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DISCLOSURE THE PHYTOCHEMICAL PROFILE AND BIOACTIVE POTENTIAL OF *IPOMOEA BATATAS*: ANTIOXIDANT AND ANTI-INFLAMMATORY EFFECTS

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ABSTRACT

Ipomoea batatas L is a conventional medicine plant belonging to the family convolvulaceae. Leaves of the plant are a source of diverse phytochemicals and were described to be used in treating various diseases. Consequently, our study was carried out to reveal the phytochemical, antioxidant and anti-inflammatory activities in tuber of *Ipomoea batatas*. The ethanolic extracts of *Ipomoea batatas* tubers were investigated for its radical scavenging; DPPH scavenging assay and H_2O_2 radical scavenging assay were utilized to determine antioxidant activity and in vitro anti-inflammatory activity by inhibition of albumin denaturation assay. The phytochemical analysis of Ipomoea batatas ethanol extract showed that the extract contains alkaloids, triterpenoids, flavonoids, tannins, and saponins that are responsible for its high antioxidant and anti-inflammatory activity in a dose-dependent way. The *Ipomoea batatas* tuber extract demonstrated influential antioxidant and anti-inflammatory activities, exhibiting 65.8% inhibition in DPPH, 65.0% in H_2O_2 radical scavenging assays, and 55.0% anti-inflammatory activity at a deliberation of 250 mg/ml. The tuber extract of *Ipomoea batatas* L., rich in diverse secondary metabolites, holds promising medicinal potential and may be developed into therapeutic agents for future healthcare applications.

Keywords: *Ipomoea batatas* L, DPPH scavenging assay, H_2O_2 radical scavenging assay, healthcare

1. INTRODUCTION

Throughout human history, plants and their derivatives have significantly contributed to medicinal advancements, serving as a primary source of treatment for various health conditions for centuries **[1]**. Medicinal plants are a vital group of plant species, revered for their remedial properties in orthodox medicine and ratified by modern science, serving as a rich source of bioactive ingredients for developing medicinal drugs **[2]**. Plant-based drugs offer numerous advantages, including easy availability, affordability, safety, and efficacy, with minimal risk of adverse side effects **[3]**.Traditionally used medicinal plants embody ancient wisdom and continue to serve as an invaluable resource for discovering innovative and efficacious pharmaceuticals **[4]**. The medicinal traits of plants are endorsed to their phytochemical constituents, which are the bioactive compounds responsible for their therapeutic effects **[5]**.

Phytochemicals or bioactive substances that are naturally occurring in plants and possess medicinal properties **[6]**. These phytochemicals include alkaloids, tannins, flavonoids, terpenoids, saponins, and phenolic compounds, which have garnered significant interest from pharmacists due to their impressive therapeutic profiles and relatively low toxicity **[7]**. These bioactive compounds present extensive range of biological activities, encompassing antibacterial, analgesic, antipyretic, anti-inflammatory, antimicrobial, antioxidant, antiviral, and anticancer properties, making them valuable for various therapeutic applications **[8]**. The vast potential of phytochemicals has made preliminary screening of plants a critical step in the quest for novel, high-efficacy therapeutic agents, with researchers globally actively investigating this promising area **[9]**.

The Ipomoea genus, comprising over 600 species, belongs to the Convolvulaceae family and is globally distributed. These plants exhibit diverse growth habits, ranging from weeds to cultivated species valued for their medicinal and ornamental properties **[10]**. *Ipomoea batatas* L., known colloquially as the sweet potato (SP), is a globally recognized species within the Ipomoea genus. As a wealth of energy and bioactive compounds, sweet potatoes have played a vital role in human nutrition and animal feed, offering numerous health benefits **[11]**. Sweet potatoes are cherished for their medicinal properties, including antioxidant, anti-inflammatory, anti-diabetic and anti-cancer effects, making them a valuable source of natural compounds for medicine and industry **[12]**. Sweet potatoes have a rich medicinal heritage due to their diverse phytochemical compounds, which exhibit distinct pharmacological properties and therapeutic value **[13]**.

This research endeavored to provide a comprehensive understanding of *Ipomoea batatas L* crude tuberous root extract, focusing on its phytochemical composition and biological activities.

2. MATERIALS AND METHODS

2.1. Collection of Plant Materials and Preparation of Extracts

The fresh tuber of *Ipomoea batatas* was obtained from in and around areas of Tiruchirappalli, Tamilnadu. *Ipomoea batatas* tuber was properly washed with sterile distilled water, desiccated in the shade at room temperature for two weeks, and then dry tubers ground into a coarse powder and tightly kept in a closed container. The *Ipomoea batatas* tubers were repeatedly extracted with ethanol by the successive solvent extraction technique employing a Soxhlet apparatus as per Indian Pharmacopoeia methodology. Extraction was performed for 18h utilizing selected solvents at a ratio 1:4 w/v according to their polarity of ethanol.

2.2. Phytochemical Analysis

Phytochemical screening of the ethanol extract of *Ipomoea batatas*, prepared via successive solvent extraction, revealed its phytoconstituent profile.

2.2.1. Test For Alkaloids

Alkaloids were detected using Maye r's reagent test. A small amount of plant extract was mixed with two drops of Mayer's reagent, added slowly down the inner wall of the test tube. The presence of alkaloids was established by the production of a white creamy precipitate.

2.2.2. Tests For Saponins

Foaming test was employed to identify saponins. 3ml of plant extract and 3ml of distilled water were vigorously mixed. The presence of stable, long-lasting foam revealed the presence of saponins.

2.2.3. Tests For Tannins

The presence of tannins was confirmed by gelatin test. A sample solution was mixed with 1% gelatin solution in which sodium chloride was present in 10% concentration. Formation of white precipitate confirmed the presence of tannins.

2.2.4. Tests For Phenolic Compounds

The ferric chloride test was utilized to determine total polyphenols, One milliliter of crude extract was combined with 2 mL of 5% ferric chloride solution, yielding a blue-green coloration, which was the sign of phenols.

2.2.5. Test For Flavonoids

The alkaline reagent test was used to detect flavonoids in the plant extracts. Three milliliters of the extract were treated with 1 mL of 10% sodium hydroxide solution, resulting in an intense yellow coloration, which indicated the presence of flavonoids.

2.2.6. Test For Steroids

The Salkowski test detected steroids. A 2ml sample solution was mixed with 5ml chloroform, and 1ml concentrated sulfuric acid (98%) was added cautiously down the test tube's inner wall. A reddish-brown ring at the interface indicated the presence of steroid.

2.2.7. Tests For Terpenoids

By mixing 2 mL of chloroform with 3 mL of sulfuric acid and then adding 5 mL of plant extract, terpenoids were found. Terpenoids were in existence since a reddish-brown hue appeared.

2.2.8. Tests For Coumarins

By mixing 2 mL of the extract with 3 mL of a 10% sodium hydroxide solution, the presence of coumarins in the plant extracts was examined. The presence of coumarins was revealed by the emergence of a yellow tint.

2.2.9. Tests For Glycoside

0.5mL crude extract mixed with 1mL distilled water and NaOH produced a yellowish tint, confirming glycoside presence.

2.2.10. Test For Quinine

A quinone test was performed by incorporating 2 mL of 5% KOH to 1 mL of extract, followed by filtration. A change in color was observed, with a pink color indicating the occurrence of quinones.

2.2.11. Test For Volatile Oils

2mL extract was treated with 0.1mL diluted NaOH and 0.1mL diluted HCl. Formation of a white precipitate revealed volatile oli.

2.3. Anti-Oxidant Studies

2.3.1. DPPH Scavenging Assay

With some slight adjustments, a method adopted from W. Brand-Williams was employed to evaluate the DPPH radical scavenging activity **[14]**. The DPPH radical scavenging assay was quantified through tracking the reduction of absorbance at 517 nm, which reflects the neutralization of the stable free radical.

A methanolic DPPH solution (90.25 mM) was stirred with an equal quantity of ethanolic tuber extract of *Ipomoea batatas* (concentrations ranging from 250-1500 µg). The final volume was adjusted to 1mL with methanolic DPPH. Methanol was suppleme nted to the control. The absorbance at 517n m was determined after 20 minutes using a Systronics UV-Vis spectrophotometer. Ascorbic acid was used as the reference standard for comparison. The inhibition of free radicals by DPPH was determined as a percentage by using the below equation.

$$\% \text{ Scavenging} = \frac{\text{A Control OD - A sample}}{\text{A blank}} \times 100$$

A control: absorbance without test compound; A sample: absorbance with test compound

2.3.2. Scavenging Of H_2O_2

The antioxidant potential of Ipomoea batatas was assessed for its hydrogen peroxide (H_2O_2) scavenging activity, following the method outlined by Souad Senhaji. A solution of H_2O_2 (40 mm) was formulated in phosphate buffer (pH 7.4). H_2O_2 was measured spectrophotometri cally based on absorption at 230 nm in a spectrophotometer (SL 159, UV- Visible Spec, *E. coli*, India). Extracts (200, 400, 600, 800 and 1000 μg) in distilled water were added to a H_2O_2 solution (0.6 mL, 40 mm). The absorbance of hydrogen peroxide (H_2O_2) was measured at 230 nm after 10-minute incubation, using a phosphate buffer solution without H_2O_2 as the blank reference. The percentage of *Ipomoea batatas* scavenging of H_2O_2 of and standard was calculated using the following equation:

A_t = absorbance of the sample A_i = absorbance of control

Percentage of hydrogen peroxide scavenging = $[(A_i - A_t)/ A_i] *100$

Where the control is the phosphate buffer with H_2O_2

2.4. Assessment Of In-vitro Anti-Inflammatory Activity

2.4.1. Inhibition Of Albumin Denaturation

Ipomoea batatas's anti-inflammatory activity was evaluated via albumin denaturation inhibition, based on Esho and Babatunde Akinyemi's method with minor adjustments **[15]**. Reaction mixture consisted of test extracts and 1% bovine albumin fraction. pH was adjusted with 1N HCl. Samples were incubated at 37°C (20 minutes) and subsequently 51°C (20 minutes). After cooling, turbidity was measured at 660nm in a UV-Vis spectrophotometer (Elico India Ltd, Model 371). The experiment was conducted in threefold.

3. RESULT AND DISCUSSION

3.1. Phytochemical analysis

The phytochemical prospecting established the detection of different secondary metabolite classes in the crude extract, which have been proven to exhibit marked biological activities and, therefore, suggested its likely pharmaceutical uses **[16]**. The preliminary phytochemical investigation of the ethanolic extract of *Ipomoea batatas* was conducted and found to contain a range of bioactive substances, as indicated in **Table 1**. The qualitative examination of the ethanolic extracts of *Ipomoea batatas* exposed the existence of moderate amounts of alkaloids and volatile oils, high amounts of saponins, phenolic compounds, flavonoids, and quinine, while tannins, steroids, terpenoids, coumarins, and glycoside were not detected.

The presence of secondary compounds in medicinal plants provides them with the capacity to combat and treat microbial disease. The variation in type and quality of phytochemical present in the plants account for deviation in their biological activities and pharmacological properties **[17]**.

Antihypertensive, antispasmodic, anti-Parkinson's, antiviral, antitussive, and analgesic activity has all been associated with alkaloid compounds **[18]**. Flavonoids have anti-inflammatory, antiviral, antibacterial, antithrombotic, and antioxidant properties that lessen oxidative stress linked to cardiovascular diseases **[19]**. Numerous biological effects, such as antibacterial, antiviral, antioxidant, anticancer, antiallergic, antiangiogenic, and spasmolytic activity, have been reported for terpenoids **[20]**. Many research have demonstrated the antibacterial, anticarcinogenic, and antimutagenic potentials of tannins **[21]**. Saponins are formed as a result of attachment of an aglycone unit to a single or several carbohydrate chains. They exhibit varied pharmacological properties including antibacterial, antifungal, antiviral, antioxidant anti-inflammatory, anticancer and immunomodulatory activities **[10]**. Phenolic chemicals, a major class of plant metabolites, exhibit a wide range of biological activities, including anti-inflammatory, anti-cancer, anti-aging, and cardiovascular protective effects **[3]**. Many studies have set up a tight relationship between the phenolic composition and antioxidant potential in different medicinally important plants **[22]**.

3.2.Antioxidant Activity

3.2.1. DPPH Scavenging Assay

DPPH radical is a common substrate for determining antioxidant activity because of its stability and ease of use. According to Manal N. Abdel Azeem, DPPH radicals interact with reducing agents to pair up electrons and produce a stoichiometric color loss in solution **[23]**, **[24].** These findings assessed the in vitro antioxidant activity of ethanolic extracts of *Ipomoea batatas* employing the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging evaluation. The observations demonstrate that the extracts exhibited significant antioxidant activity in in vitro models. The extracts demonstrated dose-dependent inhibition activity against DPPH. Notably, the ethanolic extract demonstrated maximum inhibitory activity of 65.8% at a concentration of 250 mg/ml in the DPPH assay, as shown in **Table 2**. The present findings suggest that DPPH readily accepts electrons or hydrogen radicals from antioxidant compounds, indicating its effectiveness as a free radical scavenger. In DPPH assay, it has been found that inhibitory effect of Ipomoea batatas extracts was in direct relation with their ability to donate hydrogen, showing the extracts antioxidant capacity as a function of their potential to donate a hydrogen atom. Highest inhibition came from the ethanolic extract with a 250 mg/ml concentration.

3.2.2. Scavenging Of H_2O_2

Hydrogen peroxide (H_2O_2) is a natural byproduct of oxygen metabolism in organisms. It's a primary source of highly reactive hydroxyl radicals (˙OH), which trigger lipid peroxidation. In the presence of Fe2+ and other transition metals, Fenton and Haber-Weiss reactions generate ˙OH, causing significant harm. Therefore, eliminating H_2O_2 is crucial to prevent oxidative damage **[25]**. The H_2O_2 assay indicated a dose-dependent scavenging activity, and inhibition percentages of 31.0%, 42.7%, 53.6%, 61.0%, and 65.0% at concentrations of 50, 100, 150, 200, and 250 mg/ml, respectively. These findings are corroborated with the in vitro antioxidant activity of *Ipomoea batatas* evidenced in this research, as illustrated in **Table 3 and Figure 1**.

The current research shows dose-dependent inhibition of hydroxyl radical generation from H_2O_2. H_2O_2 penetrates cell membranes, generating damaging hydroxyl radicals. Antioxidants neutralize H_2O_2 by donating electrons, converting it into water. This mechanism likely applies to the antioxidant activity observed in this study.

3.3.Anti-inflammatory Activity

3.3.1 Inhibition of Albumin Denaturation

Protein denaturation happens when proteins lose their secondary and tertiary structures as a result of external stress agents such as strong bases/acids, high salt concentration, organic solvents, or heat. Protein denaturation usually leads to the loss of their biological activity, and it is a classic cause of inflammation **[26]**. Albumin denaturation had been documented as one of the causes of inflammation and the ability of plants extracts to inhibit this process of inflammation is being monitored **[15]**. As part of the research on the anti-inflammatory process, the inhibitory effect of the plant extract on protein denaturation was investigated. The findings indicated that the extract potently inhibited albumin denaturation caused by heat. 50, 100, 150, 200, 250 at 15, 25, 35, 45, 55 maximum inhibition of 55%was observed at 250 mg/ml. Minimum inhibition of 15% was observed at 50 mg/ml, whereas the highest inhibition of 60% was obtained at 250 mg/ml, comparable to the standard anti-inflammatory drug, as illustrated in **Table 4 and Figure 2**.

Consequently, the crude extracts of *Ipomoea batatas* showed significant inhibition of protein denaturation, which was expected. The findings clearly show that this plant is of potential as an anti-inflammatory agent, thereby making this research even more valuable.

Table 1: Preliminary Phytochemical Screening of *Ipomoea batatas*

S. No	Phytochemical name	Ipomoea batatas
1	Alkaloids	++
2	Saponins	+++
3	Tannins	-
4	Phenolic Compounds	+++
5	Flavonoids	+++
6	Steroids	-
7	Terpenoids	-
8	Coumarins	-
9	Glycoside	-
10	Quinine	+++
11	Volatile Oils	++

(+) Indicates Presence; (-) Indicates Absence

Table 2: DPPH Scavenging Assay of *Ipomoea batatas* Extracts

Test	Concentration of plant extract (mg/ml)	% of Inhibition	Ascorbic acid
DPPH assay	50	28.6	35.6
	100	32.7	43.6
	150	45.1	50.0
	200	56.2	64.7
	250	65.8	70.5
IC 50 VALUE		172.76	134.75

Table 3: H_2O_2 Scavenging Activity of *Ipomoea batatas* Extracts

Test	Concentration of plant extract (mg/ml)	% of Inhibition	Ascorbic acid
H_2O_2 assay	50	31.0	33.0
	100	42.7	45.0
	150	53.6	55.0
	200	61.0	63.4
	250	65.0	70.0
IC 50 VALUE		146.68	132.82

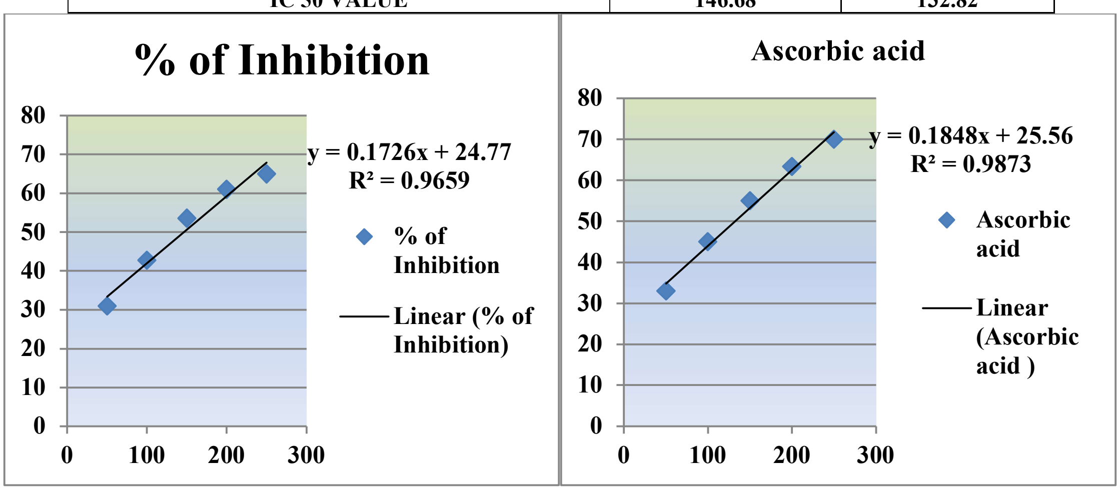

Figure 1: H_2O_2 Scavenging Activity of *Ipomoea batatas* and Ascorbic Acid

Table 4: Albumin Denaturation Assay of *Ipomoea batatas* Extracts

Test	Concentration of plant extract (mg/ml)	% of Inhibition	Aspirin
Albumin denaturation assay	50	15	20
	100	25	30
	150	35	40
	200	45	50
	250	55	60
IC $_{50}$ VALUE		225	200

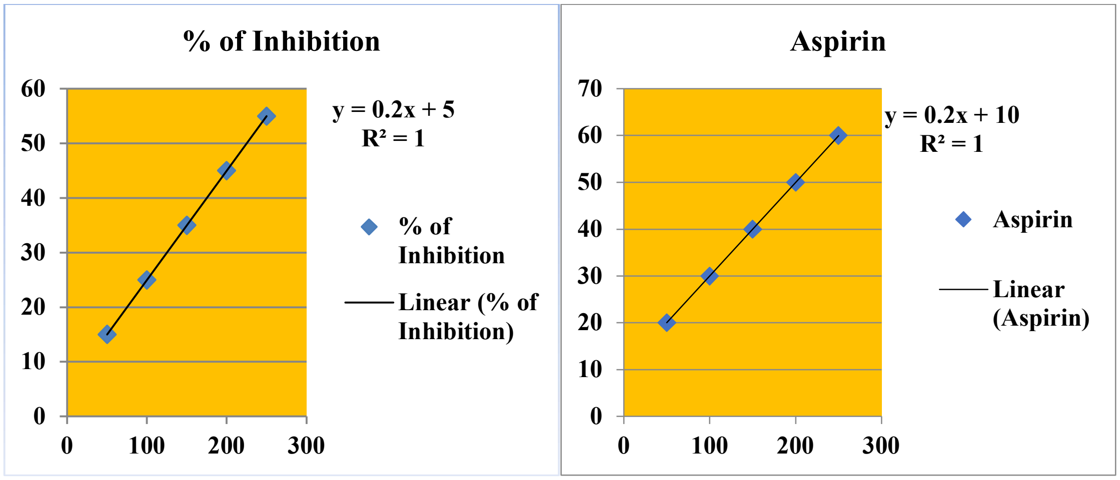

Figure 2: Albumin Denaturation Assay of *Ipomoea batatas* Extracts and Aspirin

4. CONCLUSION

Analgesic medications are often associated with undesirable consequences, including gastrointestinal disturbances and severe stomach problems. Anti-inflammatory drugs, including biologics like anticytokine therapies, work by inhibiting kinase activity, but may also significantly impair the host's immune response, making patients more susceptible to infections. The growing concern over the adverse effects of conventional anti-inflammatory medications has led to a surge in interest in naturally occurring, plant-based anti-inflammatory supplements, which offer a safer and more holistic alternative. Recently, numerous experimental approaches have been utilized to validate and identify natural antioxidants and anti-inflammatory agents derived from natural product sources. This study aims to contribute to the expansion of novel anti-inflammatory drugs for the healing and management of diverse chronic inflammatory diseases and related disorders. The findings suggest that the investigated plant species exhibit substantial anti-inflammatory and antioxidant traits. The observed anti-inflammatory activity of the plants may be endorsed to the presence of antioxidants, and the study's findings suggest a positive correlation between the two activities, indicating a potential causal relationship. Potential investigations are warranted to thoroughly investigate the detailed antioxidants involved and their corresponding mechanisms, ultimately informing the development of novel herbal drug formulations.

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