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Appraisal of Pharmacological Activities of ethanol Extract of Rumex Acetosella Leaves Role In Inflammation.

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ABSTRACT :-

Inflammation is a biological reaction that occurs when the body's immune system reacts to pathogens, damaged cells, or irritants. Rumex acetosella, a perennial herbaceous plant, is known for its bioactive substances, including flavonoids, phenolics, and anthraquinones. The plant's tart leaves have been used in herbal therapy to treat ailments like inflammation, anemia, and scurvy, and as a source of vitamin C. Rumex acetosella leaf ethanol extract has antibacterial, antioxidant, and anti-inflammatory properties. It effectively reduces inflammation by suppressing nitric oxide formation in macrophages and inhibiting COX-1 enzyme activity. The extract's antioxidant properties help reduce oxidative stress and modulate immune responses.

Rumex acetosella, a plant with high antioxidant activity, has been found to be effective in treating inflammatory diseases by mitigating oxidative stress. Its antioxidant properties, including free radical scavenging and inhibition of nitric oxide production, contribute to its anti-inflammatory effects. The ethanol extract of Rumex acetosella has potent radical scavenging activity, inhibiting pro-inflammatory mediators like emodin, chrysophanol, and physcion. The presence of ethanol in the extraction process enhances its anti-inflammatory activity by efficiently isolating bioactive compounds, such as anthraquinones and flavonoids. In conclusion, Rumex acetosella's antioxidant properties make it a promising candidate for managing Inflammatory diseases.

KEYWORD :- Rumex acetosella, Antioxidant activity, anthraquinones, inflammation.

INTRODUCTION :-

An intricate biological reaction, inflammation is the body's immune system's reaction to pathogens, damaged cells, or irritants. As a protective mechanism, it works to remove damaged cells, stop the cause of tissue damage, and start the healing process. Molecular mediators, blood vessels, and immune cells collaborate to identify and eliminate the damaging stimulus.There are two types of inflammation: acute and chronic. Acute inflammation is a transient reaction that happens right after an injury or illness. It is typified by pain (dolor), swelling (tumor), redness (rubor), heat (calor), and loss of function (functio laesa). Conversely, chronic inflammation lasts longer and can result in diseases like autoimmune disorders, atherosclerosis, and arthritis as well as tissue loss. Although severe or protracted inflammation can damage healthy tissues and play a role in chronic disorders, inflammation is necessary for recovery. Developing treatment plans for inflammatory diseases requires an understanding of their mechanisms [1].

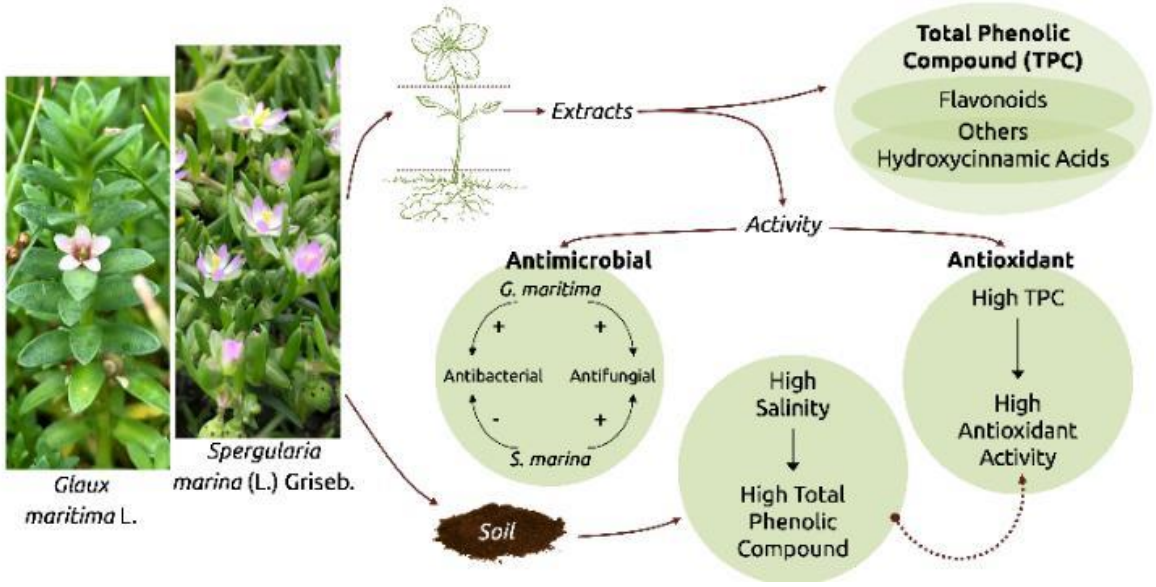
Rumex acetosella is a perennial herbaceous plant that is a member of the Polygonaceae (buckwheat) family. It is often referred to as sheep sorrel, red sorrel, or sour weed. Originally from Europe and portions of Asia, it has spread to many parts of the world, including Africa, South America, and North America. The plant is widespread in meadows, pastures, roadside ditches, and waste areas because it grows well in poor, acidic, and disturbed soils.Small reddish or yellowish-green blooms, a basal rosette of arrow-shaped leaves, and creeping rhizomes are characteristics of R. acetosella. Bioactive substances such as oxalic acid, flavonoids, and anthraquinones are abundant in the plant. Its tart leaves have long been utilized in herbal therapy to treat ailments like inflammation, anemia, and scurvy as well as a source of vitamin C. Despite its therapeutic applications, R. acetosella is regarded as invasive in some areas because of its rapid growth and capacity for vegetative reproduction by creeping roots. Additionally, it is known to harbor agricultural pests such as the virus that causes tomato spotted wilt. However, research into its pharmacological potential for use in natural therapies is still ongoing. [2].

The pharmacological properties of Rumex acetosella leaf ethanol extract, especially its function in inflammation, have drawn interest. The Polygonaceae family's Rumex acetosella species has a wealth of bioactive substances, including flavonoids, phenolics, and anthraquinones, which enhance its potential as a medicine. This plant, which has long been utilized in herbal therapy, has a variety of pharmacological qualities, such as antibacterial, antioxidant, and anti-inflammatory actions. Research has shown that R. acetosella ethanol extracts effectively reduce inflammation by suppressing the formation of nitric oxide (NO) in macrophages and inhibiting the activity of the COX-1 enzyme. The presence of bioactive substances such as chrysofanol and emodin is responsible for these effects. Its anti-inflammatory properties are further supported by the extract's strong free radical-scavenging activity.The purpose of this evaluation is to investigate the pharmacological actions of R. acetosella leaf ethanol extracts, with an emphasis on the underlying processes and anti-inflammatory characteristics. Comprehending these impacts could facilitate the creation of natural treatments for ailments linked to inflammation. Evaluation of the Pharmacological Properties of Rumex Acetosella Leaf Ethanol Extract and Its Contribution to Inflammation Significant pharmacological activity has been shown by the ethanol extract of Rumex acetosella leaves, especially when it comes to inflammation. The Polygonaceae

family member Rumex acetosella is abundant in bioactive substances such as phenolics, flavonoids, and anthraquinones. These substances are well-known for their antibacterial, anti-inflammatory, and antioxidant qualities.Studies demonstrate the ethanol extract's anti-inflammatory properties, which are ascribed to its capacity to reduce pro-inflammatory cytokines and inflammatory indicators such as COX-2 and nitric oxide (NO) production. One of the extract's main anthraquinones, emodin, is essential to these processes. The extract's strong free radical-scavenging capabilities further bolster its potential as a treatment for illnesses linked to inflammation. With a focus on its anti-inflammatory properties and its uses in natural medicine, this evaluation attempts to investigate the pharmacological activities and mechanisms of R. acetosella ethanol extract [3][4].

Bioactive substances are principally responsible for Rumex acetosella's anti-inflammatory qualities Key anthraquinones, including physcion, chrysophanol, and emodin, have been found to be important contributors. By inhibiting COX-2 expression, nitric oxide (NO) generation, and the activation of NF-κB and MAPKs (ERK and JNK), these drugs block inflammatory pathways. Emodin also decreases neutrophil infiltration and TNF-α production, while physcion and chrysophanol block pro-inflammatory cytokines such as TNF-α and interleukin-6. 2. Flavonoids: By scavenging free radicals and lowering oxidative stress, which contributes to inflammation, these substances have anti-inflammatory and antioxidant properties.Phenolic Compounds: R. acetosella's ethyl acetate fraction contains phenolic acids that have strong antioxidant activity. By reducing oxidative damage, these compounds indirectly help anti-inflammatory mechanisms. All of these substances work together to help the plant control inflammatory reactions, which could make it a natural treatment for diseases linked to inflammation [5][6].

Rumex acetosella's primary anthraquinones, along with other related 1. Emodin: Trihydroxy-methyl anthraquinone has antibacterial, anti-inflammatory, and antioxidant qualities.2. Chrysophanol: This dihydroxy-methyl anthraquinone inhibits pro-inflammatory cytokines to produce anti-inflammatory actions. 3.Physcion: A methoxy-dihydroxy-methyl anthraquinone that has been shown to have antioxidant and anti-inflammatory properties. These substances are frequently present in different Rumex species and support their pharmacological properties. [7][8][9].



Rumex acetosella's pharmacological activity greatly amplifies its anti-inflammatory qualities via a number of mechanisms 1. Anthraquinones: Important substances like physcion, chrysophanol, and emodin block inflammatory mediators like prostaglandin E2 and nitric oxide (NO). They decrease cytokine production (e.g., TNF-α, IL-6) by suppressing the expression of COX-2 and iNOS enzymes and blocking pathways such as NF-κB and MAPKs (ERK, JNK).2. Antioxidant Activity: Oxidative stress is intimately associated with inflammation, and the extract's strong antioxidant qualities help to reduce it. It stops inflammatory pathways from being activated by scavenging free radicals.3. Phenolic and Flavonoid Content: By lowering oxidative damage and regulating immunological responses, these substances also aid in the anti-inflammatory benefits. Rumex acetosella's pharmacological activity, which combines anti-inflammatory and antioxidant properties, supports its potential as a natural treatment for illnesses connected to inflammation. [10][11].

The pharmacological activity of Rumex acetosella significantly enhances its anti-inflammatory properties through multiple mechanisms.

1.Anthraquinones: Key compounds such as emodin, chrysophanol, and physcion inhibit inflammatory mediators like nitric oxide (NO) and prostaglandin E2. They suppress the expression of COX-2 and iNOS enzymes and block pathways like NF-κB and MAPKs (ERK, JNK), reducing cytokine production (e.g., TNF-α, IL-6).

2.Antioxidant Activity: The extract's potent antioxidant properties mitigate oxidative stress, which is closely linked to inflammation. By scavenging free radicals, it prevents the activation of inflammatory pathways.

3.Phenolic and Flavonoid Content: These compounds further contribute to anti-inflammatory effects by reducing oxidative damage and modulating immune responses. [12][13].

The ethanol extract of Rumex acetosella contains several specific anti-inflammatory compounds, primarily anthraquinones and their derivatives.

1.Emodin: A major anthraquinone that exhibits potent anti-inflammatory activity by inhibiting nitric oxide (NO) production and suppressing inflammatory pathways such as COX-2 expression and ERK/JNK phosphorylation.

2.Chrysophanol: Another anthraquinone that reduces inflammation by targeting pro-inflammatory cytokines and enzymes like COX-1.

3.Physcion: A methoxy-dihydroxy anthraquinone with anti-inflammatory properties, particularly through the inhibition of NO production and cytokine

release

4.Anthraquinone Glucosides: Emodin-8-O-β-D-glucoside, chrysophanol-8-O-β-D-glucoside, and physcion-8-O-β-D-glucoside, which also contribute to anti-inflammatory effects [14].

The anti-inflammatory compounds in Rumex acetosella, particularly anthraquinones such as emodin, chrysophanol, and physcion, interact with the COX-1 enzyme by inhibiting its activity. COX-1 is involved in the arachidonic acid pathway, producing prostaglandins and thromboxanes that mediate inflammation. Studies have shown that extracts from R. acetosella roots effectively inhibit COX-1, with an IC50 value of 0.36 mg/mL, indicating strong inhibition .These anthraquinones suppress the production of prostaglandin E2 (PGE2), a key inflammatory mediator, by directly inhibiting COX-1 activity. Additionally, they reduce cytokine release and neutrophil infiltration, further mitigating inflammation. Further research is required to fully elucidate their molecular interactions with COX-1 [15].

The anti-inflammatory compounds in Rumex acetosella compare favorably to those in other plants due to their unique composition and mechanisms.1. Anthraquinones (e.g., Emodin, Chrysophanol, Physcion):- Rumex acetosella contains these potent anthraquinones, which inhibit COX-1 and COX-2 enzymes, suppress nitric oxide (NO) production, and modulate inflammatory pathways like NF-κB and MAPKs.- Other plants like Aloe vera also contain emodin, but the anthraquinone concentration in R. acetosella roots and ethanol extracts is particularly high, enhancing its efficacy.2. Phenolic Compounds:- The phenolic content in R. acetosella contributes to its antioxidant and anti-inflammatory effects by scavenging free radicals and reducing oxidative stress Compared to other plants like Curcuma longa (turmeric), which relies on curcuminoids for similar effects, R. acetosella offers a distinct combination of phenolics and anthraquinones.3. Flavonoids - Flavonoids in R. acetosella support its anti-inflammatory properties by reducing cytokine production and oxidative damage. While flavonoid-rich plants like Camellia sinensis (green tea) are well-known for such effects, the synergy between flavonoids and anthraquinones in R. acetosella provides a unique advantage. Rumex acetosella stands out for its combination of anthraquinones, phenolics, and flavonoids, which collectively target multiple inflammatory pathways more comprehensively than many other plants [16][17][18].

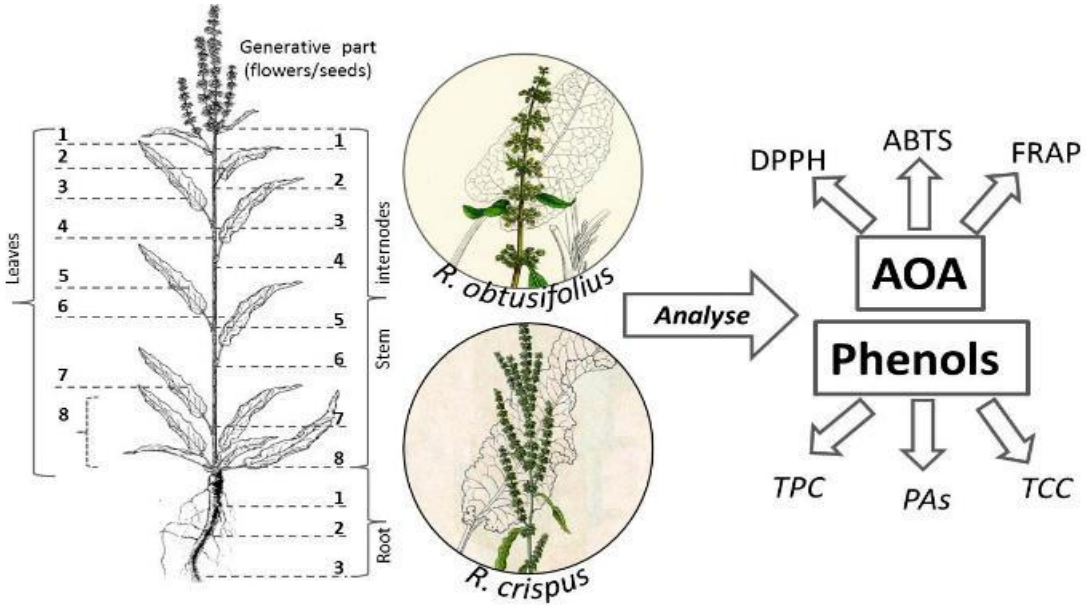
The antioxidant activity of Rumex acetosella significantly contributes to its anti-inflammatory effects by reducing oxidative stress, a key factor in inflammation. 1. Free Radical Scavenging: The ethanol extract of R. acetosella exhibits strong DPPH radical-scavenging activity, primarily due to its high phenolic and flavonoid content. This reduces oxidative damage to cells, which often triggers inflammatory responses.2. Inhibition of Nitric Oxide (NO) Production: The antioxidant compounds in R. acetosella, such as emodin and other anthraquinones, suppress NO production in LPS-induced macrophages. Excessive NO is a pro-inflammatory mediator, and its inhibition helps control inflammation.3.Modulation of Inflammatory Pathways: Antioxidants in R. acetosella reduce the activation of NF-κB and MAPK pathways, which are central to the production of pro-inflammatory cytokines like TNF-α and IL-6.By mitigating oxidative stress and directly inhibiting inflammatory mediators, the antioxidant activity of R. acetosella plays a crucial role in its anti-inflammatory properties [18].

The antioxidant activity of Rumex acetosella significantly enhances its efficacy in treating inflammatory diseases by mitigating oxidative stress, which is a key driver of inflammation. Her disease 1.Reduction of Reactive Oxygen Species (ROS): The ethanol extract of R. acetosella exhibits potent radical scavenging activity (e.g., DPPH and CUPRAC assays with IC50 values of 23.73 µg/mL and 25.31 µg/mL, respectively), reducing ROS levels that trigger inflammatory pathways.2. Inhibition of Pro-inflammatory Mediators: Antioxidant compounds like emodin, chrysophanol, and physcion suppress nitric oxide (NO) production and the expression of enzymes such as COX-2 and iNOS, which are central to inflammation.3. Modulation of Inflammatory Pathways: By reducing oxidative stress, R. acetosella inhibits the phosphorylation of MAPKs (ERK, JNK) and NF-κB activation, thereby decreasing cytokine production (e.g., TNF-α, IL-6) and neutrophil infiltration.4.Synergistic Anti-inflammatory Effects: The high phenolic and flavonoid content in the ethyl acetate fraction complements the anti-inflammatory activity by neutralizing oxidative damage and preventing the activation of inflammatory signaling cascades. R. acetosella's antioxidant properties directly reduce oxidative stress while indirectly suppressing inflammation, making it a promising candidate for managing inflammatory diseases.The antioxidant activity of Rumex acetosella is notably strong compared to other plants with similar properties due to its high phenolic and flavonoid content. Here's how it compares: 1.Superior Antioxidant Activity: The ethanol extract of R. acetosella exhibits the highest antioxidant activity among tested plants, with IC50 values of 23.73 µg/mL for the ABTS assay and 25.31 µg/mL for the CUPRAC assay. This surpasses other plants such as Capsella bursa-pastoris and Achillea millefolium, which show lower antioxidant potentials.2. Phenolic Content: R. acetosella contains high levels of phenolic compounds (111–131 mg/g), including derivatives of flavones like apigenin and luteolin, which contribute to its strong free radical scavenging ability. Other species, such as R. crispus and R. maritimus, contain flavonols like quercetin, but their antioxidant profiles are less potent compared to R. acetosella.3. Anthraquinones Contribution: The presence of anthraquinones (e.g., emodin, chrysophanol) in R. acetosella further enhances its antioxidant and anti-inflammatory effects, making it more effective than plants lacking these compounds. [20][21].

The ethanol extract of Rumex acetosella is particularly effective as an antioxidant due to the following factors:1. High Phenolic and Flavonoid Content: The ethanol extract contains a significant amount of phenolic compounds, such as flavone glycosides and rutin, which are known for their strong radical-scavenging abilities. These compounds directly neutralize free radicals, reducing oxidative stress.2. Presence of Anthraquinones: Compounds like emodin, chrysophanol, and physcion in the ethanol extract enhance its antioxidant activity. These anthraquinones not only scavenge free radicals but also inhibit oxidative pathways that contribute to inflammation and cellular damage.3. Superior Performance in Antioxidant Assays: The ethanol extract of R. acetosella has demonstrated outstanding results in ABTS and CUPRAC assays, with IC50 values of 23.73 µg/mL and 25.31 µg/mL, respectively, outperforming other plant extracts tested under similar conditions.4.Synergistic Effects: The combination of phenolics, flavonoids, and anthraquinones creates a synergistic effect, enhancing the overall antioxidant capacity compared to plants that rely on a single class of compounds.These properties make the ethanol extract of R. acetosella a potent natural antioxidant with potential applications in managing oxidative stress-related conditions [22].

presence of ethanol in Rumex acetosella affect its anti-inflammatory activity. The presence of ethanol in the extraction process of Rumex acetosella enhances its anti-inflammatory activity by efficiently isolating bioactive compounds, such as anthraquinones (e.g., emodin, chrysophanol) and flavonoids, which are responsible for its pharmacological effects. Ethanol extracts exhibit:1. Higher Concentration of Active Compounds: Compared to water extracts, ethanol extracts contain higher levels of emodin, a key anthraquinone with potent anti-inflammatory properties. This leads to stronger inhibition of nitric oxide (NO) production and suppression of inflammatory mediators like COX-2.2. Improved Free Radical Scavenging: Ethanol

extracts show superior antioxidant activity, reducing oxidative stress that drives inflammation. This contributes to their ability to modulate inflammatory pathways such as NF-κB and MAPKs.3. Enhanced Cellular Effects: Ethanol extracts effectively reduce inflammation in LPS-induced macrophages by suppressing phosphorylation of ERK and JNK, key proteins involved in inflammatory signaling.Overall, ethanol enhances the extraction efficiency of anti-inflammatory compounds from R. acetosella, making the extract more effective in treating inflammation-related conditions.Ethanol extraction significantly enhances the bioavailability of anti-inflammatory compounds in Rumex acetosella by improving the concentration and solubility of key bioactive components. Here's how: 1. Higher Emodin Content: Ethanol extracts contain substantially higher levels of emodin, a major anthraquinone with strong anti-inflammatory properties, compared to water extracts. Studies show that emodin concentration in ethanol extracts is up to eight times greater, directly boosting their efficacy in reducing nitric oxide (NO) production and suppressing inflammatory pathways.2. Improved Solubility: Ethanol serves as an efficient solvent for extracting hydrophobic compounds like anthraquinones and flavonoids, which are poorly soluble in water. This enhances the bioavailability of these active ingredients, making them more effective in modulating inflammatory responses.3. Potent Free Radical Scavenging: Ethanol extracts exhibit stronger antioxidant activity than water extracts, as demonstrated by lower IC50 values in DPPH assays. This contributes to reducing oxidative stress, which is closely linked to inflammation.Overall, ethanol extraction maximizes the therapeutic potential of Rumex acetosella by concentrating its anti-inflammatory compounds and improving their pharmacological impact [23].



LITERATURE REVIEW:-

- Ms. Dnyaneshwari K. Kurhe, janevary 2025 IJRPR Flavonoids, anthraquinones, tannins, and oxalic acid are among the many phytochemicals found in Rumex acetosa, a perennial plant with anti-inflammatory, antihypertensive, and antioxidant qualities. Its high oxalic acid concentration, however, may be harmful to your health. Although further research is needed to determine its safety and efficacy, sorrel offers potential for cultivation and usage as a vegetable, herbal remedy, and phytoremediator.
- Dmitriy Berillo IJRPR 10 February 2022 Rumex confertus, an invasive parasitic plant, has been studied for its potential in treating diseases like cancer, diabetes, and oxidative stress, with a review analyzing solvent compositions and extracts.

NEED OF WORK:-

- There is limited scientific validation for the traditional medicinal uses of Rumex acetosella, especially regarding its anti-inflammatory effects.
- Research gaps exist in understanding the plant's pharmacological activities, mechanisms, and safety.
- More studies are needed to confirm its efficacy and to support the development of plant-based therapies for inflammation.
- Filling these gaps will help connect traditional knowledge with modern medicine and may lead to new therapeutic options.

AIM:-

To evaluate the anti-inflammatory and antioxidant activities of the ethanol extract of Rumex acetosella leaves and to investigate its potential mechanisms of action relevant to inflammation.

OBJECTIVES:-

- To prepare and characterize the ethanol extract of *Rumex acetosella* leaves.

- To assess the anti-inflammatory activity of the extract using appropriate in vitro and/or in vivo models.
- To evaluate the antioxidant potential of the extract.
- To identify and quantify key phytochemical constituents (such as phenolics, flavonoids, and anthraquinones) in the extract.
- To explore the possible mechanisms of anti-inflammatory action, including effects on inflammatory mediators.
- To compare the observed activities with those reported for other Rumex species and traditional uses.

EXTRACTION PROCESS :-

The extraction process for Rumex acetosella (commonly known as red sorrel) leaves involves several steps, primarily utilizing solvents to obtain desired phytochemicals. Here's a concise overview of the methods:

1. Preparation of Plant Material:

- The leaves should be dried and then ground into a fine powder. This increases the surface area for extraction, enhancing the efficiency of the process.

2. Selection of Solvent:

- Common solvents include ethanol, methanol, or a mixture of water and organic solvents. Ethanol is particularly favored due to its effectiveness in extracting a wide range of compounds.

3. Extraction Method:

- Soxhlet Extraction: This method involves placing the powdered leaves in a Soxhlet extractor and using 70% ethanol as the solvent. The extraction is typically conducted at 80 °C for about 3 hours.
- Maceration: Alternatively, the powdered leaves can be soaked in the chosen solvent for a period (often up to 48 hours) at room temperature or slightly elevated temperatures to facilitate extraction.

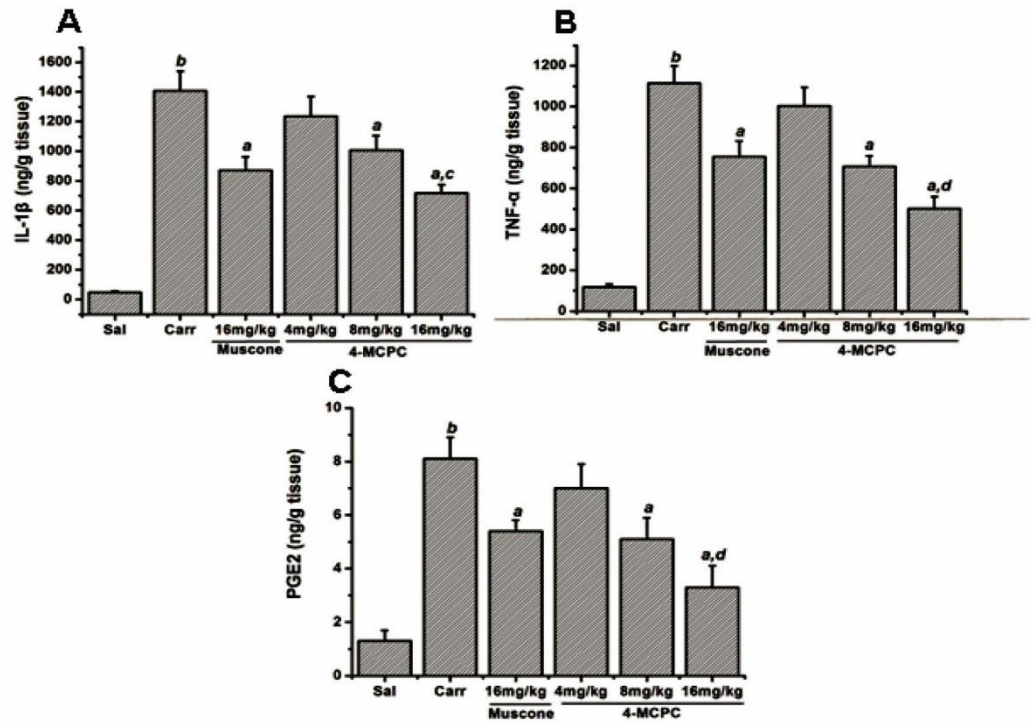
4. Separation of Extract:

- After extraction, the mixture is filtered to separate the liquid extract from the solid plant material. This can be done through decantation or filtration.

5. Concentration and Purification:

- The liquid extract may be concentrated by evaporation or lyophilization (freeze-drying) to obtain a more potent extract. Further purification steps, such as chromatography, can be employed to isolate specific active compounds if required.

OBSERVATION'S:-



RESULT :-

The study likely evaluates the pharmacological effects of ethanol extract from Rumex acetosella leaves, particularly its role in inflammation.

CONCLUSION :-

The ethanol extract of Rumex acetosella leaves holds promise as a natural remedy for inflammatory conditions, supported by its ability to mitigate oxidative stress and inflammation through various bioactive compounds. Further studies are warranted to fully elucidate its mechanisms and therapeutic applications.

Table no.1 Effects of Sample against L929 (Mouse Connective Tissue Cell line) by MTT assay

Sr.no	concentration (µg/ml)	Absorbance (O D)				Cell viability (%)
		1	2	3	Average	
1.	Control	2.107	2.114	2.11	2.110	
2.	Sample -AK 10	1.256	1.254	1.251	1.253	59.39
	40	1.452	1.453	1.459	1.454	68.91
	100	1.526	1.529	1.53	1.528	72.42

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