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Review Article

Plant Extracts as Herbal Indicators

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ABSTRACT

When the pH of the solution is altered by adding acid or alkali, indicators—which are highly specific compounds—will cause the solution's color to change. Red cabbage's actual color is blue. It will be somewhat blue after cutting it up and adding some tap water, but it will turn red when vinegar is added. This is because the color in red cabbage acts as a pH sensor. The aim of this study is to examine the possibility of using extracts of flower pigments in place of synthetic indicators. Synthetic indicators are costly, problematic in terms of supply, and hazardous chemically. An essential part of determining the herbal markers is the use of plant extracts. We must adhere to a number of crucial procedures and approaches that may be used during plant extraction in order to preserve the stability and caliber of the indicator that is intended to be displayed.

INTRODUCTION

Characteristic compounds known as indicators show color shifts and the degree of basicity or acidity in a solution. Weak organic acids or bases that display tautomerism in which one form is colored are referred to as indicators. Since weak acids differ in color from their conjugate base in aqueous solution, they are utilized as acid-base indicators in specific situations (1). Different types of indicators can be identified using a variety of techniques and processes, such as acid-base titration, which involves neutralizing an acid or base with an acid or base of known concentration. As a result, the concentration of an unknown acid or basic solution is quantitatively analyzed (2). More drawbacks of synthetic indicators are their high cost, availability, and chemical contamination (3). Most popular synthetic indicators available for purchase are expensive. Moreover, they are toxic and flammable. Negative aspects like availability, environmental harm, and chemical pollution are also highlighted. Additionally, the use of synthetic markers in food applications is avoided or greatly minimized due

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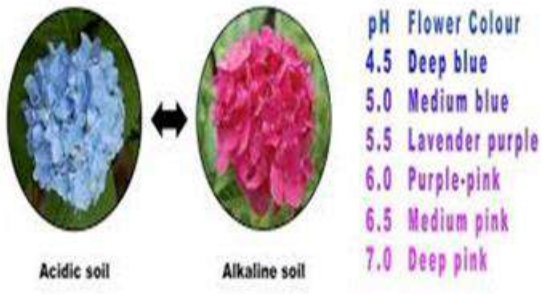
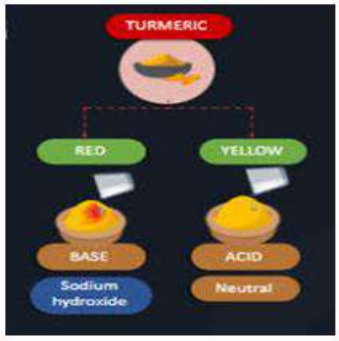
to the possibility of negative physiological effects (4). Natural pigments or colors that are found in plants are rarely toxic, free of pollutants, and easy to produce or extract. Parts of plants get their color from anthocyanins and other organic and inorganic compounds. Anthocyanins are useful as natural indicators since their color changes with pH 7. The availability, ease of extraction, excellent performance, and precise results of natural herbal indicators make them a good substitute for synthetic indicators employed in many labs and research institute (5). Enhancing the traditional medicinal system and introducing plant pigments to the market are the goals of this study. Titration is a basic chemistry lab technique used to quantitatively analyze compounds with unknown quantities using standard solutions with known values. Analytes are substances with established concentrations, whereas titrates are standard solutions (6).





Some Of the Commonly Used Plants as Herbal Indicators:

There are many different types of plants and plant extracts that are employed as herbal indicators, and they have intricate compositions. Additionally, they are taken from a specific plant section or the entire plant, depending on how it reacts and behaves. Some of the plants are as follows:

1. Red clover (Trifolium pratense)
2. Stellaria media, sometimes known as chickweed
3. Dandelion, or Taraxacum officinale
4. Butea monosperma
5. Equisetum, or horsetail

Trifolium Pratense:

Taxonomy of Trifolium pratense L.

Kingdom: Plantae
Subkingdom: Eukaryota
Division: Tracheophyta (Vascular plants)

Class: Dicotyledoneae
Order: Fabales
Family: (or Leguminosae)
Genus: Trifolium
Species: Trifolium pratense L.

Given its agricultural usefulness and the size of its species (about 300), the Trifolium taxa rank among the most significant genera in the Leguminosae family. Trifolium species are abundant in the Mediterranean region, particularly in Turkey, where 103 species are found. Red clover, or Trifolium pratense L., has significant levels of isoflavonoids, which are substances found in the Leguminosae family in large quantities. Red clover's primary isoflavones are formononetin and biohanin A (7). Red clover extract, Trifolium pratense L. (Fabaceae), has been used as a traditional medicine in Turkey, Italy, and India. The phytoestrogen daidzein, which is present in T. pratense extract, is converted by gut microbiota into equol, which has a strong affinity for the estrogen receptor (ER) β. Therefore, beneficial estrogenic effects may result from the interaction of plant-derived phytoestrogens with gut microbiota, primarily in tissues that express ER β, which modulates cholesterol metabolism. Long-term use of herbal extract has been demonstrated to control gut microbial composition (8).

Stellaria Media (Chickweed):

Taxonomy of Stellaria media L.

Kingdom: Plantae
Subkingdom: Viridiplantae
Division: Tracheophyta;
Subdivision: Spermatophytina;
Class: Magnoliopsida;
Superorder: Caryophyllanae;
Order: Caryophyllales;
Family: Caryophyllaceae;
Genus: Stellaria L.
Species: Stellaria media (L.).

One member of the Caryophyllaceae family is Stellaria media Vill. Since ancient times, the plant, which is extensively distributed throughout the world, has been utilized as a medicine. About 50 bioactive metabolites have been identified as a result of phytochemical analyses of extracts and fractions of various S. media sections. The decoction of S. medium leaves has long been used for therapeutic purposes. The entire plant is used to treat obesity, respiratory disorders, bronchitis, and asthma. The plant decoction's special calming and moisturizing qualities promote its use to ease mange, menstruation pain, and skin irritation (9).

Taraxacum Officinale (Dandelion):

Taxonomy of Taraxacum officinale:

Kingdom: Plantae

Phylum: Tracheophyta (also known as Anthophyta)
Class: Magnoliopsida (also known as Dicotyledoneae)
Order: Asterales
Family: Asteraceae (also known as Compositae or daisy family)
Genus: Taraxacum
Species: Taraxacum officinale

It is commonly referred to as a dandelion plant, a perennial plant with yellow flower heads that is a member of the Asteraceae family. It is used to treat Breast Cancer (BC) in Arabia, America, and China, as well as a number of other cancers. Its aqueous extract is made from its roots, leaves, and flowers, and it has been shown, using MCF-7/AZ cell lines, that its leaf extract has a powerful effect on the growth of BC cells through a pathway that is dependent on extracellular receptor kinases (ERK). Taraxacum officinale's anti-cancer properties are attributed to the compounds that it contains: 4-hydroxyphenylacetyl, phenyl acetyl, and 4-hydroxyphenylglyoxyl. Without harming healthy cells, the herbal extract of Taraxacum officinale exhibits apoptosis and stops the cell cycle into different cell types in BC. The proteins that control the apoptotic process on the outer membrane of the mitochondria are BH3 and Bcl-2 (10). Around the world, extensive biological monitoring is conducted using the common dandelion as a bioindicator of environmental quality. Studies using phytoindicative biogeochemicals make extensive use of Taraxacum officinale. Common dandelion (Taraxacum officinale), common nettle (Urtica dioica), and broadleaf plantain (Plantago major) are the primary species utilized in environmental biomonitoring (11).

Butea Monosperma:

Taxonomy of Butea monosperma:

Kingdom: Plantae
Phylum: Magnoliophyta
Class: Magnoliopsida
Order: Fabales
Family: Fabaceae (Legumes)
Subfamily: Faboideae
Tribe: Phaseoleae
Genus: Butea
Species: Butea monosperma

Butea monosperma is a species of the genus Butea that is a member of the Fabaceae or Leguminosae family. Timber, resin, feed, medicine, and dye are among its applications. The floral extract was thought to have the potential to serve as an indicator for many kinds of acid-base titrations. In order to determine whether the flavonoids could be used as an acid-base indicator in different acid-base titrations, they were isolated (12). Crude extracts from diverse sources of the plant are known as cures for the condition of wounds, skin disorders, cancer, ulcers, and piles. This herb is frequently utilized in Ayurveda and modern medicine in the treatment of ailments, such as krimi roga. By preserving its physiological properties, Butea monosperma exhibits a high degree of resistance to unfavorable environmental conditions. This includes changes in metabolic processes, enzyme activity, antioxidant productions, and membrane damage brought on by pollution stress. The extracts of this flower

demonstrated a promising source of elevated quantities of important chemicals with enzyme inhibitors and antioxidant capabilities (13).

Equisetum (Horsetail):

Kingdom: Plantae
Subkingdom: Viridiplantae
Infrakingdom: Streptophyta
Division: Tracheophyta
Subdivision: Polypodiophytina
Class: Polypodiopsida
Subclass: Equisetidae
Order: Equisetales
Family: Equisetaceae
Genus: Equisetum

The Equisetaceae family includes the horsetail plant (Equisetum arvense L.), a species of the genus Equisetum. It is classified as a perennial plant with rhizomes that have gametophytic and sporophytic life stages, and it comprises roughly 30 species. Europe, Asia, North Africa, South America, the United States, and Canada are all home to the E. arvense plant. When E. arvense extracts were applied to plants exposed to excessive water, they inhibited the various pathogens or herbivorous insects. Additionally, it has been demonstrated that the output and yield of basil and its essential oils were enhanced by foliar spraying with a horsetail extract. Additionally, the use of E. arvense weed as a Si fertilizer in wheat plant cultivation is another application that has been researched (14).

MATERIALS AND METHODS:

Maceration and Soxhalation.

Procedure:

Maceration. This is an extraction procedure in which coarsely powdered drug material, either leaves or stem bark or root bark, is placed inside a container; the menstruum is poured on top until completely covered the drug material. The container is then closed and kept for at least three days. The content is stirred periodically, and if placed inside bottle it should be shaken time to time to ensure complete extraction. At the end of extraction, the micelle is separated from marc by filtration or decantation. Subsequently, the micelle is then separated from the menstruum by evaporation in an oven or on top of water bath. This method is convenient and very suitable for thermolabile plant material (15). The Soxhlet extraction method uses a small amount of solvent and is very cost-effective. The Soxhlet extraction uses the solvent reflux and siphon principle to continuously extract the solid matter by pure solvent, which saves the solvent extraction efficiency and high efficiency. The sold sample is placed on a thimble-shaped filter paper, positioned into Soxhlet extractor, and the device is assembled. The solvent is added to the solvent reservoir flask and mounted onto a heating mantle. After heating, the condensed vapors of the solvent come in contact with the sample powder, and the soluble part of the powder gets mixed with the solvent for extraction. When the solvent surface exceeds the maximum height of the siphon, the solvent containing the extract is siphoned back. The flask is repeated, extracting a portion of the material each time so that the solid material is

constantly used as a pure solvent and the extracted material is concentrated in the flask (16).

DISCUSSION:

Turkey, Italy, and India have all utilized red clover extract, Trifolium pratense L. (Fabaceae), as a traditional medicine. The gut microbiota transforms the phytoestrogen daidzein, found in T. pratense extract, into equol, which binds strongly to the estrogen receptor (ER) β. About 50 bioactive compounds have been found as a consequence of phytochemical investigations of extracts and fractions of several S. media sections. The decoction of S. medium leaves has long been utilized for therapeutic purposes. The roots, leaves, and flowers of Taraxacum officinale are used to make its aqueous extract. Using MCF-7/AZ cell lines, it was demonstrated that the leaf extract significantly influences BC cell proliferation via a mechanism reliant on extracellular receptor kinases (ERK). It was believed that Butea monosperma's flower extract may be used as an indicator for a variety of acid-base titrations. The flavonoids were separated to see if they might be utilized as an acid-base indicator in various acid-base titrations. Extracts from E. arvense prevented numerous herbivorous insects and diseases when applied to plants that had been subjected to excessive water.

RESULTS:

Natural herbal indicators are a good alternative to synthetic indicators used in many labs and research institutes due to their availability, ease of extraction, superior performance, and accurate results. Use of Trifolium pratense herbal extract over an extended period of time has been shown to regulate the makeup of intestinal microbes. The unique soothing and hydrating properties of Stelleria media plant decoction encourage its use to relieve skin irritation, menstrual pain, and manage. Extensive biological monitoring is conducted using the common dandelion as a bioindicator of environmental quality. The flower extracts of Butea monosperma showed promise as a source of significant amounts of compounds with antioxidant and enzyme-inhibiting properties. Extracts from E. arvense prevented numerous herbivorous insects and diseases when applied to plants that had been subjected to excessive water.

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