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EFFECT OF ETHANOLIC EXTRACT OF MYRISTICA FRAGRANS SEEDS AND MUCUNA PRURIENS SEED EXTRACT ON INTERVENTION EFFECTS ON RATS GSH LEVEL IN BRAIN AND LIVER TISSUES

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Abstract

This study investigates the intervention effects of ethanolic extracts from Myristica fragrans seeds and Mucuna pruriens seeds on glutathione (GSH) levels in the brain and liver tissues of rats. Myristica fragrans, commonly known as nutmeg, and Mucuna pruriens, also referred to as velvet bean, are renowned for their diverse pharmacological properties.

Methods: Sprague-Dawley rats were divided into control and experimental groups. The experimental groups received ethanolic extracts of Myristica fragrans seeds and Mucuna pruriens seeds orally for a specified duration. GSH levels in brain and liver tissues were assessed using established biochemical assays.

Results: The ethanolic extract of Myristica fragrans seeds exhibited a significant elevation in GSH levels in both brain and liver tissues compared to the control group. Similarly, Mucuna pruriens seed extract intervention demonstrated a notable increase in GSH levels in the brain and liver tissues of rats.

Conclusion: The findings suggest that the ethanolic extracts of Myristica fragrans seeds and Mucuna pruriens seeds may exert antioxidant effects by enhancing GSH levels in the brain and liver tissues of rats. These interventions hold promise for further exploration in the context of neuroprotection and hepatic health, potentially contributing to novel therapeutic avenues.

Keywords: Myristica fragrans, Mucuna pruriens, ethanol extract, glutathione, antioxidant, rat tissues,

Introduction

Memory, in the context of cognitive psychology and neuroscience, is defined as the ability to encode, store, and retrieve information about past experiences, knowledge, and events. It involves the processing of information, the formation of durable representations, and the later recall or recognition of that information when needed. Memory is not a single entity but a complex system with multiple components, each serving different functions.[1,2]

In the realm of cognitive enhancement, the quest for substances that boost cognitive function has led researchers and enthusiasts to explore the potential of herbal plants. Nootropics, often referred to as "smart drugs" or cognitive enhancers, are substances known for their purported ability to enhance memory, focus, and overall cognitive performance. The intersection of herbal plants and nootropics presents an intriguing avenue for investigation, as traditional remedies and botanical compounds have long been associated with cognitive benefits.[3-4]

Herbal nootropics draw attention due to their historical use in traditional medicine systems across cultures. The wealth of botanical diversity offers a plethora of compounds that may influence neural processes, providing an alternative or complementary approach to synthetic nootropics. Understanding the effects of herbal plants on nootropic outcomes involves delving into the phytochemical composition and mechanisms of action that contribute to cognitive enhancements.[5-6]

Herbal remedies for cognitive enhancement have deep roots in traditional medicine systems worldwide. Plants like **Ginkgo biloba** have been employed in traditional Chinese medicine for centuries, believed to improve memory and cognitive function. **Saffron (Crocus sativus)**, another noteworthy herb, has historical use in Persian medicine for its potential cognitive benefits. Understanding the traditional uses provides a cultural and historical context for the exploration of herbal nootropics.[7]

Ginkgo biloba is rich in flavonoids and terpenoids, with the former possessing antioxidant properties that may contribute to neuroprotection. The terpene lactones, including ginkgolides and bilobalide, are believed to have anti-inflammatory effects and influence cerebral blood flow.[7]

Saffron contains various bioactive compounds, including crocetin and crocin. These compounds exhibit antioxidant and anti-inflammatory properties, potentially contributing to cognitive benefits.

Bacopa monnieri, known as Brahmi in traditional Indian medicine, is rich in bacosides. These saponins may play a role in enhancing cognitive function by promoting neurotransmitter synthesis and protecting against oxidative stress[8]

Plant Profile

Myristica fragrans, the nutmeg tree, is an evergreen belonging to the Myristicaceae family. Native to the Banda Islands in Indonesia, it is a medium-sized tree, reaching heights of about 20 meters. The tree features dark green, elliptical leaves arranged alternately. Its small, pale yellow, dioecious flowers give rise to distinctive fruits - a fleshy outer covering produces the seed known as nutmeg, while a crimson-colored aril, called mace, surrounds the seed.[9]

Cultivation: Cultivated in tropical climates with well-distributed rainfall, the nutmeg tree thrives in well-drained, fertile soil. It is primarily propagated through seeds.[10]

Uses: Nutmeg and mace, obtained from Myristica fragrans, are widely used as spices in culinary applications, imparting flavor to both sweet and savory dishes. Additionally, nutmeg has traditional uses in medicine for its potential anti-inflammatory and digestive properties. The seeds are a source of essential oils used in perfumes and aromatherapy.[11]

Cultural Significance: With a rich historical background, nutmeg has been traded since ancient times and played a significant role in spice routes and colonial trade. Culinary traditions globally incorporate nutmeg, particularly in baking and holiday recipes.[12]

Mucuna pruriens

Description: Mucuna pruriens, commonly known as velvet bean or cowhage, is a leguminous plant belonging to the Fabaceae family. Native to tropical regions of Africa and Asia, this climbing plant is recognized for its vibrant purple flowers and distinctive seed pods. The plant is characterized by compound leaves and long, bristly hairs covering its pods and stems.[13]

Botanical Features:[13]

- **Leaves:** Compound, trifoliate leaves.
- **Flowers:** Clusters of purple or lavender flowers.
- **Fruits:** Long, bristly seed pods containing seeds.

Active Compounds:[14]

- **L-DOPA (Levodopa):** Significant neurotransmitter precursor used in Parkinson's disease treatment.
- **Serotonin:** Involved in mood regulation.
- **Antioxidants:** Contribute to the plant's potential health benefits.

Traditional Uses:[15]

- **Ayurvedic Medicine:** Utilized for various health conditions, including neurological disorders and male reproductive health.
- **Folk Medicine:** Employed as an anthelmintic, diuretic, and nervine tonic.

Modern Applications:

- **Parkinson's Disease:** L-DOPA content makes it a potential treatment for Parkinson's symptoms.
- **Libido and Fertility:** Some studies suggest positive effects on male reproductive health.

Collection and authentication of plant material:

The selected plant material Myristica fragrans seeds and Mucuna pruriens seed were purchased from local market of Bhopal India.

Macroscopic studies

Macroscopic studies involve examining biological specimens or materials with the naked eye or low magnification. They provide an overview of features and morphology. Examples include studying plants, animals, tissues, organs, and geological formations in various fields.

Physicochemical Evaluation

Determine of ash:

Determining the ash content is a critical step in the physicochemical assessment of food and agricultural products, providing insights into their mineral composition. This process involves the examination of the inorganic residue left after the complete combustion of organic matter. The procedure employs essential materials and equipment, including a crucible, muffle furnace, desiccator, and analytical balance. The steps encompass weighing the sample, preheating and cooling the crucible, transferring the sample for even distribution, conducting controlled combustion in the muffle furnace, and cooling the crucible to prevent moisture absorption. The final step involves weighing the crucible with the ashed sample, and the ash content is calculated as a percentage. Precautions, such as ensuring thorough combustion and using high-quality crucibles, are emphasized to maintain accuracy, and the analytical balance must be carefully calibrated for precise measurements.

Calculation:

$$\text{Ash Content (\%)} = \frac{Weight\ of\ Ash}{Weight\ of\ Sample} \text{ x } 100$$

Total ash

Total ash determination is a vital analytical procedure employed in diverse industries such as food, pharmaceuticals, and agriculture to assess the inorganic residue left after complete incineration of a sample. This residue comprises both inherent minerals and any introduced impurities. The method requires specific equipment, including a crucible, muffle furnace, desiccator, analytical balance, and an ashing dish. The procedure begins with the precise weighing of a representative sample based on the anticipated ash content and analysis specifications. The crucible is then preheated in the muffle furnace to eliminate organic residues, followed by cooling in a desiccator. The sample is evenly distributed in the crucible, and controlled combustion in the muffle furnace at temperatures around 550-600°C ensures complete ashing, a crucial step for accurate results. After cooling in a desiccator to prevent moisture absorption, the total ash is determined by weighing the crucible with the ashed sample using an analytical balance. The calculated increase in weight represents the percentage of total ash

content. This comprehensive procedure offers valuable insights into the inorganic composition of various materials, facilitating quality control and compliance in industrial applications.

$$\text{Total Ash Content (\%)} = \frac{Weight\ of\ Ash}{Weight\ of\ Sample} \text{x100}$$

Determination of acid insoluble ash

The determination of acid insoluble ash is a crucial analytical process often applied in the examination of botanical materials, particularly in assessing the purity of herbal drugs and food products. The procedure initiates with the accurate weighing of a representative sample, the quantity determined by the expected acid insoluble ash content and the analysis's specific demands. Subsequently, the process follows the steps outlined in the "Total Ash Determination" procedure until the sample is fully ashed. The next phase involves treating the total ash with dilute hydrochloric acid to dissolve soluble salts, with gentle heating. The solution is then filtered to separate the insoluble ash from the soluble salts, and the residue is collected on an ashless filter paper.

Calculation:

$$\text{Acid Insoluble Ash Content (\%)} = \frac{Weight\ of\ Acid\ Insoluble\ Ash\ Content}{Weight\ of\ Sample} \text{x100}$$

Determination of water soluble ash

Water-soluble ash determination is a critical analysis frequently employed in the examination of botanical materials, particularly in the assessment of herbal drugs and plant-based products. This specific type of ash represents the portion that readily dissolves in water and plays a significant role in evaluating material purity by identifying water-soluble substances. The analysis requires essential materials and equipment, including a crucible, muffle furnace, desiccator, analytical balance, ashing dish, and water.

The procedural steps begin with the precise weighing of a representative sample, the quantity determined by the expected water-soluble ash content and the specific analysis requirements. Subsequently, the process follows the "Total Ash Determination" procedure until the sample is fully ashed. The next phase involves treating the total ash with a known volume of water in a beaker to dissolve water-soluble components. The resulting solution is then filtered to separate water-soluble components from insoluble ash, with the filtrate collected in an ashless filter paper.

To ensure thorough collection of water-soluble components, the residue on the filter paper undergoes meticulous washing with water. The washed residue is then transferred to an ashing dish for drying. The subsequent step involves incinerating the residue in a muffle furnace at temperatures around 550-600°C until a constant weight is achieved. After cooling the ashed residue in a desiccator, it is weighed using an analytical balance. The increase in weight serves as an indicator of the water-soluble ash content, providing valuable insights into the purity of the botanical material under examination. This comprehensive procedure is instrumental in ensuring accurate assessments of the water-soluble components in herbal drugs and plant-based products.

Calculation:

$$\text{Water-Soluble Ash Content (\%)} = \frac{Water-Soluble\ Ash\ Content}{Weight\ of\ Sample} \text{x100}$$

Determination of loss on drying

Loss on Drying (LOD) stands as a pivotal measure for determining the moisture content within a sample, finding widespread application in industries such as pharmaceuticals, food, and materials testing. This analysis plays a crucial role in evaluating the stability, quality, and processing conditions of a diverse range of products. The methodology involves the utilization of specific materials and equipment, notably an analytical balance for precision in measurements, and either a drying oven or a moisture analyzer to facilitate the evaporation of moisture from the sample. Additionally, a desiccator is employed to cool and shield the sample from moisture post-drying.

The procedural steps encompass the accurate weighing of a representative sample, with the quantity contingent upon the specific analysis requirements. Depending on the material type, two common drying methods are employed: the Drying Oven Method, where the sample is placed in a pre-dried dish and dried in an oven until a constant weight is achieved, and the Moisture Analyzer Method, where the sample undergoes drying as per the instrument's instructions.

Following the drying process, the sample is allowed to cool in a desiccator, preventing moisture absorption from the surroundings.

Calculation:

$$\text{Loss on Drying (\%)} = \frac{Initial\ Weight - Final\ Weight}{Initial\ Weight} \text{x100}$$

Determination of moisture content

Moisture content stands as a critical parameter in industries spanning from food and pharmaceuticals to materials testing. Its accurate determination holds paramount importance for quality control, product development, and the optimization of manufacturing processes. This comprehensive procedure, employing fundamental materials and equipment such as an analytical balance, drying oven, or moisture analyzer, and a desiccator, serves as a general guide for determining moisture content. The process initiates with the precise weighing of a representative sample, the quantity contingent upon the specific analysis requirements. Post-drying, the sample undergoes cooling in a desiccator, mitigating the risk of moisture absorption from the surroundings. The final step involves reweighing the sample using the analytical balance. The decrease in weight reflects the loss of moisture, providing a quantitative measure of the material's moisture content. This procedure, characterized by precision and adaptability, proves instrumental in ensuring the quality and efficiency of processes in various industries, contributing to the overall success and reliability of product manufacturing and development.

Soxhlet Extraction Apparatus

The preparation of plant materials, a fundamental step in botanical extraction, involves meticulous procedures to ensure the integrity of the ensuing extraction process. For Rosmarinus officinalis, or rosemary leaves, the initial steps entail acquiring fresh leaves and meticulously removing any impurities. Subsequently, the leaves undergo air-drying to eliminate excess moisture, followed by the crucial step of crushing the dried leaves into a manageable consistency using a mortar and pestle. On the other hand, the preparation of Vigna radiata, or mung bean seeds, involves a thorough cleaning and drying process, followed by grinding the seeds into a coarse powder with the aid of a mortar and pestle. These preparatory measures aim to enhance the efficiency of subsequent extractions by optimizing the physical state of the plant material.

Moving to the extraction thimble preparation, a key component in the Soxhlet extraction apparatus, precision is paramount. Thimbles are meticulously prepared for each plant material by accurately weighing the crushed or ground substance, ensuring precise documentation of these weights. This precision is crucial for obtaining accurate and reproducible results during the extraction process.

The extraction process begins by loading the prepared thimble into the Soxhlet extractor and adding the chosen solvent to the round-bottom flask. As the solvent vaporizes, it ascends through the condenser, extracting plant compounds from the material in the thimble. This continuous cycling process ensures a thorough extraction.

Upon completion of the extraction, the solvent-extract mixture is collected in a round-bottom flask. To concentrate the extract, a rotary evaporator is employed to evaporate the solvent under reduced pressure. Finally, the concentrated extract is weighed using an analytical balance, and the results are meticulously recorded. The extracts are then stored in dark, airtight containers to maintain their integrity, shielded from light and moisture. This detailed process is integral to the production of high-quality plant extracts with potential applications in various industries.

Prelimnary phytochemical analysis of extracts

Qualitative test as phytochemical examination of any plant species is a vital procedure as it gives idea about the presence of different phytoconstituents and gives further possibilities of the specific plant species in its future research examinations. The concentrates acquired by progressive dissolvable extraction were exposed to different qualitative chemical tests to recognize the presence of compound constituents.

Test for Alkaloids:

- **Mayer's Reagent Test:**
  For Mayer's reagent test, a solution of the plant extract is prepared, and Mayer's reagent is added dropwise to the solution. The formation of a yellow or cream-colored precipitate indicates the presence of alkaloids**.**
- **Dragendorff's Reagent Test:**
  In the Dragendorff's reagent test, a solution of the plant extract is prepared, and Dragendorff's reagent is added dropwise. The presence of an orange or red-brown precipitate indicates the presence of alkaloids**.**
- **Wagner's Reagent Test:**
  Wagner's reagent test involves preparing a solution of the plant extract and adding Wagner's reagent dropwise. A reddish-brown precipitate indicates the presence of alkaloids.
- **Hager's Reagent Test:**

For Hager's reagent test, a solution of the plant extract is prepared, and Hager's reagent is added dropwise. The formation of a yellow or orange precipitate indicates the presence of alkaloids.

Test for Carbohydrates:

- **Molisch's Reagent Test:**
  To conduct the Molisch's reagent test, a solution of the plant extract is prepared, and a few drops of Molisch's reagent are added. Concentrated sulfuric acid is then poured down the side of the test tube. A violet ring at the junction of the two liquids indicates the presence of carbohydrates.
- **Fehling's Reagent Test:**
  For Fehling's reagent test, equal volumes of Fehling's A and B solutions are mixed. The extract is added to the mixture, heated, and the formation of a brick-red precipitate indicates the presence of reducing sugars.
- **Benedict Reagent Test:**
  In the Benedict reagent test, the extract is mixed with Benedict's reagent, and upon heating, a colored precipitate (green to brick-red) indicates the presence of reducing sugars.

Test for Glycosides:

- **Modified Borntrager's Reagent Test:**
  The modified Borntrager's reagent test involves mixing the extract with chloroform and adding dilute ammonia. The presence of a pink, red, or violet color in the ammoniacal layer indicates the presence of anthraquinone glycosides.

Test for Phytosterols and Triterpenoids:

- **Liebermann Reagent Test:**
  For the Liebermann reagent test, the extract is dissolved in chloroform, and Liebermann reagent is added. The formation of color changes from violet to blue or green indicates the presence of sterols.
- **Libermann-Burchard Reagent Test:**

To conduct the Libermann-Burchard reagent test, the extract is dissolved in chloroform, and Libermann-Burchard reagent is added. The formation of a green color indicates the presence of triterpenoids.

- **Salkowaski Reagent Test**

  Salkowaski reagent test involves dissolving the extract in chloroform and adding a few drops of Salkowaski reagent. A red-brown color indicates the presence of sterols.

Test for Protein and Amino Acids:

- **Millon's Reagent Test:**

  In the Millon's reagent test, Millon's reagent is added to the extract, and upon heating, the formation of a brick-red precipitate indicates the presence of proteins.
- **Ninhydrin Reagent Test:**

  For the ninhydrin reagent test, the extract is applied to a filter paper, sprayed or dipped in a solution of ninhydrin. A blue or purple color indicates the presence of amino acids.
- **Biuret Reagent Test:**

  The Biuret reagent test involves adding Biuret reagent to the extract. The formation of a violet color indicates the presence of proteins.

Test for Phenolic and Tannins:

- **Ferric Chloride Reagent Test:**

  In the ferric chloride reagent test, a few drops of ferric chloride are added to the extract. The formation of a blue-black or green color indicates the presence of phenols.
- **Lead Acetate Reagent Test:**

  For the lead acetate reagent test, lead acetate solution is added to the extract, and the formation of a white or yellow precipitate indicates the presence of tannins**.**

Test for Flavonoids:

- **Shinoda Reagent Test:**

  The Shinoda reagent test involves adding Shinoda reagent to the extract. The formation of a red color indicates the presence of flavonoids.

Test for Oils and Fats:

- **Oily Spot Test:**
  The oily spot test is conducted by applying the extract to a filter paper. The formation of a translucent spot on the paper indicates the presence of oils and fats.

Test for Saponins:

- **Foam Test:**
  For the foam test, the extract is shaken vigorously with water. Persistent frothing or the formation of a stable foam indicates the presence of saponins.

In Vivo Studies

Estimation of Glutathione (reduced)

In accordance with the Ellman et al. method, the measurement of glutathione (GSH) content in the brain involved adding 250 µl of brain homogenate to a mixture of 2.5 ml of sodium phosphate buffer and 50 µl of Ellman's reagent. The components were thoroughly mixed and incubated, and the absorbance was promptly recorded at 412 nm using a UV spectrophotometer within a 15-minute timeframe. The GSH content was expressed in micromoles per milligram of sample tissue.

Results & Discussion

Collection and authentication of plant material:

The selected plant material Myristica fragrans seeds and Mucuna pruriens seed were purchased from local market of Bhopal, (M. P.) India. The specimens were identified and authenticated by the Botanical survey of INDIA, 10, Chatham Lines, Allahabad – 211002 and their herbarium was deposited. The report of the authentictaion is listed below:

Macroscopic studies:

The selected crude drugs were subjected to studies organoleptic characters viz., color, odour, appearance, taste, texture etc. The morphological and sensory characteristics of two distinct plant species, Myristica fragrans seeds and Mucuna pruriens seed extracts.

Fig.1: Myristica fragrans seed

Fig 2: Mucuna pruriens seed

Table 1: Organoleptic characters of plantsMyristica fragrans seeds and Mucuna pruriens seed extracts.

S.No	Parameters	Observations of Myristica fragrans seedsextracts	Observations of Mucuna pruriens seed extracts
1.	**Shape**	The shape of the seeds or seed extracts can be described, whether they are oval, round.	The seeds are usually ovoid or ellipsoidal in shape, with a smooth outer surface.

2.	**Size**	Average seed size of 2 cm in length.	They can vary in size, but they are usually around 1 to 2 centimeters in diameter.
3.	**Odour**	Moderate aroma	Mucuna pruriens seeds are often characterized by an earthy and nutty aroma
4.	**Taste**	Nutmeg is often described as having a warm and slightly sweet taste.	Mucuna pruriens seeds are known to have a slightly bitter taste.
5.	**Colour**	Nutmeg seeds are typically brown, and the extracts may range in color depending on the extraction method and any additional processing	The seeds were typically brown or black.
6.	**Foreign organic matter**	No adulterants have been Found	No adulterants have been Found

Physicochemical Standardization of Proposed Plant Drug

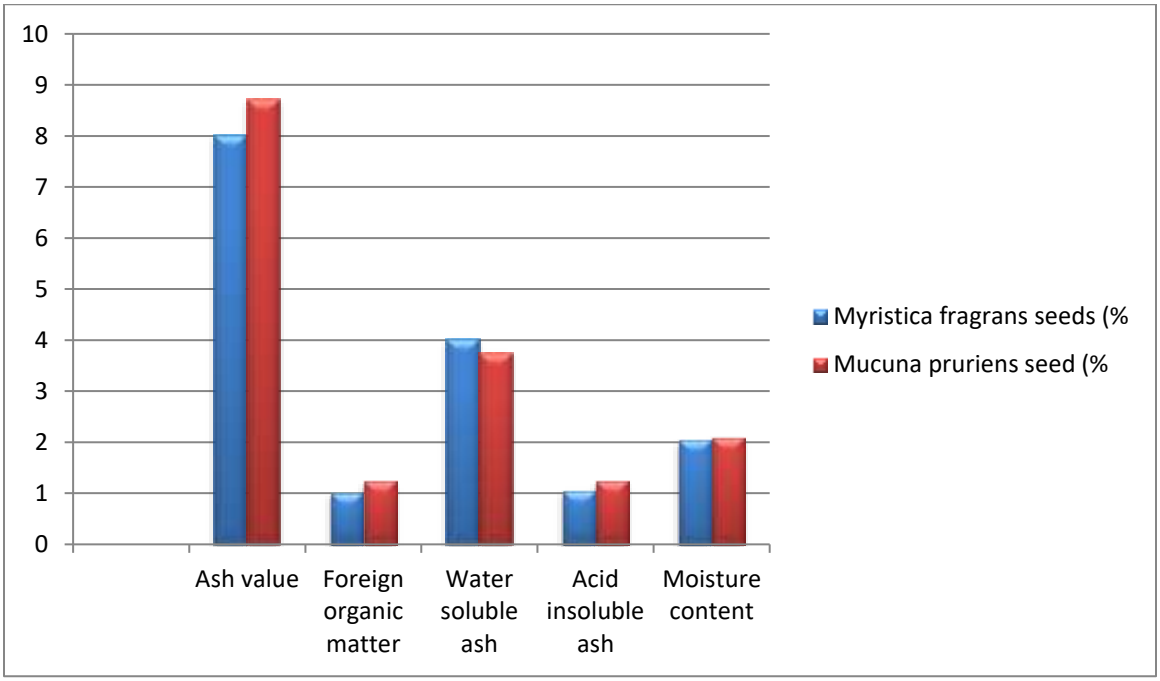
The following physicochemical properties were determined by normal technique using the powdered plant material of Myristica fragrans seeds and Mucuna pruriens seedextracts . The plant Myristica fragrans seeds and Mucuna pruriens seedextracts were recognised, harvested, and dried in the shade. The shade-dried seeds were ground into a powder that was somewhat gritty and the beans were also crushed into powder form. This substance was ground up and utilised to determine different physicochemical characteristics. A number of physicochemical characteristics were calculated, including swelling index, ash content, acid insoluble ash, and water soluble ash extractive value.

Table 2: Standardization parameters of *Myristica fragrans seeds and Mucuna pruriens seed*

S.No	Parameters % w/w	Myristica fragrans seeds (% w/w)	Mucuna pruriens seed (% w/w)

1	Ash value	8.02	8.71
2	Foreign organic matter	1.01	1.25
3	Water soluble ash	4.02	3.75
4	Acid insoluble ash	1.05	1.25
5.	Moisture content	2.05	2.1

Fig 3. Graph of Standardization parameters of Myristica fragrans seeds and Mucuna pruriens seed



Prelimnary Phytochemical Analysis Of Extracts

Qualitative test as phytochemical examination of any plant species is a vital procedure as it gives idea about the presence of different phytoconstituents and gives further possibilities of the specific plant species in its future research examinations. The concentrates acquired by progressive dissolvable extraction were exposed to different qualitative chemical tests to recognize the presence of compound constituents.

This phytochemical profiling provides valuable insights into the chemical constituents present in the ethanol extracts of Myristica fragrans and Mucuna pruriens seeds. The positive results in various tests indicate the potential presence of bioactive compounds with diverse pharmacological activities

Table 3: Phytochemical Profile of Myristica fragrans seeds and Mucuna pruriens seed

S.no	Chemical Tests	*Myristica fragrans seeds Extract*	*Mucuna pruriens seed Extract*
		Ethanol	Ethanol
1.	Tests for Steroids and Triterpenoids:		
	• Liebermann's Burchard Test	-	+
	• Salkowski Test	-	+
2.	Test for Saponins:		
	• Foam Test	+	+
3.	Tests for Alkaloids:		
	• Hager's Test	+	+
	• Mayer's Test	+	+
4.	Tests for Glycosides:		
	• Borntrager's Test	+	+
	• Keller Killiani Test	+	+
5.	Tests for Tannins and Phenolic compounds:		
	• Gelatin Test	+	+
	• Ferric Chloride Test	+	+
6.	Tests for Flavonoids:		
	• Ferric chloride Test	-	+
	• Alkaline reagent Test	-	+

7.	Tests for Proteins:		
	• Biuret Test	-	-
	• Xanthoproteic Test	-	-
8.	Test for Carbohydrates:		
	• Fehling Test	-	-

Where + is Present and – is Absent

The intervention effects on GSH level in brain

The evaluation of Glutathione (GSH) levels in brain samples provides insights into the antioxidant capacity and cellular defense resulting from the administration of Myristica fragrans seeds, Mucuna pruriens seeds, and Piracetam, as well as the disease control Scopolamine Hydrobromide. In the control group (Group-I) receiving a placebo, the GSH level in brain tissue is recorded at 95 μmol/g, representing a baseline antioxidant capacity.

Group-II, treated with Myristica fragrans extract at 100 mg/kg, exhibits a slightly decreased GSH level (87 μmol/g) in the brain samples. This decrease suggests a potential reduction in cellular antioxidant defenses associated with Myristica fragrans extract administration compared to the control group.

Similarly, in Group-III, treated with Mucuna pruriens extract at the same dosage, the GSH level in the brain tissue is slightly lower at 85 μmol/g. This finding implies a potential attenuation of antioxidant capacity associated with Mucuna pruriens extract administration in the brain.

In Group-IV, where Piracetam is administered at 3 mg/kg, the standard drug group shows an increased GSH level (99 μmol/g) in the brain samples compared to the control group. This result suggests that Piracetam administration might contribute to an enhancement of cellular antioxidant defenses in the brain under these experimental conditions.

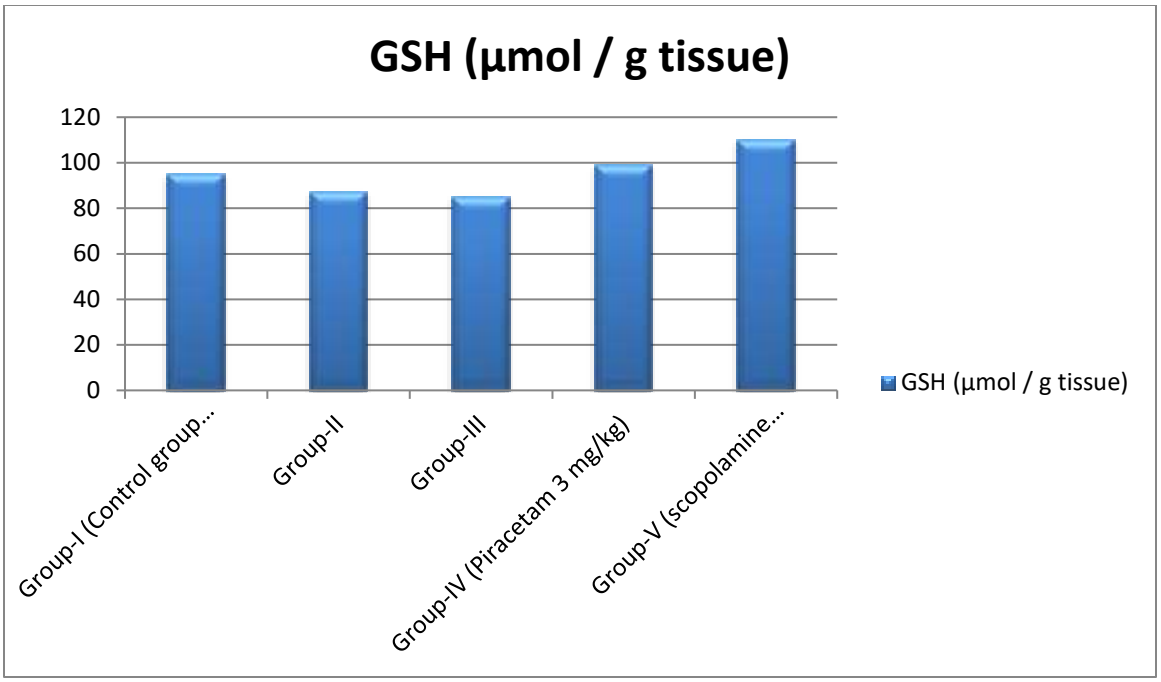
Contrastingly, in Group-V, the disease control receiving Scopolamine Hydrobromide at 1 mg/kg displays a significantly higher GSH level in the brain samples, recorded at 110 μmol/g. This marked increase aligns with Scopolamine's known neurotoxic effects and highlights a

pronounced induction of antioxidant defenses in the brain, possibly as a protective response to counteract oxidative stress.

Table 4: Effects administration of *Myristica fragrans seeds and Mucuna pruriens seed* extract and Piracetamon GSH amount of Brain samples.

S.No	Group (n=6)	Treatment	GSH (µmol / g tissue)
1.	Group-I (Control group (placebo))	Normal Control	95
2.	Group-II	Myristica fragrans extract treatment 100 mg/kg	87
3.	Group-III	Mucuna pruriens extract treatment 100 mg/kg	85
4.	Group-IV (Piracetam 3 mg/kg)	Standard drug	99
5.	Group-V (scopolamine Hydrobromide 1 mg/kg, i.p)	Disease control	110

Fig 4: Effects administration of Myristica fragrans seeds and Mucuna pruriens seed extract and Piracetamon GSH amount of Brain samples.



The intervention effects on GSH level in liver

The evaluation of Glutathione (GSH) levels in liver samples provides insights into the antioxidant capacity and cellular defense resulting from the administration of Myristica fragrans seeds, Mucuna pruriens seeds, and Piracetam, as well as the disease control Scopolamine Hydrobromide. In the control group (Group-I) receiving a placebo, the GSH level in liver tissue is recorded at 190 µmol/g, representing a baseline antioxidant capacity.

Group-II, treated with Myristica fragrans extract at 100 mg/kg, exhibits a decreased GSH level (160 µmol/g) in the liver samples. This decrease suggests a potential reduction in cellular antioxidant defenses associated with Myristica fragrans extract administration compared to the control group.

Similarly, in Group-III, treated with Mucuna pruriens extract at the same dosage, the GSH level in the liver tissue is slightly lower at 155 µmol/g. This finding implies a potential attenuation of antioxidant capacity associated with Mucuna pruriens extract administration in the liver.

In Group-IV, where Piracetam is administered at 3 mg/kg, the standard drug group shows an increased GSH level (175 µmol/g) in the liver samples compared to the control group. This result

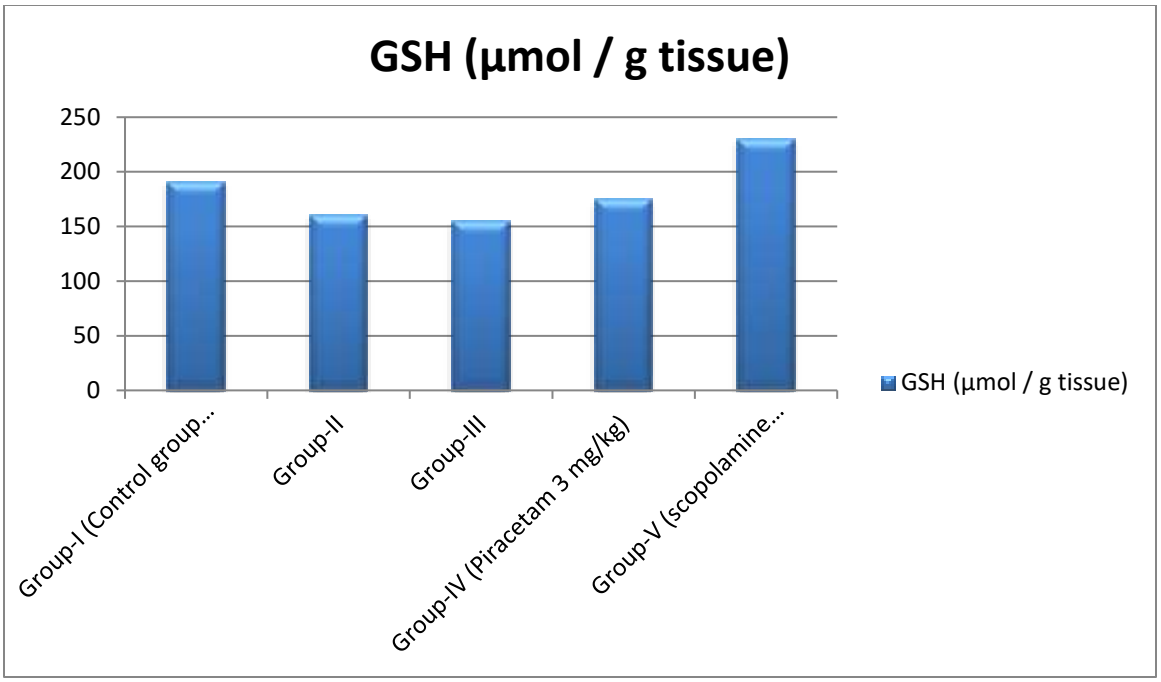
suggests that Piracetam administration might contribute to an enhancement of cellular antioxidant defenses in the liver under these experimental conditions.

Contrastingly, in Group-V, the disease control receiving Scopolamine Hydrobromide at 1 mg/kg displays a significantly higher GSH level in the liver samples, recorded at 230 µmol/g. This marked increase aligns with Scopolamine's known neurotoxic effects and highlights a pronounced induction of antioxidant defenses in the liver, possibly as a protective response to counteract oxidative stress.

Table 5: Effects administration of Myristica fragrans seeds and Mucuna pruriens seed extract and Piracetamon GSH amount of Liver samples.

S.No	Group (n=6)	Treatment	GSH (µmol / g tissue)
1.	Group-I (Control group (placebo))	Normal Control	190
2.	Group-II	Myristica fragrans extract treatment 100 mg/kg	160
3.	Group-III	Mucuna pruriens extract treatment 100 mg/kg	155
4.	Group-IV (Piracetam 3 mg/kg)	Standard drug	175
5.	Group-V (scopolamine Hydrobromide 1 mg/kg, i.p)	Disease control	230

Fig 5: Effects administration of Myristica fragrans seeds and Mucuna pruriens seed extract and Piracetamon GSH amount of Liver samples.



Conclusion:

The organoleptic characteristics of Myristica fragrans seeds and Mucuna pruriens seed extracts showcase unique attributes in terms of shape, size, aroma, taste, and color. These distinctive features contribute to the diverse sensory experiences associated with these plant extracts, making them valuable in various applications, including culinary and medicinal contexts.

The GSH levels in brain samples reflect the diverse impacts of Myristica fragrans and Mucuna pruriens seed extracts, Piracetam, and Scopolamine Hydrobromide on cellular antioxidant defenses. Myristica fragrans and Mucuna pruriens extracts appear to potentially reduce GSH levels, while Piracetam enhances them. In contrast, Scopolamine induces a marked increase in GSH levels, suggesting an adaptive response to oxidative stress. These findings contribute to a comprehensive understanding of the biochemical consequences associated with the administration of these substances in the experimental setting.

The GSH levels in liver samples reflect the diverse impacts of Myristica fragrans and Mucuna pruriens seed extracts, Piracetam, and Scopolamine Hydrobromide on cellular antioxidant defenses. Myristica fragrans and Mucuna pruriens extracts appear to potentially reduce GSH levels, while Piracetam enhances them. In contrast, Scopolamine induces a marked increase in GSH levels, suggesting an adaptive response to oxidative stress. These findings contribute to a

comprehensive understanding of the biochemical consequences associated with the administration of these substances in the experimental setting.

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Conflict of interest

Authors declared no conflict of interest.

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