

## ANTIOXIDANT PROPERTIES OF INDIGENOUS PLANTS USED IN CULINARY PREPARATIONS

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### ABSTRACT

*Indigenous plants are important sources of food, traditional medicine, and biologically active compounds. Many indigenous plants contain phytochemicals such as phenolic compounds, flavonoids, tannins, vitamins, and carotenoids that may possess antioxidant properties. Antioxidants help protect cells from oxidative damage caused by free radicals and reactive oxygen species. The purpose of this study is to investigate the antioxidant properties of selected indigenous plants and determine their potential as natural sources of antioxidants. Plant samples will be collected, identified, dried, powdered, and extracted using a suitable solvent. The antioxidant activity of the extracts will be evaluated using laboratory-based assays such as the DPPH radical-scavenging method. Total phenolic and flavonoid contents may also be determined. The data will be analyzed statistically to compare the antioxidant activity of the selected plants. The study is expected to demonstrate that indigenous plants contain bioactive compounds with varying levels of antioxidant activity and may have potential nutritional and functional-food applications.*

**KEYWORDS:** Antioxidant properties, indigenous plants, culinary preparations, traditional foods, phytochemicals, phenolic compounds, flavonoids, bioactive compounds, free radical scavenging activity, oxidative stress, natural antioxidants, functional foods, traditional cuisine, nutritional value, total phenolic content, total flavonoid content.

### INTRODUCTION

Indigenous plants are plant species that naturally occur in a particular geographical region or have been traditionally cultivated and used by local communities. They have been used for generations as food, spices, vegetables, beverages, and traditional remedies. These plants may provide important nutrients as well as biologically active compounds. Antioxidants are substances that can help prevent or reduce oxidative damage caused by free radicals. Free radicals are unstable molecules that can react with important biological molecules such as proteins, lipids, and DNA von Gadow, A., Joubert, E., & Hansmann, C. F. (1997) found that.. Plant-derived antioxidants are of particular interest because many edible plants contain naturally occurring antioxidant compounds. Indigenous plants contain a variety of phytochemicals, including phenolic acids, flavonoids, tannins, carotenoids, and other secondary metabolites. These compounds can contribute to the color, taste, aroma, and biological properties of plants. Phenolic compounds and flavonoids are particularly associated with antioxidant activity. Investigating the antioxidant properties of indigenous plants can provide scientific information about their nutritional and functional value. It can also help identify plants that may serve as natural sources of antioxidant compounds for food and related applications. Many communities use indigenous plants in traditional foods and culinary preparations. Their continued use reflects local knowledge concerning their availability and nutritional value. Scientific investigation can complement this traditional knowledge by measuring specific biochemical properties. Although many indigenous plants are traditionally consumed, their antioxidant properties are not equally well documented. Guo, X., Tresserra-Rimbau, A., Estruch, R., Martinez-Gonzalez, M. A., Medina-Rejon, A.,

Castañer, O., ... & Lamuela-Raventós, R. M. (2016) explained that Differences in plant species, growing conditions, maturity, processing, and extraction methods can influence antioxidant activity. Therefore, further laboratory investigation of selected indigenous plants is needed. This study may provide useful information about the antioxidant potential of selected indigenous plants. The findings could contribute to research on traditional foods, plant-based antioxidants, nutrition, and functional foods. The study may also encourage further scientific investigation of underutilized indigenous plant resources.

Indigenous plants are an important component of traditional food systems and have been used by local communities for generations as vegetables, fruits, herbs, spices, beverages, and medicinal resources. These plants are naturally adapted to the environmental conditions of their regions and are often readily available to rural and local populations. In addition to providing essential nutrients such as carbohydrates, proteins, vitamins, minerals, dietary fiber, and fats, many indigenous plants contain biologically active compounds known as phytochemicals. These compounds include phenolic acids, flavonoids, tannins, carotenoids, terpenoids, alkaloids, and other secondary metabolites. Kang, J., Thakali, K. M., Xie, C., Kondo, M., Tong, Y., Ou, B., ... & Wu, X. (2012). Revealed on A number of these phytochemicals possess antioxidant properties, making indigenous plants an important area of interest in food, nutrition, and health research. Antioxidants are substances that can protect biological molecules from oxidative damage. During normal metabolic processes, the human body continuously produces free radicals and reactive oxygen species (ROS). These molecules can also be generated by environmental factors such as air pollution, ultraviolet radiation, smoking, certain chemicals, and other forms of environmental stress. Free radicals are highly reactive because they contain unpaired electrons. When present in excessive amounts, they can react with cellular components such as lipids, proteins, and DNA. This imbalance between the production of reactive molecules and the body's ability to neutralize them is commonly referred to as oxidative stress.

Oxidative stress has attracted considerable attention in nutritional and biological research because excessive oxidation can damage cells and tissues. The body has its own antioxidant defense systems, including enzymes such as superoxide dismutase, catalase, and glutathione peroxidase. In addition to these internal defenses, antioxidants can also be obtained through the diet. Fruits, vegetables, herbs, spices, cereals, legumes, and other plant foods can provide antioxidant compounds. Indigenous plants may therefore make a useful contribution to dietary antioxidant intake, particularly in communities where these plants form part of traditional diets. One of the major groups of antioxidant compounds found in plants is phenolic compounds. Phenolics are characterized by the presence of one or more hydroxyl groups attached to aromatic structures. They include phenolic acids, flavonoids, tannins, and related compounds. These substances can interact with free radicals and may help prevent oxidation by donating hydrogen atoms or electrons. Halliwell, B. (1996). elobreated on Because of their chemical properties, phenolic compounds are frequently investigated when studying the antioxidant potential of plant foods. Flavonoids are another important group of plant-derived compounds associated with antioxidant activity. They occur naturally in many fruits, vegetables, leaves, flowers, herbs, and spices. Different flavonoids have different chemical structures and biological properties. Their antioxidant activity can involve free-radical scavenging, interaction with reactive oxygen contain carotenoids species, and other

mechanisms. The amount and type of flavonoids present in an indigenous plant can vary depending on the plant species, variety, geographical location, maturity, climate, soil conditions, and method of cultivation.

Indigenous plants may also, which are pigments responsible for yellow, orange, and red colors in many plants. Some carotenoids have antioxidant activity and can interact with certain reactive molecules. Vitamins such as vitamin C and vitamin E may also contribute to the antioxidant properties of edible plants. Therefore, the overall antioxidant activity of a plant is generally influenced by a combination of different compounds rather than by a single substance. The antioxidant properties of indigenous plants are particularly relevant because many of these plants are traditionally incorporated into culinary preparations. Leaves may be cooked as vegetables, seeds may be used as spices, roots and tubers may be used as food ingredients, while fruits may be consumed fresh or processed into beverages, sauces, and other products. Herbs and spices are often used in relatively small quantities but can contain concentrated amounts of certain phytochemicals. Their contribution to the antioxidant characteristics of traditional foods is therefore an important area for investigation. Traditional knowledge provides valuable information about the use of indigenous plants. Communities have developed methods for collecting, preparing, cooking, and preserving plants over many generations. However, traditional use alone does not provide quantitative information about antioxidant capacity. Scientific investigation can complement traditional knowledge by identifying phytochemicals and measuring antioxidant activity using laboratory techniques. This can help establish differences among plant species and provide information about their potential nutritional value. The antioxidant activity of indigenous plants can be affected by processing and cooking methods.

Extraction conditions also influence the measured antioxidant properties of plants. Different solvents can extract different groups of compounds because phytochemicals vary in their chemical characteristics and solubility. For example, aqueous, ethanol, methanol, and hydroalcoholic extracts may produce different antioxidant measurements from the same plant material. Therefore, standardized sample preparation and extraction procedures are important when comparing the antioxidant activity of different indigenous plants. Several laboratory methods are available for assessing antioxidant activity. The DPPH (2,2-diphenyl-1-picrylhydrazyl) radical-scavenging assay is widely used because it is relatively simple and can provide an estimate of the free-radical-scavenging capacity of plant extracts. Other methods include ABTS radical-scavenging, ferric-reducing antioxidant power (FRAP), and oxygen radical absorbance capacity (ORAC) assays. Since different methods measure antioxidant activity through different chemical mechanisms, using more than one method can provide a broader understanding of the antioxidant potential of a plant. Determination of total phenolic content and total flavonoid content can also provide useful information about the chemical characteristics of indigenous plants. Comparing these measurements with antioxidant activity may help researchers investigate whether plants containing greater amounts of phenolic or flavonoid compounds also demonstrate greater antioxidant capacity. However, antioxidant activity is complex, and the measured activity cannot necessarily be explained by the concentration of one group of compounds alone. Research on indigenous plants is also important from a food security and biodiversity perspective. Many traditional plant species are underutilized despite being adapted to local environments. Studying their

nutritional and functional characteristics may increase scientific knowledge about these resources. It may also encourage their appropriate utilization and conservation. However, scientific evidence is necessary before making claims about specific health effects or therapeutic applications.

The antioxidant properties of indigenous plants can therefore be viewed from several perspectives, including their phytochemical composition, traditional culinary use, nutritional value, processing characteristics, and potential functional-food applications. Investigating these properties can provide a scientific basis for understanding the role of indigenous plant foods in traditional diets. Despite the growing interest in plant-based antioxidants, many indigenous species remain less studied than widely commercialized fruits, vegetables, and herbs. Information may be particularly limited regarding locally consumed species and the effect of traditional preparation methods on their antioxidant activity. Therefore, systematic investigation of selected indigenous plants can help address this research gap. In conclusion, indigenous plants represent a potentially valuable source of naturally occurring antioxidant compounds. Their phenolics, flavonoids, carotenoids, vitamins, and other phytochemicals may contribute to their antioxidant capacity. Evaluating these properties through standardized laboratory methods can provide useful information about their nutritional and functional characteristics. Such research can also contribute to the scientific documentation of traditional plant resources and provide a foundation for further studies concerning food composition, processing, and potential applications of indigenous plants.

## **RESEARCH QUESTION**

1. What are the antioxidant properties of selected indigenous plants?

## **RESEARCH OBJECTIVE**

1. To determine and compare the antioxidant activity of selected indigenous plants using appropriate laboratory antioxidant assays.

## **LITERATURE REVIEW**

Indigenous plants contain numerous naturally occurring chemical compounds that contribute to their nutritional and biological properties. Phenolics, flavonoids, tannins, terpenoids, and carotenoids are among the important phytochemicals found in many edible plants. Their concentration can vary according to plant species and environmental conditions. Phenolic compounds are widely distributed in plants and are important secondary metabolites. They have chemical structures that allow them to interact with free radicals. Total phenolic content is therefore frequently investigated when evaluating the antioxidant potential of plant materials Dastmalchi, K., Dorman, H. D., Vuorela, H., & Hiltunen, R. (2007) revealed. Flavonoids are a large group of polyphenolic compounds found in vegetables, fruits, herbs, and spices. They have been widely studied for their free-radical-scavenging and other biological activities. The flavonoid content of a plant can contribute to its overall antioxidant capacity. Free radicals and reactive oxygen species are generated naturally through normal metabolic processes and can also arise from environmental factors.

When their production exceeds the body's protective antioxidant capacity, oxidative stress can occur. Dietary antioxidants are therefore an important area of nutritional and food research. The DPPH assay is a commonly used laboratory method for evaluating the free-radical-scavenging capacity of plant extracts. DPPH is a stable radical with a characteristic color. When antioxidants react with it, the intensity of the color decreases, and this change can be measured spectrophotometrically. Drying, boiling, roasting, frying, and other processing techniques can change the concentration and availability of antioxidant compounds in plants Kang, J., Thakali, K. M., Xie, C., Kondo, M., Tong, Y., Ou, B., ... & Wu, X. (2012). found that Some compounds may be reduced by heat, whereas other compounds may become more extractable following processing. Therefore, the method used to prepare plant samples can influence experimental results. Previous research on edible and medicinal plants has demonstrated that many plant extracts possess measurable antioxidant activity. However, antioxidant capacity differs considerably among species and depends on the chemical composition of each plant. Studying locally important indigenous plants can therefore help identify potentially valuable sources of natural antioxidants.

Indigenous plants are an important part of traditional food systems and have been used by local communities as vegetables, fruits, herbs, spices, beverages, and medicinal plants. Many of these plants contain biologically active compounds that can contribute to their nutritional and functional properties. Research on plant foods has shown that phenolic compounds and other phytochemicals are important contributors to antioxidant activity. Indigenous plants are therefore increasingly being investigated as potential sources of natural antioxidants for food and nutritional applications. PubMed+1 A study of wild culinary vegetables used by communities in the Lesser Himalayas of Pakistan investigated their traditional uses, phenolic contents, and antioxidant properties. The researchers evaluated water and acetone extracts and demonstrated that traditional edible plants can be scientifically investigated for their phenolic composition and antioxidant capacity. This type of research is particularly relevant because many locally consumed plants remain less studied than commercially important vegetables and fruits. Research on indigenous fruits has similarly indicated that they can contain considerable amounts of phenolic acids, flavonoids, and other bioactive compounds. A review of Southern African indigenous fruits reported substantial antioxidant potential and identified these plants as possible candidates for food-antioxidant applications. However, the authors also emphasized that additional research is required to understand their biological activity and practical food applications.

Phenolic compounds are among the most extensively studied phytochemicals in plant foods. They occur naturally in fruits, vegetables, cereals, legumes, herbs, spices, and other plant materials. Phenolic compounds include phenolic acids, flavonoids, tannins, stilbenes, and related substances. Their chemical structures allow them to participate in reactions that can neutralize or reduce certain reactive species. Naczek and Shahidi reviewed the occurrence, extraction, and analysis of phenolics in cereals, fruits, and vegetables and noted that phenolic and polyphenolic compounds are important food bioactives because of their antioxidant properties. Their work also highlights the importance of appropriate extraction and analytical procedures because the measured phenolic content can depend on the characteristics of the plant material and the extraction method used. The relationship between phenolic content and antioxidant activity has also been investigated in commonly consumed plant foods Guo, X.,

Tresserra-Rimbau, A., Estruch, R., Martinez-Gonzalez, M. A., Medina-Remon, A., Castañer, O., ... & Lamuela-Raventós, R. M. (2016)elobrated on. Research involving Indian plant foods examined cereals, legumes, oilseeds, leafy vegetables, vegetables, spices, roots, and tubers and compared their antioxidant activity with their phenolic content. The results demonstrated considerable variation among plant foods, illustrating that different plants can make different contributions to dietary antioxidant capacity. PubMed Flavonoids are an important subgroup of polyphenolic compounds found widely throughout the plant kingdom. They occur in many edible leaves, fruits, flowers, herbs, and spices. Their antioxidant properties are associated with their chemical structures and their ability to participate in reactions involving free radicals and reactive oxygen species. In addition to flavonoids, indigenous plants can contain tannins, carotenoids, tocopherols, vitamin C, and other potentially bioactive substances. A study examining edible herbs from Assam found that several of the investigated herbs had strong antioxidant potential and relatively high phenolic contents. Rutin and gallic acid were among the important phenolic constituents identified, while  $\alpha$ -tocopherol was detected in all of the herbs examined. ScienceDirect The presence of several antioxidant compounds in the same plant is important because total antioxidant activity may result from the combined effects of multiple constituents. Consequently, measuring only one compound does not necessarily provide a complete picture of the antioxidant properties of an indigenous plant. Free radicals and reactive oxygen species are produced naturally during biological processes.

They can also arise from external environmental factors. Because these molecules are chemically reactive, excessive levels can contribute to oxidative damage to biological molecules. Dietary antioxidants have consequently received considerable attention in food and nutritional research. von Gadow, A., Joubert, E., & Hansmann, C. F. (1997)explained that Plant foods provide a variety of antioxidant compounds, particularly phenolics and polyphenolics. The DPPH method is useful for research on indigenous plants because it is relatively straightforward and can be applied to different plant extracts. However, results depend on factors such as extract concentration, solvent, reaction time, temperature, and measurement conditions. Consequently, standardized procedures are necessary when comparing different plants. The antioxidant properties measured in an indigenous plant can be strongly influenced by how the sample is prepared. Extraction solvents differ in their ability to dissolve particular phytochemicals. As a result, an aqueous extract and an organic-solvent extract of the same plant may have different phenolic concentrations and antioxidant activities. The presence of phenolic compounds and antioxidant activity has increased interest in indigenous plants as potential functional-food ingredients. Functional foods are generally eded to examine how traditional preparation methods affect antioxidant compounds and whether laboratory findings translate into meaningful nutritional effects.

## METHODOLOGY

Selected indigenous plants will be collected from local markets, farms, or areas where they are traditionally grown. The samples will be properly labeled and transported to the laboratory. They will be cleaned to remove dirt and foreign materials, followed by drying under suitable conditions. The dried plant material will then be ground into a fine powder and stored in airtight containers. A measured quantity of each powdered plant sample will be

extracted using a suitable solvent, such as ethanol, methanol, or aqueous ethanol. The extract will be filtered and stored appropriately before analysis. Antioxidant activity will be evaluated using a suitable method such as the DPPH radical-scavenging assay. Where facilities permit, total phenolic and total flavonoid contents will also be determined. The study will primarily use a quantitative research approach because antioxidant activity will be measured numerically using laboratory assays. The resulting measurements will allow comparisons between different indigenous plant samples. An experimental approach will be used because plant extracts will be prepared under controlled laboratory conditions and tested using standardized procedures. The research will involve controlled laboratory procedures for sample preparation, extraction, antioxidant testing, and measurement of results. The antioxidant activity of the selected indigenous plants will be compared to determine differences between the samples. The same extraction and testing procedures will be applied as consistently as possible to all samples to improve the reliability and comparability of the results.

## **RESEARCH DESIGN**

The research will use an experimental design in which selected indigenous plants are treated as different experimental samples. Their extracts will be subjected to the same antioxidant testing procedures. The study will compare antioxidant activity among the selected plants using quantitative measurements. Each test should be conducted in replicates to improve the reliability of the findings. The research design for the study An experimental design will be used to investigate the antioxidant properties of selected indigenous plants under controlled laboratory conditions. Different plant samples will be collected and prepared using the same procedures. Their extracts will then be tested for antioxidant activity using standardized laboratory methods. A number of indigenous plants commonly used as food, herbs, spices, or traditional ingredients will be selected for the study. The plants will be identified according to their botanical characteristics and documented according to their local and scientific names. Selection will be based on their availability, traditional use, and relevance to the research topic. Fresh plant materials will be collected and cleaned to remove soil, dust, and other foreign materials. The samples will be dried under suitable conditions and then ground into powder. Equal or standardized amounts of each powdered sample will be used for extraction so that the antioxidant activities of the plants can be compared fairly. Plant extracts will be prepared using an appropriate solvent, such as ethanol, methanol, or water, depending on the laboratory protocol. The antioxidant activity of each extract will be evaluated using a suitable assay, such as. A standard antioxidant, such as ascorbic acid, may be included as a reference.

## **DATA ANALYSIS**

The experimental results will be summarized using the mean and standard deviation. These values will describe the average antioxidant activity and variation among replicate measurements. Where appropriate, statistical tests such as one-way ANOVA can be used to determine whether differences in antioxidant activity between the selected plants are statistically significant. A significance level of  $p < 0.05$  may be applied. The data collected from the laboratory analysis of indigenous plant extracts will be analyzed quantitatively. The antioxidant activity of each plant will be determined using the results obtained from the

selected antioxidant assay, such as the DPPH radical-scavenging method. Absorbance values obtained from the samples and control will be recorded. The percentage of antioxidant activity will be calculated using: A higher percentage indicates greater radical-scavenging activity under the conditions of the assay. Each plant sample should be tested at least three times. The results will be expressed as mean  $\pm$  standard deviation (SD). The mean will represent the average antioxidant activity, while the standard deviation will show the variation among repeated measurements. For example, the results can be presented as: The actual values should be entered after laboratory testing; they should not be estimated without experimental data. The mean antioxidant activity of the different indigenous plants will be compared to determine differences between the samples. If appropriate, one-way analysis of variance (ANOVA) can be used to determine whether the observed differences are statistically significant. A significance level of  $p < 0.05$  may be used. If total phenolic and flavonoid contents are also measured, these values can be compared with antioxidant activity to investigate whether plants containing greater amounts of these compounds also demonstrate greater antioxidant activity. The data analysis will help identify differences in the antioxidant properties of the selected indigenous plants. Higher DPPH radical-scavenging activity will indicate stronger antioxidant capacity in the specific assay used. However, the results should be interpreted carefully because antioxidant activity can be affected by the plant species, extraction solvent, concentration, processing method, and experimental conditions.

## FINDINGS

Because the laboratory experiment has not actually been conducted, the following should be treated as expected/potential findings rather than actual results. The selected indigenous plants are expected to show different levels of antioxidant activity. Differences may result from variations in their phenolic, flavonoid, and other phytochemical compositions. Plants containing higher concentrations of phenolic and flavonoid compounds may demonstrate stronger radical-scavenging activity. However, antioxidant activity cannot necessarily be attributed to one compound alone because several compounds may act together. The findings of the study on the antioxidant properties of indigenous plants indicate that indigenous plants can contain several natural compounds with antioxidant potential. The antioxidant activity of plants may differ according to their species, plant parts, phytochemical composition, and preparation methods. The selected indigenous plant extracts are expected to show measurable antioxidant activity when tested using the DPPH radical-scavenging method. The extracts may reduce the DPPH free radical, indicating the presence of compounds capable of donating electrons or hydrogen atoms. The percentage of antioxidant activity may vary among the selected plants. The indigenous plants are expected to contain phenolic compounds and flavonoids, which are important phytochemicals associated with antioxidant activity. Plants with higher levels of phenolic and flavonoid compounds may show greater radical-scavenging activity. These compounds may contribute substantially to the overall antioxidant potential of the plants. The antioxidant properties are likely to differ between plant species. Some indigenous plants may demonstrate stronger antioxidant activity than others because of differences in their chemical composition. Factors such as geographical location, soil, climate, maturity, plant part, and harvesting conditions can influence the concentration of antioxidant compounds.

The method used to prepare and extract the plants can affect their antioxidant activity. Drying, heating, boiling, and other culinary processes may either reduce or increase the availability of certain antioxidant compounds. Similarly, different extraction solvents can extract different phytochemicals and therefore produce different antioxidant values. Overall, the findings suggest that indigenous plants have potential as natural sources of antioxidant compounds. Their antioxidant properties may be associated with phenolic compounds, flavonoids, vitamins, carotenoids, and other phytochemicals. However, actual antioxidant values should be determined through laboratory testing rather than assumed, and the findings should be interpreted according to the specific plants and methods used in the study.

## CONCLUSION

The study is expected to show that selected indigenous plants possess measurable antioxidant properties. Their antioxidant capacity may vary depending on plant species, phytochemical composition, and sample preparation methods. Indigenous plants may represent useful natural sources of antioxidant compounds and may have potential nutritional and food-related applications. Further research, including studies of different plant varieties, processing methods, and biological effects, would be useful for establishing their potential more fully.

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