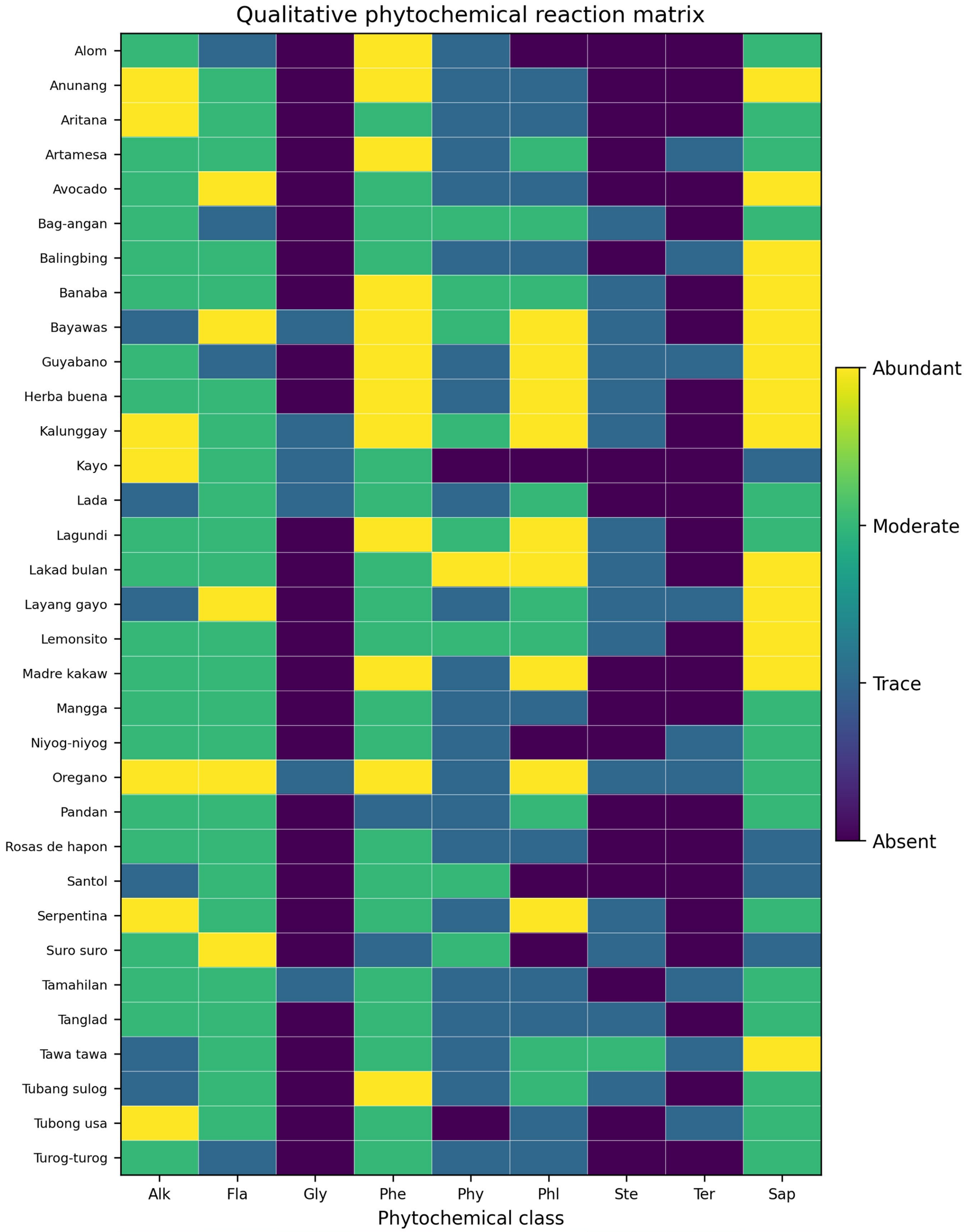

Figure 3. Heatmap of qualitative phytochemical reaction scores across 33 medicinal taxa. Rows are identified by local names corresponding to the standardized scientific names in Table 1. Scores: 0 = absent, 1 = trace, 2 = moderate, 3 = abundant.

3.5. Association between Ethnobotanical Use Value and Screening Metrics

Across the 33 taxa, published UV was positively associated with phytochemical richness (Spearman $\rho = 0.54$, $p = 0.0010$) and with the ordinal screening index ($\rho = 0.61$, $p < 0.001$). Figure 4 presents the relationship between published UV and the screening index.

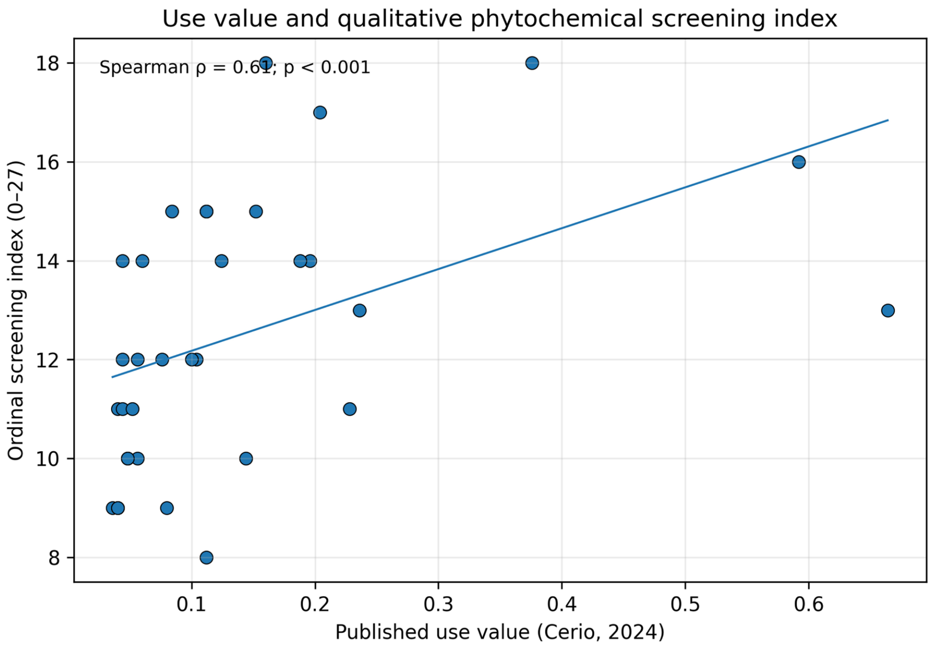

Figure 4. Relationship between published ethnobotanical use value reported by Cerio (2024) [14] and the ordinal qualitative phytochemical screening index across the 33 medicinal taxa. Spearman $\rho = 0.61$, $p < 0.001$.

4. Discussion

The qualitative screening of the 33 medicinal plants selected from the Partido Albularyo use-value dataset revealed a broad distribution of secondary-metabolite classes. Alkaloids, flavonoids, phenolics, and saponins were detected in every extract, while phytosterols and phlobatannins were also widely represented. Glycoside and terpenoid reactions occurred less frequently. The prevalence estimates, ordinal score distributions, and global matrix statistics describe a phytochemical profile dominated by phenolic-, saponin-, flavonoid-, and alkaloid-positive reactions.

The widespread flavonoid and phenolic reactions are consistent with the broad occurrence of these metabolites in higher plants and with their efficient recovery in hydroalcoholic extraction systems [19]-[21]. Saponins likewise occur across many plant families as steroidal or triterpenoid glycosides [22] [23], while phytosterols are common constituents of plant membranes [24]. The strong representation of these classes in the Partido samples therefore agrees with established patterns in medicinal-plant chemistry.

Several taxa with broad reaction profiles have well-documented phytochemistry. *Moringa oleifera* contains phenolics, flavonoids, glucosinolates, and other secondary metabolites [40] [41]. *Psidium guajava* leaves contain diverse flavonoids and phenolic acids [42] [43], *Zingiber officinale* contains prominent phenolic and terpenoid constituents [44], and *Blumea balsamifera* contains a chemically diverse mixture that includes terpenoids and flavonoids [45]. These published chemical profiles correspond with the multiple positive qualitative reactions observed for these plants.

Broad phytochemical diversity has been reported for *Averrhoa carambola* [46], *Cordia dichotoma* [47], Artemisia species [48], *Coleus amboinicus* [49], and *Vitex negundo* [50]. *Annona muricata* is characterized by acetogenins, alkaloids, phenolics, and other metabolites [51]-[53]. *Curcuma zedoaria* contains sesquiterpenes and related constituents [54], Rauvolfia species are notable for monoterpene indole alkaloids [55], and *Peperomia pellucida* contains phenolic and terpenoid constituents [56]. The qualitative reactions recorded in the present study add locality-specific screening data for these ethnobotanically important taxa.

The remaining taxa also represent chemically established medicinal-plant groups. *Jatropha gossypiifolia* and related *Jatropha* species contain diterpenes, phenolics, and other secondary metabolites [57] [58]. *Cymbopogon citratus* is rich in volatile terpenoids and associated phytochemicals [59] [60], while *Mimosa* species contain alkaloids, flavonoids, terpenoids, saponins, steroids, and glycosides [61]. Together, these reports support the broad range of reaction classes observed across the screening matrix.

Additional chemical literature is available for several other screened taxa. *Mangifera indica* leaves contain mangiferin and related phenolics [62]; *Ficus* species contain diverse polyphenolic and terpenoid metabolites [63]; and *Lagerstroemia speciosa* is associated with corosolic acid and other characteristic constituents [64]. *Chrysanthemum* × *morifolium* contains numerous flavonoids and caffeoylquinic acids [65], while *Persea americana* leaves have documented phytochemical and pharmacological profiles [66] [67]. *Kalanchoe pinnata* contains flavonoids and bufadienolides [68], *Gliricidia sepium* has characterized saponins [69], *Sandoricum koetjape* yields modified limonoids [70], and *Capsicum frutescens* is a source of capsaicinoids with extensively characterized pharmacology [71] [72].

The observed association between published UV and the qualitative screening metrics provides an additional link between the ethnobotanical and laboratory datasets. Use value reflects the relative frequency with which a plant is cited or used within an ethnobotanical setting, and it is commonly employed to identify culturally salient taxa for focused investigation [6] [8] [10] [14] [26] [27]. Within the 33 selected Partido plants, higher UV corresponded with greater phytochemical richness and higher ordinal screening scores. This pattern complements the cultural documentation of Partido Albularyo practice [11] [12] and places the chemical screening results within the wider social and cultural context of Camarines Sur [13].

5. Conclusion

Thirty-three medicinal plants selected from the published Partido Albularyo use-value dataset showed diverse qualitative phytochemical profiles after ethanolic extraction. Alkaloids, flavonoids, phenolics, and saponins were detected in all extracts; phytosterols and phlobatannins were also widely distributed, whereas steroid, terpenoid, and glycoside reactions occurred less frequently. *Coleus amboinicus* reacted positively for all nine screened classes, and both *C. amboinicus* and *Moringa oleifera* attained the highest observed screening index. The prevalence estimates, ordinal reaction distributions, phytochemical richness measures, global matrix statistics, and association with published use value provide a structured chemical-class profile of medicinal plants of high ethnobotanical relevance in Partido District. These findings add laboratory phytochemical documentation to the published record of medicinal-plant use by Partido Albularyo.

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Ethics Statement

This laboratory phytochemical study did not involve human or animal participants. Plant selection was based on the published ethnobotanical dataset of Cerio (2024) [14].

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] World Health Organization (2019) WHO Global Report on Traditional and Complementary Medicine 2019. World Health Organization.

[2] Atanasov, A.G., Zotchev, S.B., Dirsch, V.M., Orhan, I.E., Banach, M., Rollinger, J.M., *et al.* (2021) Natural Products in Drug Discovery: Advances and Opportunities. *Nature Reviews Drug Discovery*, **20**, 200-216. https://doi.org/10.1038/s41573-020-00114-z

[3] Newman, D.J. and Cragg, G.M. (2020) Natural Products as Sources of New Drugs over the Nearly Four Decades from 01/1981 to 09/2019. *Journal of Natural Products*, **83**, 770-803. https://doi.org/10.1021/acs.jnatprod.9b01285

[4] Heinrich, M., Lardos, A., Leonti, M., Weckerle, C., Willcox, M., Applequist, W., *et al.* (2018) Best Practice in Research: Consensus Statement on Ethnopharmacological Field Studies-ConSEFS. *Journal of Ethnopharmacology*, **211**, 329-339. https://doi.org/10.1016/j.jep.2017.08.015

[5] Heinrich, M., Appendino, G., Efferth, T., Fürst, R., Izzo, A.A., Kayser, O., *et al.* (2020) Best Practice in Research-Overcoming Common Challenges in Phytopharmacologi-

cal Research. *Journal of Ethnopharmacology*, **246**, Article 112230. https://doi.org/10.1016/j.jep.2019.112230

[6] Fabricant, D.S. and Farnsworth, N.R. (2001) The Value of Plants Used in Traditional Medicine for Drug Discovery. *Environmental Health Perspectives*, **109**, 69-75. https://doi.org/10.1289/ehp.01109s169

[7] Ekor, M. (2014) The Growing Use of Herbal Medicines: Issues Relating to Adverse Reactions and Challenges in Monitoring Safety. *Frontiers in Pharmacology*, **4**, Article ID: 177. https://doi.org/10.3389/fphar.2013.00177

[8] Abe, R. and Ohtani, K. (2013) An Ethnobotanical Study of Medicinal Plants and Traditional Therapies on Batan Island, the Philippines. *Journal of Ethnopharmacology*, **145**, 554-565. https://doi.org/10.1016/j.jep.2012.11.029

[9] Balangcod, T.D. and Balangcod, A.K.D. (2011) Ethnomedical Knowledge of Plants and Healthcare Practices among the Kalanguya Tribe in Tinoc, Ifugao, Luzon, Philippines. *Indian Journal of Traditional Knowledge*, **10**, 227-238.

[10] Ong, H.G. and Kim, Y. (2014) Quantitative Ethnobotanical Study of the Medicinal Plants Used by the Ati Negrito Indigenous Group in Guimaras Island, Philippines. *Journal of Ethnopharmacology*, **157**, 228-242. https://doi.org/10.1016/j.jep.2014.09.015

[11] Rebuya, N.R., Lasarte, E.S. and Amador, M.M.A. (2020) Medical Pluralism, Traditional Healing Practices, and the Partido Albularyo: Challenge in Inclusion. *Open Journal of Social Sciences*, **8**, 72-79. https://doi.org/10.4236/jss.2020.86007

[12] Cerio, C.T. (2020) Albularyo Folk Healing: Cultural Beliefs on Healthcare Management in Partido District, Camarines Sur, Philippines. *Journal of Southeast Asian Studies*, **25**, 210-236. https://doi.org/10.22452/jati.vol25no1.11

[13] Rebuya, N.R., Lasarte, E.S., Amador, M.M.A. and Roca, G.R.D.L. (2020) Assessing Religious Tourism Motivational Factors and Experiences of Visitors to Selected Religious Sites in Camarines Sur, Philippines. *OALib*, **07**, 1-10. https://doi.org/10.4236/oalib.1106404

[14] Cerio, C.T. (2024) Ethnobotanical Documentation of Plants Used as Traditional Therapies by Partido Albularyo in the Philippines. *Interdisciplinary Research Review*, **19**, 12-20. https://ph02.tci-thaijo.org/index.php/jtir/article/view/249147

[15] Harborne, J.B. (1998) Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. 3rd Edition, Chapman & Hall.

[16] Evans, W.C. (2009) Trease and Evans Pharmacognosy. 16th Edition, Saunders Elsevier.

[17] Azmir, J., Zaidul, I.S.M., Rahman, M.M., Sharif, K.M., Mohamed, A., Sahena, F., *et al.* (2013) Techniques for Extraction of Bioactive Compounds from Plant Materials: A Review. *Journal of Food Engineering*, **117**, 426-436. https://doi.org/10.1016/j.jfoodeng.2013.01.014

[18] Sasidharan, S., Chen, Y., Saravanan, D., Sundram, K. and Latha, L. (2011) Extraction, Isolation and Characterization of Bioactive Compounds from Plants' Extracts. *African Journal of Traditional, Complementary and Alternative Medicines*, **8**, 1-10. https://doi.org/10.4314/ajtcam.v8i1.60483

[19] Panche, A.N., Diwan, A.D. and Chandra, S.R. (2016) Flavonoids: An Overview. *Journal of Nutritional Science*, **5**, e47. https://doi.org/10.1017/jns.2016.41

[20] Dai, J. and Mumper, R.J. (2010) Plant Phenolics: Extraction, Analysis and Their Antioxidant and Anticancer Properties. *Molecules*, **15**, 7313-7352. https://doi.org/10.3390/molecules15107313

[21] Olszowy, M. (2019) What Is Responsible for Antioxidant Properties of Polyphenolic Compounds from Plants? *Plant Physiology and Biochemistry*, **144**, 135-143. https://doi.org/10.1016/j.plaphy.2019.09.039

[22] Augustin, J.M., Kuzina, V., Andersen, S.B. and Bak, S. (2011) Molecular Activities, Biosynthesis and Evolution of Triterpenoid Saponins. *Phytochemistry*, **72**, 435-457. https://doi.org/10.1016/j.phytochem.2011.01.015

[23] Sparg, S.G., Light, M.E. and van Staden, J. (2004) Biological Activities and Distribution of Plant Saponins. *Journal of Ethnopharmacology*, **94**, 219-243. https://doi.org/10.1016/j.jep.2004.05.016

[24] Zhang, R., Han, Y., McClements, D.J., Xu, D. and Chen, S. (2022) Production, Characterization, Delivery, and Cholesterol-Lowering Mechanism of Phytosterols: A Review. *Journal of Agricultural and Food Chemistry*, **70**, 2483-2494. https://doi.org/10.1021/acs.jafc.1c07390

[25] Cowan, M.M. (1999) Plant Products as Antimicrobial Agents. *Clinical Microbiology Reviews*, **12**, 564-582. https://doi.org/10.1128/cmr.12.4.564

[26] Heinrich, M., Edwards, S., Moerman, D.E. and Leonti, M. (2009) Ethnopharmacological Field Studies: A Critical Assessment of Their Conceptual Basis and Methods. *Journal of Ethnopharmacology*, **124**, 1-17. https://doi.org/10.1016/j.jep.2009.03.043

[27] Andrade-Cetto, A. and Heinrich, M. (2011) From the Field into the Lab: Useful Approaches to Selecting Species Based on Local Knowledge. *Frontiers in Pharmacology*, **2**, Article ID: 20. https://doi.org/10.3389/fphar.2011.00020

[28] Edeoga, H.O., Okwu, D.E. and Mbaebie, B.O. (2005) Phytochemical Constituents of Some Nigerian Medicinal Plants. *African Journal of Biotechnology*, **4**, 685-688. https://doi.org/10.5897/ajb2005.000-3127

[29] Adesegun, S., Ayoola, G., Coker, H., Adepoju-Bello, A., Obaweya, K., Ezennia, E., *et al*. (2008) Phytochemical Screening and Antioxidant Activities of Some Selected Medicinal Plants Used for Malaria Therapy in Southwestern Nigeria. *Tropical Journal of Pharmaceutical Research*, **7**, 1019-1024. https://doi.org/10.4314/tjpr.v7i3.14686

[30] Nortjie, E., Basitere, M., Moyo, D. and Nyamukamba, P. (2022) Extraction Methods, Quantitative and Qualitative Phytochemical Screening of Medicinal Plants for Antimicrobial Textiles: A Review. *Plants*, **11**, Article 2011. https://doi.org/10.3390/plants11152011

[31] Sofowora, A. (2008) Medicinal Plants and Traditional Medicine in Africa. 3rd Edition, Spectrum Books.

[32] Yadav, R.N.S. and Agarwala, M. (2011) Phytochemical Analysis of Some Medicinal Plants. *Journal of Phytology*, **3**, 10-14.

[33] Raaman, N. (2006) Phytochemical Techniques. New India Publishing Agency.

[34] Tiwari, P., Kumar, B., Kaur, M., Kaur, G. and Kaur, H. (2011) Phytochemical Screening and Ex-Traction: A Review. *Internationale Pharmaceutica Sciencia*, **1**, 98-106.

[35] Govaerts, R., Nic Lughadha, E., Black, N., Turner, R. and Paton, A. (2021) The World Checklist of Vascular Plants, a Continuously Updated Resource for Exploring Global Plant Diversity. *Scientific Data*, **8**, Article No. 215. https://doi.org/10.1038/s41597-021-00997-6

[36] Royal Botanic Gardens, Kew (2026) Plants of the World Online (POWO). Kew Science. https://powo.science.kew.org/

[37] Agresti, A. and Coull, B.A. (1998) Approximate Is Better than "Exact" for Interval Estimation of Binomial Proportions. *The American Statistician*, **52**, 119-126. https://doi.org/10.1080/00031305.1998.10480550

[38] Cochran, W.G. (1950) The Comparison of Percentages in Matched Samples. *Biometrika*, **37**, 256-266. https://doi.org/10.1093/biomet/37.3-4.256

[39] Friedman, M. (1937) The Use of Ranks to Avoid the Assumption of Normality Implicit in the Analysis of Variance. *Journal of the American Statistical Association*, **32**, 675-701. https://doi.org/10.1080/01621459.1937.10503522

[40] Liu, R., Liu, J., Huang, Q., Liu, S. and Jiang, Y. (2022) *Moringa oleifera*: A Systematic Review of Its Botany, Traditional Uses, Phytochemistry, Pharmacology and Toxicity. *Journal of Pharmacy and Pharmacology*, **74**, 296-320. https://doi.org/10.1093/jpp/rgab131

[41] Mbikay, M. (2012) Therapeutic Potential of *Moringa oleifera* Leaves in Chronic Hyperglycemia and Dyslipidemia: A Review. *Frontiers in Pharmacology*, **3**, Article ID: 24. https://doi.org/10.3389/fphar.2012.00024

[42] Díaz-de-Cerio, E., Verardo, V., Gómez-Caravaca, A., Fernández-Gutiérrez, A. and Segura-Carretero, A. (2017) Health Effects of *Psidium guajava* L. Leaves: An Overview of the Last Decade. *International Journal of Molecular Sciences*, **18**, Article 897. https://doi.org/10.3390/ijms18040897

[43] Kumar, M., Tomar, M., Amarowicz, R., Saurabh, V., Nair, M.S., Maheshwari, C., *et al.* (2021) Guava (*Psidium guajava* L.) Leaves: Nutritional Composition, Phytochemical Profile, and Health-Promoting Bioactivities. *Foods*, **10**, Article 752. https://doi.org/10.3390/foods10040752

[44] Mao, Q.Q., Xu, X.Y., Cao, S.Y., Gan, R.Y., Corke, H., Beta, T. and Li, H.B. (2019) Bioactive Compounds and Bioactivities of Ginger (*Zingiber officinale* Roscoe). *Foods*, **8**, Article 185. https://doi.org/10.3390/foods8060185

[45] Pang, Y., Wang, D., Fan, Z., Chen, X., Yu, F., Hu, X., *et al.* (2014) *Blumea balsamifera*—A Phytochemical and Pharmacological Review. *Molecules*, **19**, 9453-9477. https://doi.org/10.3390/molecules19079453

[46] Luan, F., Peng, L., Lei, Z., Jia, X., Zou, J., Yang, Y., *et al.* (2021) Traditional Uses, Phytochemical Constituents and Pharmacological Properties of *Averrhoa carambola* L.: A Review. *Frontiers in Pharmacology*, **12**, Article ID: 699899. https://doi.org/10.3389/fphar.2021.699899

[47] Raghuvanshi, D., Sharma, K., Verma, R., Kumar, D., Kumar, H., Khan, A., *et al.* (2022) Phytochemistry, and Pharmacological Efficacy of *Cordia dichotoma* G. Forst. (Lashuda): A Therapeutic Medicinal Plant of Himachal Pradesh. *Biomedicine & Pharmacotherapy*, **153**, Article 113400. https://doi.org/10.1016/j.biopha.2022.113400

[48] Sharifi-Rad, J., Herrera-Bravo, J., Semwal, P., Painuli, S., Badoni, H., Ezzat, S.M., *et al.* (2022) *Artemisia* Spp.: An Update on Its Chemical Composition, Pharmacological and Toxicological Profiles. *Oxidative Medicine and Cellular Longevity*, **2022**, Article ID: 5628601. https://doi.org/10.1155/2022/5628601

[49] Arumugam, G., Swamy, M. and Sinniah, U. (2016) *Plectranthus amboinicus* (Lour.) Spreng: Botanical, Phytochemical, Pharmacological and Nutritional Significance. *Molecules*, **21**, Article 369. https://doi.org/10.3390/molecules21040369

[50] Zheng, C., Li, H., Ren, S., Xu, C., Rahman, K., Qin, L., *et al.* (2015) Phytochemical and Pharmacological Profile of *Vitex negundo*. *Phytotherapy Research*, **29**, 633-647. https://doi.org/10.1002/ptr.5303

[51] Moghadamtousi, S., Fadaeinasab, M., Nikzad, S., Mohan, G., Ali, H. and Kadir, H. (2015) *Annona muricata* (Annonaceae): A Review of Its Traditional Uses, Isolated Acetogenins and Biological Activities. *International Journal of Molecular Sciences*, **16**, 15625-15658. https://doi.org/10.3390/ijms160715625

[52] Coria-Téllez, A.V., Montalvo-Gónzalez, E., Yahia, E.M. and Obledo-Vázquez, E.N. (2018) *Annona muricata*: A Comprehensive Review on Its Traditional Medicinal Uses, Phytochemicals, Pharmacological Activities, Mechanisms of Action and Toxicity. *Arabian Journal of Chemistry*, **11**, 662-691. https://doi.org/10.1016/j.arabjc.2016.01.004

[53] Zubaidi, S.N., Mohd Nani, H., Ahmad Kamal, M.S., Abdul Qayyum, T., Maarof, S., Afzan, A., *et al*. (2023) *Annona muricata*: Comprehensive Review on the Ethnomedicinal, Phytochemistry, and Pharmacological Aspects Focusing on Antidiabetic Properties. *Life*, **13**, Article 353. https://doi.org/10.3390/life13020353

[54] Lobo, R., Prabhu, K.S., Shirwaikar, A. and Shirwaikar, A. (2009) *Curcuma zedoaria* Rosc. (White Turmeric): A Review of Its Chemical, Pharmacological and Ethnomedicinal Properties. *Journal of Pharmacy and Pharmacology*, **61**, 13-21. https://doi.org/10.1211/jpp.61.01.0003

[55] Kumar, S., Kumari, D. and Singh, B. (2022) Genus *Rauvolfia*: A Review of Its Ethnopharmacology, Phytochemistry, Quality Control/Quality Assurance, Pharmacological Activities and Clinical Evidence. *Journal of Ethnopharmacology*, **295**, Article 115327. https://doi.org/10.1016/j.jep.2022.115327

[56] Ho, K.L., Yong, P.H., Wang, C.W., Kuppusamy, U.R., Ngo, C.T., Massawe, F., *et al*. (2022) *Peperomia pellucida* (L.) Kunth and Eye Diseases: A Review on Phytochemistry, Pharmacology and Toxicology. *Journal of Integrative Medicine*, **20**, 292-304. https://doi.org/10.1016/j.joim.2022.02.002

[57] Félix-Silva, J., Giordani, R.B., Silva-Jr, A.A.D., Zucolotto, S.M. and Fernandes-Pedrosa, M.D.F. (2014) *Jatropha gossypiifolia* L. (Euphorbiaceae): A Review of Traditional Uses, Phytochemistry, Pharmacology, and Toxicology of This Medicinal Plant. *Evidence-Based Complementary and Alternative Medicine*, **2014**, Article ID: 369204. https://doi.org/10.1155/2014/369204

[58] Sabandar, C.W., Ahmat, N., Jaafar, F.M. and Sahidin, I. (2013) Medicinal Property, Phytochemistry and Pharmacology of Several *Jatropha* Species (Euphorbiaceae): A Review. *Phytochemistry*, **85**, 7-29. https://doi.org/10.1016/j.phytochem.2012.10.009

[59] Ekpenyong, C.E., Akpan, E. and Nyoh, A. (2015) Ethnopharmacology, Phytochemistry, and Biological Activities of *Cymbopogon citratus* (DC.) Stapf Extracts. *Chinese Journal of Natural Medicines*, **13**, 321-337. https://doi.org/10.1016/s1875-5364(15)30023-6

[60] Avoseh, O., Oyedeji, O., Rungqu, P., Nkeh-Chungag, B. and Oyedeji, A. (2015) *Cymbopogon* Species; Ethnopharmacology, Phytochemistry and the Pharmacological Importance. *Molecules*, **20**, 7438-7453. https://doi.org/10.3390/molecules20057438

[61] Rizwan, K., Majeed, I., Bilal, M., Rasheed, T., Shakeel, A. and Iqbal, S. (2022) Phytochemistry and Diverse Pharmacology of Genus *Mimosa*: A Review. *Biomolecules*, **12**, Article 83. https://doi.org/10.3390/biom12010083

[62] Kumar, M., Saurabh, V., Tomar, M., Hasan, M., Changan, S., Sasi, M., *et al*. (2021) Mango (*Mangifera indica* L.) Leaves: Nutritional Composition, Phytochemical Profile, and Health-Promoting Bioactivities. *Antioxidants*, **10**, Article 299. https://doi.org/10.3390/antiox10020299

[63] Salehi, B., Prakash Mishra, A., Nigam, M., Karazhan, N., Shukla, I., Kiełtyka-Dadasiewicz, A., *et al*. (2021) *Ficus* Plants: State of the Art from a Phytochemical, Pharmacological, and Toxicological Perspective. *Phytotherapy Research*, **35**, 1187-1217. https://doi.org/10.1002/ptr.6884

[64] Stohs, S.J., Miller, H. and Kaats, G.R. (2012) A Review of the Efficacy and Safety of

Banaba (*Lagerstroemia speciosa* L.) and Corosolic Acid. *Phytotherapy Research*, **26**, 317-324. https://doi.org/10.1002/ptr.3664

[65] Chen, S., Liu, J., Dong, G., Zhang, X., Liu, Y., Sun, W., *et al*. (2021) Flavonoids and Caffeoylquinic Acids in *Chrysanthemum morifolium* Ramat Flowers: A Potentially Rich Source of Bioactive Compounds. *Food Chemistry*, **344**, Article 128733. https://doi.org/10.1016/j.foodchem.2020.128733

[66] Yasir, M., Das, S. and Kharya, M. (2010) The Phytochemical and Pharmacological Profile of *Persea americana* Mill. *Pharmacognosy Reviews*, **4**, 77-84. https://doi.org/10.4103/0973-7847.65332

[67] Adeyemi, O.O., Okpo, S.O. and Ogunti, O.O. (2002) Analgesic and Anti-Inflammatory Effects of the Aqueous Extract of Leaves of *Persea americana* Mill (Lauraceae). *Fitoterapia*, **73**, 375-380. https://doi.org/10.1016/s0367-326x(02)00118-1

[68] Fürer, K., Simões-Wüst, A., von Mandach, U., Hamburger, M. and Potterat, O. (2016) *Bryophyllum pinnatum* and Related Species Used in Anthroposophic Medicine: Constituents, Pharmacological Activities, and Clinical Efficacy. *Planta Medica*, **82**, 930-941. https://doi.org/10.1055/s-0042-106727

[69] Kojima, K., Zhu, X. and Ogihara, Y. (1998) Saponins from *Gliricidia sepium*. *Phytochemistry*, **48**, 885-888. https://doi.org/10.1016/s0031-9422(97)00977-1

[70] Ismail, I.S., Ito, H., Hatano, T., Taniguchi, S. and Yoshida, T. (2003) Modified Limonoids from the Leaves of *Sandoricum koetjape*. *Phytochemistry*, **64**, 1345-1349. https://doi.org/10.1016/s0031-9422(03)00500-4

[71] Cordell, G.A. and Araujo, O.E. (1993) Capsaicin: Identification, Nomenclature, and Pharmacotherapy. *Annals of Pharmacotherapy*, **27**, 330-336. https://doi.org/10.1177/106002809302700316

[72] Zhang, W., Zhang, Y., Fan, J., Feng, Z. and Song, X. (2024) Pharmacological Activity of Capsaicin: Mechanisms and Controversies (Review). *Molecular Medicine Reports*, **29**, Article No. 38. https://doi.org/10.3892/mmr.2024.13162