**Title of Article**

First Author1,\*, Second Author2, Third Author1, Fourth Author3

***Abstract***

*Abstract should be in ~300 words.*

**Keywords:** There should be five to ten keywords

# Introduction

Manuscript should be submitted in .doc, .docx, .rtf files. Manuscript should be around 2000 to 7000 word count [1]. The main text of the article should appear here with headings as appropriate.

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Figures and their Captions (all Figures have been numbered and cited; Source of all Figures have been provided) (7–8 Figures).

Tables and their Captions (all Tables have been numbered and cited; Source of all Tables. have been provided) (7–8 Tables).

References (reference have been arranged as per Author-Number System) (at least 10 references and not more than 50 references; also, recent references should be included.).[3].

The reasons for increasing demands are medicinal plants often being more available, affordable, sometimes perceived as more effective than conventional drugs, culturally acceptable and their relatively lower cost. However, most of these medicinal plants which are claimed to be effective in traditional practice for various diseases lack scientific documented evidence of their safety, efficacy or quality [3].

All References mentioned in the reference list are cited in the text and vice versa. In reference list, each reference should have at least name of author, title of the article, place of publication (name of book or journal), and year of publication [4]. All References mentioned in the reference list are cited in the text and vice versa. In reference list, each reference should have at least name of author, title of the article, place of publication (name of book or journal), and year of publication [5]. All References mentioned in the reference list are cited in the text and vice versa. In reference list, each reference should have at least name of author, title of the article, place of publication (name of book or journal), and year of publication (Figure 1) [5].

According to WHO guidelines, standardization and quality control of herbals is the process involved in the physicochemical evaluation of crude drug covering aspects, such as selection and handling of crude material, safety, efficacy and stability assessment of finished product, documentation of safety and risk based on experience, provision of product information to consumer and product promotion [6–8]. This includes the following basic evaluation for quality of herbal medicines [6, 7]: all aspects that contribute to the quality of the herbal drugs, namely correct identity of the sample, organoleptic evaluation, pharmacognostic evaluation, volatile matter, quantitative evaluation (ash values, extractive values), phytochemical evaluation, test for the presence of xenobiotics, microbial load testing, toxicity testing, and biological activity. Of these, the phytochemical profile is of special significance since it has a direct bearing on the activity of the herbal drugs [39].



**Figure 1.** Figures should their Captions.

# ObjectiveS

## General Objective

The general objective of this review is to explore, synthesize and compile evidence of analytical methods used for the quality control and standardization of medicinal plants.

##

## Specific Objectives

* To identify and describe analytical methods used for phytochemical analysis of medicinal plants.
* To identify and describe analytical methods used for physicochemical analysis of medicinal plant.
* To identify potential applications in standardization of medicinal plants.

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# Methodology

## Search Strategies

A web-based research literature search strategy was employed for studies reported on quality control and standardization of medicinal plants with analytical methods commonly used for their investigations. Relevant literatures were gathered by two different search approaches, including: Search for published journal articles using international scientifc databases including PubMed, Science direct, Web of Science, Google scholar and using Google search engine as a general for supplementary guidelines and standards.

* Not related to study topic objectives (standardization of medicinal plants).
* Review articles.
* Unpublished research data.

## Data Extraction and Evaluation

Analytical methods used for the phytochemical investigation and standardization of medicinal plants were entered in to excel spreadsheet and summarized using descriptive statistics (tables and charts). The review of the selected 34 original research articles was included for data evaluation and their detailed characteristics of the studies such as botanical name, part used, the extraction method, analytical method for phytochemicals analysis and physicochemical analysis, year of publication, were analyzed and presented using tables.

# Results

**Data Evaluation for Analytical Methods**

Results of data evaluation for analytical methods used are summarized as following (Table 1):



**Figure 2.** Flowchart for Selection of Relevant Literature for the Review.

**Table 1.** Tables should their Captions.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scientific Name** | **Part Used** | **Publication Year** | **Analytical Method** | **Constituents** | **Reference** |
| *Piper longum Linn* | Fruit | 2006 | RP-HPLC | sesamin, brachystamide guineensine | [20] |
| *Woodfordia fruticosa* | Flower | 2014 | TLC Fingerprint, Fluorescence | ellagic acid, gallic acid | [17] |
| *Dioscorea bulbifera* | Whole | 2013 | AAS, UV | Vit C, Vit D | [29] |
| *Cucurbita maxima* | Seed | 2012 | TLC, HPTLC, GC/MS | glucaosazone | [23] |
| *Aerva lanata* | Whole | 2014 | FT-IR |  | [28] |
| *Curcuma caesia* | Leaf | 2017 | GC MS, FT-IR | α-Santalol, Retinal, Ar-tumerone | [27] |
| *Boswellia serrate* | Leaf | 2012 | TLC, IR, GC/MS, NMR | Tetrahydro-2H-pyran-2, 3, 4, 5-tetrol | [30] |
| *Aloe vera* | Stem | 2012 | HPTLC Fingerprint | Berberine, gallic acid | [18] |
| *Entada Africana* | leaf $ stem | 2019 | UV-Vis, Fluorescence |  | [24] |

Result of fluorescence analysis of medicinal plants is summarized as following (Table 2):

# Discussion

Based the above scientific studies, a different plant part is used for standardization and phytochemical investigations. The most frequently used parts are illustrated in Figure 3. For all these investigations recommended standards are used for collection, drying, storage, transport and preparation of medicinal plants (Table 3) [9, 10, 2, 16, 17, 18, 20, 23, 24, 26–53].

**Table 2.** Fluorescence Study of Selected Medicinal Plants.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Study** | **Scientific Name** | **Part Used** | **Reagent Used** | **Reference** |
| Physicochemical properties  | *Butea frondosa Koen.* | Leaf | H2SO4, HNO3, NaOH, FeCl3 and Picric acid | [31] |
| >> | *Woodfordia fruticosa* | Flower | NaOH, HCl and H2SO4 | [17] |
| >> | *Cajanus scarabaeoides* | Whole | NaOH, HCl, H2SO4, HNO3 and KOH | [26] |

# Table 3. Detail Characteristics of Studies Included (n=34) for Review.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Scientific Name** | **Collection Site** | **Part Used** | **Extraction Method** | **Pysico-Method** | **Pyto-Method** | **Ref.$ Pub.y** |
| *Moringa Oleifera* | Ethiopia | Leaf | Soxhlet | Standard | Standard Test | [33], 2014 |
| *Fadogia cienkowski* | Nigeria | Leaf | Maceration | Standard | Standard Test | [34], 2019 |
| *Enicostemma Littorale* | Sri Lanka | Whole | Soxhlet | Standard | Standard Test | [35], 2013 |
| *Caesalpinia crista L* | India | Root | Soxhlet | Fluorescence | Standard Test | [36], 2019 |
| *Acacia auriculiformis A.* | India | Stem Bark | Soxhlet | Standard | Standard Test | [37], 2017 |
| *Limonium stocksii* | India | Leaf $ Stem | Solvents Extraction | Fluorescence | Standard Test | [38], 2018 |
| *Quercus infectoria* | Sudan | Galls | Solvents Extraction | Standard | UV | [39], 2018 |
| *Amaranthus Spinosus /inn* | India | Root | Soxhlet | Standard | TLC | [40], 2011 |
| *raetem (forssk) Webb* | Libya | Leaf | Soxhlet | Not Specified | Standard Test | [41], 2017 |
| *Sesamum indicum L* | India | Seed | Soxhlet | standard | Standard Test | [42], 2018 |
| *Woodfordia fruticosa* | India | Flower | Soxhlet | Fluorescence | TLC Fingerprint | [17], 2014 |
| *Aerva lanata*  | India | Whole | Soxhlet | Not Specified | FT-IR | [28], 2014 |
| *Aloe vera* | India | Leaf | Solvents Extraction | Not Specified | HPTLC | [18], 2012 |
| *Argemone mexicana* | Mali | Leaf | Not Specified | Standard | Standard Test | [43], 2020 |
| *Dioscorea bulbifera* | Malaysia | Whole | Not Specified | Standard | AAS | [29], 2013 |
| *Cassia fistula* | India | Leaf | Solvents Extraction | Not Specified | HPTLC | [44], 2014 |
| *Cayratia trifolia* | India | Stem | Not Specified | Fluorescence | Standard Test | [45], 2012 |
| *Cissampelos pareira* | India | Stem | Solvents Extraction | Standard | TLC | [46], 2012 |
| *Crotalaria lachnosema* | Nigeria | Leaf | Solvents Extraction | Standard | TLC | [47], 2012 |
| *Cucurbita maxima* | India | Seed | Solvents Extraction | Standard | TLC, HPTLC, GC/MS | [23], 2012 |
| *Curcuma caesia* | India | Rhizomes | Soxhlet | Not Specified | GC MS, FT-IR | [27], 2017 |
| *Lasia Spinosa* | India | Whole | Percolation | Fluorescence | TLC | [16], 2013 |
| *Pterocarpus santalinus* | India | Leaf $ Stem | Solvents Extraction | Fluorescence | Standard Test | [48], 2017 |
| *Strychnos nux* | India | Seed | Solvents Extraction | Standard | HPTLC | [49], 2012 |
| *Butea frondosa Koen.* | India | Leaf | Soxhlet | Fluorescence | TLC | [31], 2012 |
| *Boswellia serrata* | India | Leaf | Soxhlet | Not Specified | TLC, IR, GC/MS, NMR | [30], 2012 |
| *Cajanus scarabaeoides* | India | Whole | Maceration | Fluorescence | UV | [26], 2018 |
| *Cassia surattensis* | India | Seed | Maceration | Standard | Standard Test | [2], 2020 |
| *Madhuca Indica* | India | Leaf $ Stem | Not Specified | Fluorescence | Standard Test | [50], 2015 |
| *Mallotus rhamnifolius* | India | Leaf | Soxhlet | Standard | Standard Test | [51], 2017 |
| *Calliandra calothyrsus Meissn* | Indonesia | Leaf | Digestion | Standard | DPPH Assay | [52], 2019 |
| *Piper longum* | India | Fruit | Solvents Extraction | Not Specified | RP-HPLC | [20], 2006 |
| *Lunasia amara* | Indonesia | Wood | Solvents Extraction | Not Specified | UFLC | [53], 2016 |
| *Entada africana* | Ghana | Leaf $ Stem | Not Specified | Fluorescence | UV | [24], 2019 |

Based on these studies, sample preparation involves extraction of crude drugs for further analysis using different solvents depending on nature of medicinal plant and solvent extraction capacity by different methods such as maceration, soxlet, percolation, digestion and continuous solvent extractions [9, 2, 16, 30, 49, 52].

**Figure 3.** Chart of Frequently Used Plant Parts (%) from (n=34) included in Review.

**Figure 4.** Summary of Studies Included in the Review (n=34) by Year of Publication.

Phytochemicals are naturally occurring chemical compounds found in the medicinal plants, which serve for defense mechanism and prevention from various diseases. Phytochemicals are primary and secondary compounds. Chlorophyll, proteins and common sugars are included in primary constituents and secondary compounds have terpenoid, alkaloids and phenolic compounds [9]. These secondary metabolites are responsible for medicinal activity of the plant [10]. Numbers of plants were screened for secondary metabolites for their medicinal values [10].

# Conclusion

The conclusions section should come in this section at the end of the article, before the acknowledgements.

# Acknowledgement

The acknowledgements come at the end of an article after the conclusions and before the notes and references.

#

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