

**ROLE OF HERBAL EXTRACTS FOR NEUROPROTECTION****Minakshi\*, Shabnam<sup>1</sup>, Damini Saini<sup>1</sup>, Dr. Neeraj Pooni<sup>1</sup>**

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**ABSTRACT**

Degenerative brain diseases are serious brain conditions. In simple words, these diseases slowly damage brain cells over time. Because of this, a person may start facing problems with memory, thinking ability, and even movement. At present, medicines such as Donepezil, Memantine, Levodopa, and Selegiline are commonly used. These drugs mainly help in temporarily managing the symptoms. For example; they may temporarily improve memory, thinking, or movement. However, one important point is that these medicines do not stop the disease completely, nor can they reverse the damage already done. There overuse can also cause some adverse effects. On the other hand, herbal extracts are gaining attention because they may work in multiple ways and help protect brain cells. Plants like Withania somnifera (Ashwagandha), Curcuma longa (Curcumin), Ginkgo biloba, Bacopa monnieri, and Centella

asiatica. In simple terms, herbal extracts reduce stress in the brain cells and also control inflammation. For example, Ashwagandha supports neuron health, curcumin helps reduce brain cell damage so the plant obtained extracts are able to support memory, focus, and overall brain health.

**KEYWORDS:** Neuro-protection, herbal extract, Allopathic Agents, Neurotropic.

**1. INTRODUCTION****1.1 chronic neurological diseases**

It is a loss or damage of brain cells. These conditions usually develop slowly and become more severe over time.

Even though these diseases are different from each other, they still share some common features. An example of this is oxidative stress, brain inflammation, and other adverse changes that occur within cells. Simply put, these processes slowly harm brain cells and affect how they work. As the damage gets worse, neurons (brain cells) can't function properly. This will damage the memory, thinking and as well as our body movement also.

### **1.2 weaknesses of synthetic drugs**

Allopathic drugs, helps to treat the disease by improving the symptoms so it have a lot of limitations. Synthetic drugs have limited effectiveness to the patient. These have also different type of side effects that's why herbal drugs are best for treatment.

### **1.3 Importance of Herbal Extracts**

Natural extracts from plants are very beneficial for treatment they have less side effects they act on multiple pathway not in single pathway as allopathic drugs, herbal medications are also very helpful in the long time diseases and protect cell damage These are seen as more safer medication Overall, herbal extracts offer a promising complementary approach in modern medicine, especially when.

### **1.4 Role of Herbal Compounds in Inhibiting Microglial-Mediated Neurotoxicity**

Microglia is good for brain and spinal cord. In normal healthy conditions, they protect neurons and help maintain brain health. But in case they become highly active, they may release inflammatory products which harm neurons and lead to neurodegeneration. Research indicates that some herbal extracts can be used to suppress this hyperactivity. These substances decrease neurotoxicity through inhibition of inflammation and control of microglial activity. They have an effect on certain pathways in brain inflammation and neuronal damage For this reason, the use of herbal compounds as potential treatments for neurodegenerative diseases is being studied, especially for their role in controlling inflammation and protecting brain cells. (Fu et al., 2018).

### **1.5 Neuroprotective and Cognitive Effects of Herbal Remedies**

The use of herbal remedies is gaining lots of researches as an alternative method to treat neurodegenerative diseases. Natural bioactive compounds that promote brain functions are found in many herbs. An example is Green Tea it is a great antioxidant, which helps protect neurons and improves memory function. Ashwagandha is well known for reducing stress, and also support brain functioning (Ahmed.et al., 2025).

### 1.6 Aim of the Review

The review is aimed to analyse the neuroprotective nature of different herbal extracts in the treatment of neuronal disorder. In this review, the working mechanism of action of herbal compounds such as their antioxidant, anti-inflammatory. It will also evaluate the effectiveness of different herbal extracts and highlight their potential as safer and more promising alternatives to conventional synthetic drugs for neuroprotection. Moreover, the review will discuss scientific evidence on herbal extracts in a simple way.

## 2. Causes of neurodegeneration

The concept of brain cell degeneration is the gradual loss of neuronal functions that result in such diseases like Alzheimer and Parkinson diseases. There are a number of causes of neurodegeneration.

### 2.1. Oxidative stress

Normal cellular signaling involved in physiological conditions involves the importance ROS. However, if there a large generation of ROS occur then it results oxidative which can damage important biomolecules such as proteins, lipids, and DNA. With aging, elevated levels of ROS lead to the build-up of oxidized and misfolded proteins, which cause neuronal dysfunction. Oxidative stress is considered as a main cause of cell degenerative diseases Hence, the oxidative stress is seen as a significant factor of causing cell degenerative disorder (Korovesis *et al.*, 2023).

### 2.2 Inflammation

Many neurodegenerative diseases share the common feature of inflammation. Even though the specific cause of inflammation may vary according to the disease, Most of the underlying processes are quite similar. These involve the mechanism of sensing dangerous signals by the body, the transmission of inflammatory signals, and their Enhancement with time. Due to these processes, some toxic substances are formed in the brain which can destroy neurons and influence their normal functioning. In the long run, it can result in the death of neurons. However, it is still not fully clear whether targeting these inflammatory pathways with drugs is completely safe or effective in slowing down or reversing disease progression. More research is still needed in this area (Glass *et al.*, 2010).

### 2.3 Neuronal Damage

In normal circumstances neuron death in the central nervous system is very limited, even in old age. In the neurodegenerative diseases, however, neurons are lost gradually and along with gradual shrinkage of specific areas of the brain. This damage of neurons is regarded as one of the very essential pathological features of these disorders. Various ways may contribute to neuronal death and these pathways tend to be interrelated. Such proteins disrupt the normal functioning of neurons and ultimately lead to degeneration (Chi et al., 2018).

### 2.4 Mitochondrial Dysfunction

Neurodegenerative diseases are chronic progressive conditions where certain groups of neurons lose their functions progressively over time and ultimately die. One of the major factors contributing to this process is mitochondrial dysfunction. The role of mitochondrial dynamics in terms of their shape, size, movement and the balance between fission and fusion processes have also been noted to be significant in recent studies. These are required to keep the neurons functioning well. Disrupted by these processes, mitochondria will not be able to work correctly and will produce less energy and experience cell stress. This leads to the destruction of neurons and hence the onset of various neurodegenerative disorders including Parkinson, Huntington, amyotrophic lateral sclerosis, and Alzheimer (Johri A et al., 2012).

## 3. Mechanism of neuroprotection

Neuroprotection refers to the processes that help protect neurons from damage and prevent their death. It mainly works by reducing harmful conditions inside the brain.

### 3.1 Herbal Extracts

#### 1. Antioxidant Activity

To oxidative stress brain is very sensitive due to its high lipid content, high energy need and relatively very poor antioxidant defence system. The antioxidants are essential in regulating these levels of ROS and balancing it in the cell. Experimental and clinical studies have been conducted on both enzymatic and non-enzymatic antioxidants as adjunctive therapies. Hence the antioxidant activities have a major role in protecting brain damage, and normal neuronal functioning (Lee et al., 2020).

#### 2. Inflammation inhibiting Activity

One of the significant processes that contribute in development of neuronal is neuroinflammation. It involves a number of processes like the activation of the signals of

inflammation and the release of toxic substances that may damage neurons. The basic inflammatory pathways are usually similar, although the first factors that initiate inflammation might vary among diseases. These pathways lead to cell loss. Due to this, the control of inflammation is very important to reduce the risk neurodegeneration. (Glass CK *et al.*, 2010).

### 3. Multi-target Action

Alzheimer disease is the widely seen memory loss disease in old people and it requires some complicated therapies. The existing medications, including Donepezil, Rivastigmine, Memantine, and Galantamine, are primarily focused on one of the pathways, like cholinesterase enzymes or NMDA receptors. Nonetheless, this one drug-one target method has proved to be not very successful as the disease itself is a network of many interrelated processes. To address this shortcoming, a novel technology referred to as Multi-Target Directed Ligands (MTDLs) has been devised. The strategy is oriented at coming up with one compound that can target several targets of the disease process. Scientists are examining various chemical structures and their activities (both in laboratory and living systems) to see how they can be more effective. In general, multi-target approaches provide a more promising and widespread approach to creating more effective therapies against Alzheimer disease (Pathak *et al.*, 2024).

### 4. Role of herbs in protecting brain cells.

**Table.1 (table shows the Neuroprotective Actions of Herbs.)**

| Mechanism                      | Key Function                              | Examples                |
|--------------------------------|-------------------------------------------|-------------------------|
| <b>Antioxidant</b>             | Protect brain cells from oxidative damage | Curcumin, Flavonoids    |
| <b>Inflammation inhibition</b> | Reduces brain inflammation                | Ashwagandha, Ginkgo     |
| <b>Anti-apoptotic</b>          | Prevents neuronal death                   | Withanolides, Bacosides |
| <b>Neurotrophic</b>            | Supports synaptic growth                  | Ashwagandha, Centella   |
| <b>Anti-amyloid</b>            | Prevents toxic protein buildup            | Curcumin, Withanolides  |

### 3.2 Allopathic Drugs

Allopathic drugs are widely used in the brain related conditions. These medications mainly aim to manage symptoms by acting on specific neurotransmitter systems.

Most of these drugs act on specific molecular targets, such as neurotransmitter receptors and enzymes, to help restore the chemical balance in the brain. This helps improve communication between neurons and provides temporary relief in symptoms. However, their role is mostly limited to symptomatic management. They do not directly prevent neuronal

damage or address the root causes of the disease. Their long term effectiveness remains limited despite their importance in clinical use.

#### **4. Herbal extracts used in neuroprotection**

Nowadays the use of natural extracts for protection of neuron is in the large scale as compared to the synthetic medications because of limitations of them. Because the neuronal diseases are very complicated so a single targeted drug is not able to treat the disorder so as herbal medication follow multiple pathway so they support survival of neuron that's why they are more preferred to use, so natural extracts obtained by plants are used as support therapy for neuronal damage.

#### **Different Types of Herbs Used in Neuroprotection**

There are several types of herbs used in the treatment of neuronal disorder They are classified as given below.

1. **Memory and Cognitive Enhancers:** bacopa Monnieri, centella asiatica
2. **Inflammation reducing and Antioxidant Herbs:** curcuma longa, G. biloba
3. **Neurotrophic and Neuroregenerative Herbs:** Withania somnifera

#### **4.1 Withania somnifera (Ashwagandha)**

W. somnifera is very known herb used in Ayurveda its common name is ashawagandha it have almost 50 bioactive compound this herb is used as anticancer, antidiabetic and well used in neuroprotection it belongs to the family solanaceae From the recent researches it is shown that researchers are using genetically modified drosophila models so that they can realize how w. somnifera does its work. This helps to cover up the distinction between laboratory experiments and real life treatment use. (Lerise V et al., 2024)

#### **4.1.1. Neuroprotective Effects**

there are some neuroprotective effects shown by W. somnifera given below.

1. Antioxidant Activity
2. Anti-inflammatory Effects
3. Anti-apoptotic and Neurotrophic Actions
4. Modulation of Neurotransmitter Systems
5. Protein Aggregation and Amyloid Clearance

## 4.2 Curcuma longa

C. longa is used a lot in ancient treatment methods, its common name is turmeric it belongs to the family named Zingiberaceae, and the part that is taken in use of it is rhizome.

### Role of Curcumin in Neuroprotection

1. Antioxidant activity
2. Anti-inflammatory effects
3. Cognitive and synaptic support

## 4.3 Gingko biloba

it is the one of the oldest types of trees on the earth so it is also known as living fossil, in the Chinese medication system its leaves are used to enhance the memory and also to maintain the good blood circulations from a very long time. So Biloba is a very supportive for brain treatment. Gingko biloba improves blood flow without affecting other vital blood parameters.

### Medical uses of gingko biloba

1. Improves blood flow
2. Improves cognition
3. Protect neurons

## 5. Plant based drugs & synthetic drugs.

| Feature              | Herbal Extracts                                     | Allopathic Drugs                              |
|----------------------|-----------------------------------------------------|-----------------------------------------------|
| Target Mechanism     | Multiple pathways and targets                       | Usually single receptor or pathway            |
| Side Effects         | Generally fewer, mild                               | Can be significant or severe                  |
| Preventive Benefits  | Often provide antioxidant & neuroprotective effects | Primarily symptom-based                       |
| Long-term Use        | Safer for prolonged use                             | Long-term use may cause toxicity              |
| Accessibility & Cost | Widely available, often cost-effective              | Usually more expensive, requires prescription |
| Cultural Acceptance  | Traditionally used widely accepted                  | May be less culturally integrated             |
| Onset of Action      | Usually gradual, gentle                             | Often rapid and strong                        |

Table.2 (differences plant based drug and modern drugs)

## 6. Limitation of herbal extracts

Basically herbal drugs help to improve the brain damage but they have some limitations because herbal extracts have usually different active compounds so it is hard to manage the proper standardization. So, because of the drawbacks it is very hard to confirm the safety and

effectiveness of the herbal drugs Stronger rules and better standardizations are needed to improves the herbal treatments and to ensure the safety of herbal treatment.

**There are some limitations as below**

1. Slow actions
2. Very less clinical proof
3. More studies are needed

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