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Comparative analysis of pigment contents, phytochemical constituents, and antioxidant properties of selected plants in the Philippines

Kim Mariel S. Casuga[1], Lexter R. Natividad[2]
[1]*Institute of Arts and Sciences, Bulacan Agricultural State College, San Ildefonso, Bulacan, Philippines*
[2]*Department of Science Education, College of Education, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines*
Corresponding email: kimmarielcasuga@gmail.com

ABSTRACT

During the pandemic, people turned to cultivating ornamental plants in their gardens. One of the trending plants is Mayana (*Coleus blumei*) for its leaves are pleasing to the eyes. Katuray (*Sesbania grandiflora)* and Sweet Potato Tops (*Ipomoeas batatas)*, on the other hand, can be found everywhere in the different localities in the Philippines. This study aimed to trace the presence of different phytochemical constituents of Mayana, Katuray, and sweet potato tops. The presence of phytochemical constituents in *Ipomoea batatas* gave its property of anti-inflammatory, anti-bacterial, anti-fungal, and many more. In addition, results showed the presence of pigments in three plants such as carotenoid and chlorophyll content in the three plant samples. Further, the antioxidant properties were also identified. Analysis of Variance (ANOVA) results showed that there is a significant difference among the three plants at a 5% level of significance in terms of total carotenoid content. Furthermore, statistical analysis showed that there is a significant difference in the chlorophyll *a* and *b* in *Ipomoea batatas*, however, the post hoc test revealed that *Coleus blumei* and *Sesbania grandiflora* have no significant difference in their chlorophyll content. Meanwhile, thin-layer chromatographic analysis revealed that *Ipomoea batatas* has the greatest number of spots of all plant samples. Analysis of the total phenolics and antioxidant activity exhibited that *Ipomoea batatas* has the least quantitative result which means that it is the most potent among the three plant samples. This study therefore concluded that *Ipomoea batatas* can be formulated as a drug or supplement due to its antioxidant properties. The remarkable presence of different phytochemical constituents can give rise to new pharmaceutical products in the market.

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INTRODUCTION

As science and technology progressed, humans embarked on scientific endeavors to learn and comprehend everything around them. People relied on indigenous plants for survival. According to Raju (2021), natural products have been the cornerstone of traditional medical systems all over the globe. In addition, Guzman and colleagues (2018) stated that natural products play an essential part in the discovery and development of innovative antibacterial medications. This may help in the impediment of drug-resistant pathogens that continue threatening public health (Garcia et al., 2023; Gundran et al., 2018; Olaoye et al., 2023). Thus, prior drug research depends largely on plants, particularly those with ethnopharmacological benefits.

Traditional healing is the accumulation of indigenous ideas, views, and expertise used for medical management as well as the prevention, detection, amelioration, or mitigation of both mental and physical illnesses (Raju, 2021). In 2017, WHO recognized traditional medicine as one of the most essential medical support tools that could help achieve greater medical outcomes, including those specified by the MDGs such as progressive maternal health, lessening mortality of children, and providing underdeveloped nations with inexpensive necessary medications. However, due to a lack of scientific information on traditional knowledge, there is a necessity for drug development which is plant-based to bridge the gap and find novel methods to combat various diseases (Masinas et al., 2018; Sakilan et al., 2019). As a result, it is essential to screen medicinal plants for pertinent compounds that are active to act as the basis for subsequent biomedical research.

Mbaebie et al. (2012) stated that individual and community health benefits greatly from medicinal plants. Traditional medicines have shown to have a tremendous amount of potential for the discovery of new medicinally noteworthy substances that could be used in the treatment of a broad variety of illnesses. Gutierrez et al. (2013) assert that many Filipinos, especially those who live in rural regions, cannot afford synthetic pharmaceuticals due to their massive cost. Current research on the use of less expensive plant-based pharmaceuticals is therefore urgently needed. A naturally occurring plant product with intricate chemical compositions has the potential to lead to the creation of new medicinal products that will benefit humankind (Sakilan et al., 2019).

The Philippines caters to many varieties of plant species, the majority of which are used for medicinal purposes. These plants' medicinal value stems from their phytochemical constituents, which have specific pharmacological effects on humans (Akinmoladum et al., 2016; Sarkingobir et al., 2022). The alkaloid compounds, tannins, flavonoids, and phenolic substances that are present are among the most significant of the aforementioned medicinal chemical components (Mallikharjuna et al., 2007; Navarro et al., 2018). One of the phytochemical constituents like saponin has been documented in the literature for its application. In an in vivo assay conducted by Bibon (2021), it was demonstrated that *Melanthera elliptica* also known as squarestem has antifungal and antibacterial activity against several known fungal and bacterial species from its extracted chemicals.

Considering that over 80% of the global population depends on conventional treatments for their main health care requirements, it is observed that synthetic chemical analysis and the pursuit of herbal remedies from life forms (such as higher plants) are the main avenues of locating a new bioactive compound to treat medical conditions caused by pathogenic microbes (Clemen-Pascual et al., 2022). One percent of plant species have been identified as possessing secondary, phytochemical, and biologically active metabolites. Traditional herbal medicines (THM) are the richest source of newly discovered biologically active chemical entities due to the diversity of ecosystems and chemical-based foundations present within each species (Kebede et al., 2021). Communities have therefore utilized the traditional medicinal plants Mayana (*Coleus blumei*), Katuray *(Sesbania grandiflora)***,** and sweet potato leaves (*Ipomoea batatas*) to treat some illnesses caused by dangerous pathogenic agents. Nevertheless, there are not enough thorough studies on the carotenoid content, antioxidant properties, and phytochemical content of these plants.

Mayana *(Coleus blumei)*

Coleus is the term given to a genus of perennial plants that are indigenous to the Pacific Islands, Australia, Asia, and tropical Africa. It is related to salvia, basil, thyme, oregano, spearmint, and peppermint. It is a member of the plant family Lamiaceae, which also includes more than 150 species of mint. Furthermore, it is an annual herb with upright branches that can grow to a height of around 100 cm and its coleus leaves feature square stems and blotched margins. The coleus' ovate-shaped leaves have a length of 5 to 10 cm (Moron et al, 2017). The plant known as Mayana (*Coleus blumei*), sometimes referred to as *lampunaya* in some parts of the Philippines, is typically grown for decorative purposes. Its leaves typically come in shades of yellow, green, pink, and red, but the most typical hue is purple. Many decide to show different species of it in their homes because of the leaves' alluring colors. According to Moron et al. (2017), Coleus was first used as medicine in antiquity, according to reliable references from old Sanskrit manuscripts. It has been utilized as a supplement for health and medication for cardiac problems in Ayurveda. (Indian traditional medicine) such as chest discomfort, breathing difficulties, intestinal issues, and sleeplessness. Del Fiero's (2013) research indicates that herbalists have used *Mayana* to quickly cure wounds, swelling, and bruises, as well as sprains and cysts. Some researchers revealed that Mayana leaves have antibacterial qualities, but findings also showed that they have wound-healing capabilities (Moron et al., 2017).

Katuray *(Sesbania grandiflora)*

Guillasper et al. (2020) noted that Katuray or *Sesbania grandiflora* in the Philippines is commonly used in food preparations like salad and in various cuisines. It came from the family Leguminosae. In other countries such as India, the Katuray plant has been a great help when it comes to treating illnesses therapeutically. Moreover, the Philippines is one of the Asian countries that has a tropical climate, which is one of the necessities for *Sesbania grandiflora* to grow. Katuray's leaves or the "usbong" were used by the netizens to upsurge the yield of milk production in cattle. Further research on Katuray exposed that its leaf extract contains constituents that can suppress bacteria and fungus (Adriatico, 2019). *S. grandiflora* is extensively utilized in traditional medicine to manage diverse ailments including but not limited to fever, smallpox, diarrhea, headache, and sore throat (Guzman et al., 2018). According to Bautista et al. (2022), the diverse constituents of this entity have been employed in customary folk medicine as a therapeutic intervention for a wide range of maladies. Despite the considerable focus on the therapeutic attributes of *S. grandiflora*, scant consideration has been accorded to its plausible adverse ramifications. Sakilan et al.'s (2019) study necessitates the screening of biologically active agents of medicinal plants to lay the groundwork for further biomedical exploration while taking into consideration the significant capability of the native flora.

Sweet potato tops (*Ipomoea batatas*)

The *Ipomoea batatas*, belonging to the Convolvulaceae family, is an annual or biennial plant with a storage root crop being its primary use. China has been the world's top producer of sweet potatoes in 2020. In terms of high yield and photosynthetic efficiency, it is among the five most significant products including potatoes, corn, wheat, and rice (Chen et al, 2022). A study conducted by Jang et al. (2019) found that sweet potato leaves possess higher levels of antioxidants compared to petioles. Thermal degradation and leaching during blanching using both traditional and microwave methods are observed to drastically decrease the antioxidant content and activity of the leaves. At least 15 biologically active anthocyanins, which are beneficial as natural food coloring agents and have significant therapeutic value for treating a variety of human illnesses, are present in sweet potato leaves (Islam, 2016). Alam (2021), in his study, purports sweet potatoes as a greater provider of steroids, alkaloid compounds, glycosides, saponins, terpenoids, and polyphenols, among many others. An investigative analysis revealed that the purple-fleshed sweet potato cultivars possess ample levels of anthocyanins, whereas the orange-fleshed sweet potato crop species demonstrate superiority as a source of carotene.

OBJECTIVES OF THE STUDY

The primary objective of this study is to determine the presence of phytochemical constituents of the three plants namely Mayana (*Coleus blumei*), Katuray (*Sesbania grandiflora*), and sweet potato tops (*Ipomoea batatas*), and to appraise the plants' carotenoid composition and antioxidant traits following an evaluation of the above information. This research was conducted to see whether these traditional medicinal plants can advance pharmacology. Given that sicknesses and diseases are unavoidable, people are becoming more health conscious during this post-pandemic period, and there has been a history of bacterial resistance, thus, this study must aid in the production of more medications and provide a solution for both new variants of diseases or viruses and current ailments.

MATERIALS AND METHODS

To determine the presence of various chemical ingredients in the three plant samples, the researchers employed qualitative phytochemical screening. Thin layer chromatographic analysis, Total phenolic content analysis, and Antioxidant activity determination were also employed by the researchers. These tests were run in triplicate.

Materials

This study used: Mayana, Katuray, sweet potato tops, beakers, test tubes, distilled water, Osterizer, UV-vis (Shimadzu UV-1800), stirring rod, graduated cylinder, dropper, ethanol (Sigma-Aldrich, Singapore), weighing scale, ferric chloride, sodium hydroxide, nitric acid, potassium iodide, naphthol, magnesium turning, hydrochloric acid, olive oil, and chloroform.

Procedure

The botanical specimens were gathered and subjected to processing, subsequently undergoing phytochemical assessment, pigment analysis via thin-layer chromatography, and antioxidant examination with the use of total phenolics and DPPH.

Sample Preparation

Samples of *Coleus blumei* (Mayana), *Sesbania grandiflora* (Katuray), and *Ipomoea batatas* (Sweet Potato Tops) were collected and processed within San Ildefonso, Bulacan, located in the Philippines. Prior to the analysis of its phytochemical constituents, the botanical specimens underwent a process of desiccation through exposure to ambient air at normal temperature within an environment devoid of light. The osterizer was utilized to pulverize the plant specimens to extract the chemical constituents from the trio of botanical specimens. The plant samples were immersed in ethanol for 72 hours, using a ratio of 1 gram of plant material to 10 milliliters of ethanol. During this time, the mixture was continuously stirred. The process of isolating the pure plant extract from its residue involved filtration of the plant samples, followed by the use of a rotavapor (Rotary Evaporator R-100, United States) dryer at a temperature spectrum of 55-85°C to eliminate the ethanol. The plant extracts that were concentrated were placed in glass vials and centrifuge tubes that were covered with paper for storage. The vials were subjected to refrigeration to maintain the extract's freshness until it was deemed suitable for subsequent analysis. Investigations about pigmentation were carried out through the utilization of botanical extracts that were preserved in a refrigerated environment.

Phytochemical Screening

The researchers employed Pant et al. (2017) method for determining the phytochemicals present in plant extracts. This qualitative analysis is dependent on the hue reaction, as outlined in his study. Phenols, flavonoids, anthraquinones glycosides, cardiac glycosides, carbohydrates, terpenoids, saponins, tannins, alkaloids, and glycosides are the primary chemical constituents determined.

Test for tannins

A minute amount of ferric chloride, with a concentration of 0.1%, was mixed with 0.1 g of the extract that had undergone heating in a solution consisting of 2 milliliters of aqueous/ethanolic composition. Subsequently, the specimen underwent examination to identify any indications of a blue-black or brownish-green hue.

Test for alkaloids

A volume of 10 mL of acid-modified ethanol was introduced to 0.1 g of the extract, then subjected to boiling followed by filtration. Subsequently, a mixture of 0.4 mL of an ammoniacal reagent and one milliliter of chloroform was added to one milliliter of the filtrate and subjected to mild agitation. Two milliliters of acetic acid were employed to segregate the chloroform layer. The specimen was partitioned into two segments, where the initial segment was treated with Dragendroff's reagent and the latter with Mayer's reagent. The identification of a positive outcome in the qualitative analysis of the alkaloid test was determined by the observation of either a cream precipitate, as detected by Mayer's reagent, or a reddish-brown precipitate, as detected by Dragendroff's reagent.

Test for glycoside

Upon subjecting 0.2 grams of the test substance to heating in a water boiler, extraction was done by utilizing a five-milliliter mixture of water and dilute sulfuric acid. The acid residue was purified subsequently and then neutralized using a 5% solution of aqueous sodium hydroxide. The aqueous solution was acquired through an equivalent volume of water as that utilized for the acidic solution. Fehling's solutions A and B were alkalized and subsequently subjected to a thermal treatment in a water bath for two minutes. The potential existence of glycosides was confirmed with the amount of crimson precipitate obtained from the acid extract surpassed that obtained from the water extract.

Test for carbohydrates (Molisch's test)

The appearance of a purple ring at the acid-sample interface, after the introduction of Molisch's solution (comprising α-naphthol dispersed in ethyl alcohol) into the sample with sulfuric acid, served as an indication of the ostensible existence of carbohydrate compounds.

Test for saponins

The identification of saponins was achieved through the observation of an emulsion formed by intense shaking subsequent to the combination of 3 droplets of olive oil with the foam generated by the addition of 0.1 g of the extract to one milliliter of distilled water.

Test for cardiac glycosides

The detection of cardiac glycosides was achieved through the formation of a brown ring at the interface, which is observed after adding two milliliters of glacial acetic acid with a drop of ferric chloride solution, then by adding one milliliter of concentrated sulfuric acid to a 0.5 mg extract that has been diluted with five milliliters of water.

Test for flavonoids

- Shinoda test: Upon the addition of magnesium, followed by a dropwise introduction of concentrated hydrochloric acid, the emergence of a green-to-blue, crimson-red, or pink scarlet color served as an indicator of flavonoids.

• Alkaline reagent test: A strong yellow color forms after a small amount of sodium hydroxide solution is added to the tested solution; however, after a few droplets of diluted acid are added, the solution returns to its original colorless state, indicating the presence of flavonoids.

Test for terpenoids (Salkowski's test)

The appearance of a dark brown hue at the boundary upon the introduction of 0.4 mL of chloroform and concentrated sulfuric acid to 0.1 g of the extract served as an indicator for the actual presence of terpenoids.

Test for proteins

Two milliliters of Biuret reagent were mixed with two milliliters of the extract. The development of a violet hue served as an indicator of protein.

Test for phenol

The formation of a dark green color upon the administration of about three drops of a neutral 5% ferric chloride solution to fifty milligrams of the test solution in five milliliters of distilled water was taken as a sign of the presence of phenolic compounds.

Pigment Analysis

Total Carotenoid Analysis

The methodology for carotenoid analysis employed by Natividad et al. (2014) was adopted. A 500 mg amount of plant powder was introduced into a centrifuge tube with a volume of 50 mL. The extraction process was conducted three times with 10 mL of ethyl alcohol per extraction, with each extraction lasting for a minute. Vortex mixing was employed to agitate the contents during the extraction process. The solution was subjected to heat until the suspended particles underwent sedimentation. The supernatants were collected and quantified. The carotenoid extract's final volume was reduced to 75 mL with the incorporation of 95% ethyl alcohol. The absorption of the carotenoid extract at 450 nm was determined using a UV-visible (UV-Vis) spectrometer. The procedures above were executed thrice for every botanical sample.

The following formula was used to obtain the overall carotenoid yield (dry weight):

$$Total\ carotenoid\ yield\ (\frac{\mu g}{g}\ dried\ weight\ ) = \frac{V(A - 0.0051)}{0.175W}$$

where A – is the absorbance measurement of diluted extraction at 450 nanometers; V – is the extract's final volume (mL); 0.175 – is the Carotenoid Extinction Coefficient; and W – is the dry powder weight (grams).

Thin Layer Chromatographic Analysis

A demarcation line was established on a Thin Layer Chromatography (TLC) plate, with a distance of 1 cm from each end defining the boundaries. The samples of extract were transferred onto the TLC plate via the employment of a capillary tube. The experimental setup consisted of a solvent-filled beaker, which was covered using a watch glass. The chamber for development was equipped with paper filters and charged with a solvent mixture to promote the saturation of solvents. Instead of employing a toluene solution containing 5% methanol, the chosen solvent solution was xylene solution containing 5% methanol, as reported by Natividad and Rafael (2014). An additional aliquot of the mixture of solvents was introduced into the chamber, under the minimum level of the TLC plates. The TLC plate, containing spotted extracts, was moved into the development chamber with particular attention paid to ensure that the baseline was situated above the solvent system. The displacement of the spot and solvent had been recorded. To obtain a visual representation of the spots on the thin-layer chromatography plates, an ultraviolet light source and an iodine chamber were utilized. The locations were delineated utilizing a pencil. (Velasco et al., 2018). The retention factor (*Rf*) was calculated by utilizing the prescribed formula.

$$Rf = \frac{distance\ travelled\ by\ the\ spot}{distance\ travelled\ by\ the\ solvent}$$

The TLC analysis was performed on three occasions to corroborate the spots generated.

Chlorophyll Analysis

The chlorophyll content of the plant specimens was determined according to the methodology described by Baluran et al. (2018a, 2018b). An analysis of the methanolic solutions of plant extracts for chlorophylls *a* and *b* at a concentration of 2 mg/ml was conducted utilizing a UV-Vis in 653 and 666 nm wavelengths. The chlorophyll content was determined using the formulas supplied.

$$Chlorophyll\ a\ \left(\frac{mg}{L}\right) = 15.65Abs_{666} - 7.340Abs_{653}$$

$$Chlorophyll\ b\ \left(\frac{mg}{L}\right) = 27.05Abs_{653} - 11.21Abs_{666}$$

Antioxidant Potential

Determination of Total Phenolic using Folin-Ciocalteau Reagent

Ortinero et al.'s (2021) methodology was employed to ascertain the overall phenolic content (TPC). A combination of 400 mL of extract and 800 mL of purified water was amalgamated with 1.0 mL of diluted Folin-Ciocalteau phenol reagent. (1:10). Subsequently, 1.0 mL of 7.5% (w/v) sodium carbonate was introduced after 5 minutes. A collection of gallic acid performance indicators was established. The extracts' and reference solutions' absorbance at 765 nanometers was read utilizing a UV-Vis. The number of phenolic compounds present in the plant extract was calculated as milligrams of gallic acid equivalent per gram dry weight of the sample (mg GAE/DW).

Determination of Antioxidant Activity using the DPPH Radical Scavenging Method

The 2,2-diphenyl-1-picrylhydrazyl (DPPH) scavenging of radical assay outlined by Chan et al. (2007) was conducted with minor adjustments according to Ortinero et al.'s approach (2021). A range of extract solutions was created with concentrations of 1000, 100, 10, 1, 0.1, and 0.01 parts per million, while a 6.0-milligram DPPH solution was synthesized in 100 milliliters of methanol. The test vial with 2.5 mL DPPH solution received 1.5 mL of extract BHA standard. The mixture was violently shaken and left in the dark for 30 minutes. UV-Vis Spectrophotometer 1500 recorded solution absorbance at 517 nm. Each extract of DPPH radical was scavenged using the following method.:

$$DPPH\ Scavenging\ activity = \left(\frac{Abs_{blank} - Abs_{sample}}{Abs_{blank}}\right) x100$$

EC_{50} values were calculated by the use of a nonlinear regression approach (sigmoidal dose-response) to the results to estimate the scavenging capabilities of the extracts.

Data Analysis

Each experiment was conducted on three replicates. Analysis of Variance (ANOVA) was employed at a 5% level of significance to ascertain any significant discrepancies in the total amount of phenolic, carotenoid compounds, and chlorophyll content of the plant specimens. IBM SPSS was employed to perform statistical analysis.

RESULTS AND DISCUSSION

The utilization of various plant sources, readily available within localities, for medicinal purposes and therapeutic treatments has been a practice employed by ancient societies through the processes of collection, pounding, and extraction. Nonetheless, the available literature is insufficient to establish the potential risks or benefits associated with them. The study conducted by the researcher intended to identify the presence of various phytochemicals, analyze the pigmentation, and evaluate the antioxidant properties of *C. blumei*, *I. batatas*, and *S. grandiflora*.

Phytochemical Screening

Table 1 presents the phytochemical constituents identified in each plant. The confirmed presence of tannins, carbohydrates, flavonoids (as per Shinoda tests), and phenols has been observed in Mayana and Sweet Potato tops. All plant specimens exhibit the presence of saponins, cardiac glycosides, alkaline flavonoids, and glycosides. Nevertheless, it has been confirmed that only sweet potato tops test positive for the presence of alkaloids.

Sakilan et al. (2019) stated that the presence of flavonoids and tannins, in conjunction with steroids and alkaloids, may account for the observed antimicrobial and antioxidant properties of Mayana and Sweet potato tops extract. These two plants also contain phenolic compounds that are essential in the reproductive and growth processes of plants, as they function as defensive mechanisms against various forms of biotic stressors such as pathogens, parasites, and predators. Additionally, these compounds are involved in the pigmentation of plants (Baides et al., 2017). All plant samples had saponins, and saponins in plants have a defensive mechanism and are present in phytoanticipins or phytoprotectants. Studies have shown that plant saponins have molluscicidal, anti-inflammatory, antimicrobial, antifungal, antiviral, antihelmintic, antidermatophytic, antitussive, and cytotoxic properties (De Jesus, 2021). Hence, saponins in Mayana, Katuray, and Sweet Potato Tops may contribute to their antioxidant, anticancer, and immune-boosting properties.

Table 1. The Phytochemical Screening Results

	Katuray	Mayana	Sweet Potato Top
Tannins	-	+	+
Carbohydrates	-	+	+
Saponins	+	+	+
Cardiac glycosides	+	+	+
Flavonoids			
• Shinoda	-	+	+
• Alkaline	+	+	+
Terpenoids	+	+	+
Proteins	-	-	-
Phenols	-	+	+
Alkaloids			
• Mayers	-	-	+
• Dragendroffs	-	-	+
Glycosides	+	+	+

Terpenoids that are present in all plant samples have been found to possess various therapeutic benefits such as antibacterial, antiviral, antispasmodic, and antidiabetic properties. Additionally, they exhibit immunomodulatory effects, among other potential therapeutic benefits (Raju, 2021). Moreover, further research done by Kemegne et al. (2017) states that anthraquinone glycosides, exhibit diverse biological and pharmacological properties which include anti-bacterial and anti-fungal effects. Anthraquinones are classified into two distinct categories, specifically alizarin and emodine. The emodine class has been identified as possessing antibacterial characteristics which can be found in all plant samples. Alkaloids are present solely in sweet potato tops, as indicated in the findings. According to Raju (2021), alkaloids demonstrate pharmacological activities including but not limited to as analgesic, local anesthetic, hypotensive, and muscle relaxant properties.

Pigment Analysis

Total Carotenoid

Table 2. Total carotenoid content of Mayana, Katuray, and Sweet potato tops.

Plant Samples	Total Carotenoid
Coleus Blumei	374.2400^{a}
Ipomeas batatas	231.9533^{b}
Sesbania grandiflora	93.0200^{c}

Note: The same subscript means there is no significant difference at a 5% level of significance.

Table 2 shows the aggregate carotenoid content of the plant specimen. The data indicates that the levels of carotenoids range from 93.02 to 375.57 µg/g. Mayana has the maximum total carotenoid content, followed by sweet potato tops, and Katuray. This is strong evidence that Mayana is a rich source of carotenoids. At the 5% level of significance, ANOVA and Tukey's post hoc test reveals a statistically significant difference in the total carotenoid content of the three plant samples. Mayana has the highest carotenoid content, while Katuray has the lowest.

Thin Layer Chromatographic Analysis of Carotenoids

Table 3 shows that the Mayana yielded 10 identified spots, while Katuray and sweet potato tops produced 9 and 8 identified spots, respectively. Since the obtained Rf values varied from 0 to 1.00, it was clear that the spot polarities were unique for each plant extract. For a chemical to have an Rf value of 0.00, it must be highly polar and exhibit a strong affinity for the polar silica gel plate. The spotted objects might be carotenoids that have been exposed to oxygen. Spots with an Rf value of 0.98 are likely to have the least polarity of any spots seen.

According to Natividad and Rafael (2014), the term "nonpolar" is used to describe the characteristics of a particular spot, which is typically identified as a carotenoid hydrocarbon such as B-carotene in spots exhibiting higher Rf values. The retention factor demonstrates a marked affinity towards the mobile phase, characterized by an elevated concentration of the nonpolar xylene solvent. The presence of related substances may be indicated by the discovery of comparable spots with Rf values of 0.00, 0.16, and between Katuray and Mayana (Rf = 0.86; 0.96) in all three plants.

Table 3. Retention factor values of the plants using thin-layer chromatography

Plant Samples	Katuray	Mayana	Sweet Potato Top
	0.00	0.00	0.00
	0.16	0.16	0.10
			0.16
	0.30	0.28	0.32
		0.34	
			0.38
R*f* values	0.49		
	0.59	0.52	0.55
	0.64		0.63
	0.75	0.76	0.74
	0.86	0.84	0.86
	0.96		0.96
		1.00	

Chlorophyll Analysis

Table 4 shows that Ipomoea batatas has a significant difference at a 5% level of significance in terms of its chlorophyll *a* and *b* content. However, Tukey's Post hoc test revealed that Mayana and Katuray have no significant difference in their chlorophyll *a* and *b* content. Sweet Potato tops contain the highest chlorophyll *a* and *b* for both plants. They contain minerals in addition to carotene. Chlorophyll *a* is the primary pigment responsible for converting light into the chemical energy required by plants for photosynthesis. Chlorophyll *b* is yet another pigment present in plants.

Table 4. Chlorophyll a and b content of plant samples

Plant Samples	Chlorophyll a	Chlorophyll b
Coleus Blumei	1.2033^{b}	3.6633^{b}
Ipomeas batatas	2.3033^{a}	6.1867^{a}
Sesbania grandiflora	1.1900^{b}	3.1700^{b}

Note: The same subscript means there is no significant difference at a 5% level of significance.

Antioxidant Analysis

Table 5 shows the values of the total phenolics and total DPPH of the three plant samples. Analysis of variance then revealed that at a 5% level of significance, there is a significant difference in the total phenolics and total DPPH of the plants.

Given the abundance and prevalence of phenolics in plants, it is not surprising that they are present in fruit and vegetable peels (Ortinero et. al, 2020). The analysis showed that Katuray has the highest phenolic content. As mentioned in the study of Aryal et al. (2019), because of their proclivity to give hydrogen atoms to free radicals, flavonoid and phenolic compounds are key antioxidant elements accountable for free radical deactivation.

In the three plant samples, *Ipomoea batatas* has the lowest amount of scavenging activity which denotes its high potency. Ding et al. (2010) found out in their study that sweet potato top has an IC_{50} of 8.60 mg/L in scavenging DPPH radicals. They claimed that even though the plant has a scavenging potential, rutin, and vitamin

C are much more potent. However, they added that it was more effective at scavenging superoxide radicals than rutin, but not as effectively as vitamin C. It was also more effective at scavenging hydroxyl radicals than rutin or vitamin C. A similar study done by Islam (2016) stated that sweet potatoes have been found to contain phenolic acids. To protect the body against various chronic conditions, leaves may have anti-mutagenic, anti-diabetic, anti-cancer, and antibacterial properties.

Table 5. Total phenolics and Total DPPH

Plant samples	Total Phenolics	Total DPPH IC_{50} values
Coleus blumei	53.1533^{a}	223.1267^{a}
Ipomeas batatas	56.5000^{b}	84.2933^{b}
Sesbania grandiflora	111.3733^{c}	435.1133^{c}

Note: The same subscript means there is no significant difference at a 5% level of significance.

CONCLUSION AND RECOMMENDATION

This study showed that among the three plants, *Ipomoea batatas* has the greatest number of phytochemical constituents while *Coleus blumei* has the highest total carotenoid content. Ipomoea batatas is the most potent among the three plant samples. Therefore, it is concluded that *Ipomoea batatas* can be used to produce new pharmaceutical products for its remarkable trace of phytochemical constituents, carotenoid content, and antibacterial activity.

The findings of this research may be utilized to examine the total amount of phytochemical constituents in each plant sample. Furthermore, findings can be used as a basis for the formulation and drug developments made of natural products.

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