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Original Article

GC-MS Analysis of an Ayurveda Formulation *Erandamula Niruha Basti* (Medicated Therapeutic Enema)

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ABSTRACT

Background: The scientific credibility of modern and Indian System of Medicine, such as *Ayurveda* and Siddha, is highly relevant in the current era. The gas chromatography-mass spectrometry (GC-MS) instrument separates chemical mixtures (the GC component) and identifies the components at a molecular level. Since *Basti* is the most effective remedy for *Vata Dosha*, it occupies a prominent position among the five Therapeutic measures of *Panchakarma*. **Aim and Objectives:** This study uses Gas Chromatography-Mass Spectrometry (GC-MS) analysis to examine the *Erandamula Niruha Basti*, with the goal of identifying links between its medicinal properties and the biomolecules it comprises. **Materials and Methods:** GCMS analysis was conducted using 7890 A GC with 5975C with a triple-axis detector. The compounds were identified after comparing the spectral configurations obtained with those of the available mass spectral database (NIST-08 SPECTRAL DATA). **Results:** Important compounds were found in the profile that resulted, showing the presence of some important molecules like 5-Acetoxymethyl-2-furaldehyde,2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one,3-Furanmethanol, and furfural, which exhibit pharmacological actions like anti-inflammatory and antioxidant, which is in keeping with the therapeutic qualities that *Eranndamoola Niruha Basti* is said to possess. **Conclusion:** The current study uses GC-MS analysis to demonstrate the scientific validity of conventional formulations such as Erandamoola Niruha Basti. This Ayurvedic remedy's pharmacological claims are supported by the finding of important phytochemicals. Certain molecules, like furfural and 5-acetoxymethyl-2-furaldehyde, have antioxidant and anti-inflammatory qualities. These results are consistent with Basti's traditional therapeutic benefits in treating Vata disorders. The discovery of these biomolecules validates *Erandamula Niruha Basti's* function as a potent treatment for *Vata vyadhi (musculoskeletal* disorders) in *Ayurveda*.

Keywords: *Erandamula niruha Basti*, GCMS, Basti, Anti-Inflammatory.

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INTRODUCTION

Musculoskeletal Disorders (MSDs) are injuries or conditions that impact the musculoskeletal system or the movement of the human body. Musculoskeletal issue that may be brought on by or made worse by contemporary lifestyle choices. Among the main causes are inactivity, bad posture, and sedentary behavior. In *Ayurveda* musculoskeletal disorders are explained as *Vataja vyadhi*. Plant metabolites are important source with a variety of structural arrangements and properties. Gas chromatography involves a sample being vaporized and injected onto the head of the chromatographic column. As a unique and powerful technology, the GC-MS provides a rare opportunity to perform the analysis of new compounds for characterization and identification of synthesized or derivatized compounds.[1] Prior GCMS Analysis studies on Dhanwantarm Taila[2] and Balaguluchyadi Tailam[3] have been carried out to validate their anti-inflmmatory properties.

Basti is one of the *Panchakarma* explained in classical texts. Here the medicine is administered through anal route. *Ayurveda* describes three fundamental Humors or doshas: *Vata, Pitta*, and *Kapha*. These *doshas* are believed to govern various physiological and psychological functions within the body. In *Ayurveda*, when a specific site (*sthana*) is indicated for a particular *dosha*, the imbalance of that *dosha* should be addressed and removed from the nearest site. For example, since *Vata* is in the colon (*Pakwashaya*), treatments such as enema (*basti*) are primarily used for *Vata dosha*, targeting the colon route for correction. *Erandmula Niruha Basti* acts as *Deepana* (appetizer) and *Lekhana* (Scraping) in nature, which helps in pacifying *Kapha* and reduces

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symptoms like heaviness and stiffness. *Eranda* (*Ricinus communis* Linn.*)* which is the main content of *Erandmula Niruha Basti* possess anti-inflammatory, antioxidant, analgesic and bone regeneration properties.[2]

The ingredients of *Erandamula niruha basti* includes *Saindhava lavana, Shatapushpa kalka, makshika, moorchita tila taila*, and *Erandamula kwatha. Erandamula* as one of the main ingredient, it has multiple properties like *Bhedana, Dipana, Grahi, Rechana, Sara, Shodhana, Vayasthapana, Vatahara, Vrshya*.[3] *Eranda* is one among the *Agrya aushadhi* explained as *Vrushyavataharanam* by *Acharya charaka*. *Saindhava lavana* in general is having the properties like *Vishyandi, Sukshma, Tikshna* and *Vataghna*, it promotes the evacuation of bladder and rectum.[3] Various studies have revealed the presence of diverse phytochemicals such as alkaloids, flavonoids, terpenes, saponins, phenolic compounds such as kaempferol. These phytochemicals have been responsible for pharmacological and therapeutic effects, including anti-inflammatory, bone regenerative, and analgesic activity.[4] Honey has a simulative effect on probiotic microorganisms in the colon. Honey is a natural emulsifying agent that can also be utilized to bind the liquids together and stabilize the colloid. Components may eventually separate once more if the emulsion is not effectively stabilized. Contemporary science and traditional knowledge are strengthened by the incorporation of sophisticated analytical tools such as GC-MS. Using quantifiable scientific criteria, it confirms the effectiveness of *Ayurveda*. Such studies improve Indian medical systems legitimacy and recognition globally.

MATERIALS AND METHODS

All the raw drugs were collected from GMP-certified KLE Ayurveda Pharmacy, Shahpur, Belagavi, Karnataka, and authentication was carried out in AYUSH, GoI-approved DTL of KLEU's Shri BMK Ayurveda Mahavidyalaya, Belagavi, Karnataka.

Methods

1. Preparation of *Erandamula Niruha basti*.
2. GCMS analysis of *Erandamula Niruha Basti*.

Preparation of *Erandamula Niruha basti*

Equipment used: Mortar and pestle, filter**,** stainless steel vessel, and measuring cylinder.

Basti Preparation

Basti was prepared step wise in sequential order of mixing the ingredients (Table 1).[5]

Step 1 - Honey and rock salt are mixed in the beginning and blended well.

Step 2 - M*oorchita tila taila* was added to the above mixture and then meticulously mixed.

Step 3 - *Shatapushpa kalka* was mixed in it. The mixture is then again mixed thoroughly.

Step 4 - Then *Erandamula kashaya* was added to it and mixed till the homogenous mixture is obtained.

Time taken for preparing whole *EMNB* was 40 min

GCMS analysis of Erandamula Niruha Basti

100 µL of the sample was diluted with 0.5 mL Methanol, filtered through a syringe filter (Nylon 13 mm 0.2 um) and injected to GCMS. Analysis was performed by injecting 1 μL of the sample with a split ratio of 50:1. Helium gas (99.9995%) was used as the carrier gas at a flow rate of 1 mL/min. The analysis was performed in the EI (electron impact) mode with 70 eV of ionization energy. The injector temperature was maintained at 280°C (constant).

The compounds were identified after comparing the spectral configurations obtained with that of available mass spectral database (NIST -08 SPECTRAL DATA). It offers comprehensive details regarding the molecular makeup of the sample's constituent parts. Because the analysis was conducted according to a recognized protocol, the results were consistent and trustworthy. Throughout the experiment, standard operating procedures for mass spectrometric detection, chromatographic separation, injection, and sample preparation were followed. The National Institute of Standards and Technology (NIST) retention times were compared to understand the GC-MS analysis results.[6] Since there are no human or animal participants in the study, ethical approval is not considered. This study is primarily qualitative in chemical profiling. The future study on quantitative analysis and statistical validation of peak intensities can be conducted.

RESULTS

According to the relative contents, the primary chemicals found were 5-Acetoxymethyl-2-furaldehyde,2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one, 1,2,3-Propanetriol, 1-acetate, 3-Furanmethanol, Furfural, Methyl 2-furoate, 1,2-Cyclopentanedione, these compounds are known for its anti-inflammatory and antioxidant properties. Comprehensive information is provided by *Erandamula Niruha basti* GC-MS profile (Figure 1 and Table 2), which includes retention duration, possible compound kinds, molecular formulas, molecular mass, and percentage peak area. By comparing retention time and fragmentation patterns with mass spectra from the NIST spectral library kept in the GC-MS program, metabolite identification was achieved.

DISCUSSION

Ayurvedic knowledge combined with contemporary GC-MS analysis is an example in bridging the gap between Ayurveda wisdom and scientific research. This has consequences for the advancement of integrative healthcare strategies that blend evidence-based procedures with the benefits of conventional therapy. The presence of 2-Furancarboxaldehyde, 5-(hydroxymethyl) compound in *madhu* exhibits antioxidant properties by scavenging free radicals and reducing oxidative stress, which plays a crucial role in preventing degenerative diseases.[7] 2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one (Figure 2 and Table 2) has been shown to suppress pro-inflammatory cytokines, making it beneficial in inflammatory disorders.[8] Dihydromercitin is a flavanoid found in EMNB has been shown to inhibit the release of pro-inflammatory cytokines and suppress inflammatory pathways such as NF-κB, which plays a significant role in the inflammatory response by promoting the production of pro-inflammatory cytokines and enzymes, such as TNF-α, IL-1β, and COX-2.[9] 1,2,3-Propanetriol, 1-acetate (Figure 3 and Table 2), the Acetate derivatives, including Monoacetin, may reduce inflammation by modulating cytokine production and inhibiting NF-κB signaling, which is associated with chronic inflammatory diseases.[10] 3-Furanmethanol (Figure 4 and Table 2) exhibits free

Table 1: **Ingredients of *Erandamula Niruha Basti*.**

Sl. No.	Ingredient	Latin/English Name	Classical Ratio	Quantity Prepared
1	*Saindhava lavana*	Rock salt	1	5 g
2	*Shatapushpa Kalka*	Paste of *Athenum sowa*	8	40 g
3	*Makshika*	Honey	16	80 mL
4	*Murchita tila taila*	*Sesame oil*	24	120 mL
5	*Eranda Mula Kwatha*	Decoction of *Ricinus comunis* Roots	32	160 mL

Table 2: **Compounds with its retention time and its activity.**

Sl. No.	Retention time	Molecule	Medicinal value
1	23.621	5-Acetoxymethyl-2-furaldehyde	Anti-inflammatory, antioxidant[6]
2	19.027	2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one	Anti-inflammatory[7]
3	24.881	1,2,3-Propanetriol, 1-acetate	Anti-inflammatory[9]
4	8.379	3-Furanmethanol	Anti-inflammatory, antioxidant[10]
5	7.436	Furfural	Anti-inflammatory, antioxidant[10]
6	16.605	Methyl 2-furoate	Anti-inflammatory, hepatoprotective, antiviral, antioxidant
7	10.988	1,2-Cyclopentanedione	Natural inflammation inhibitor

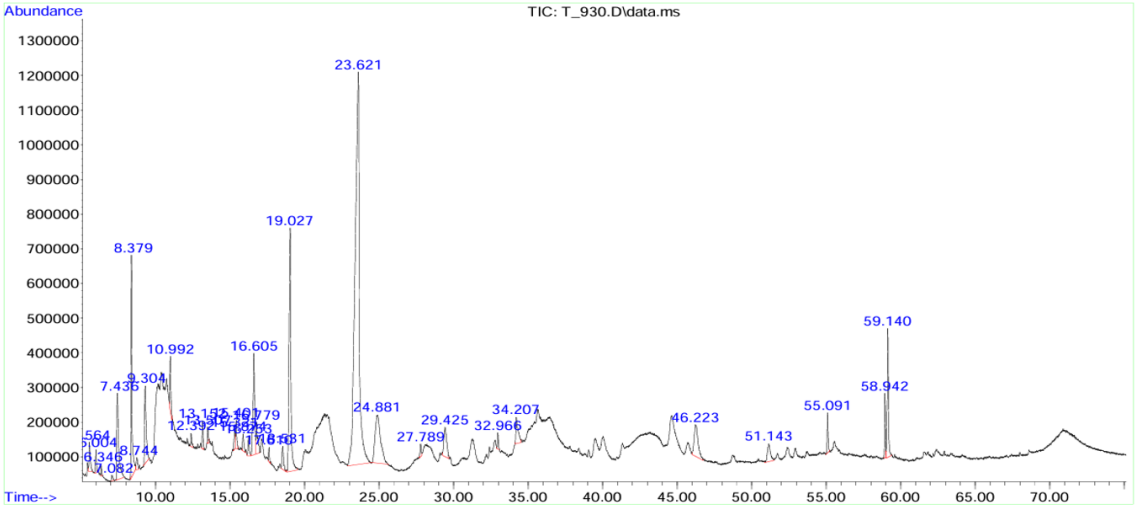

Figure 1: Chromatogram of GCMS of *Eranda moola Niruha basti*.

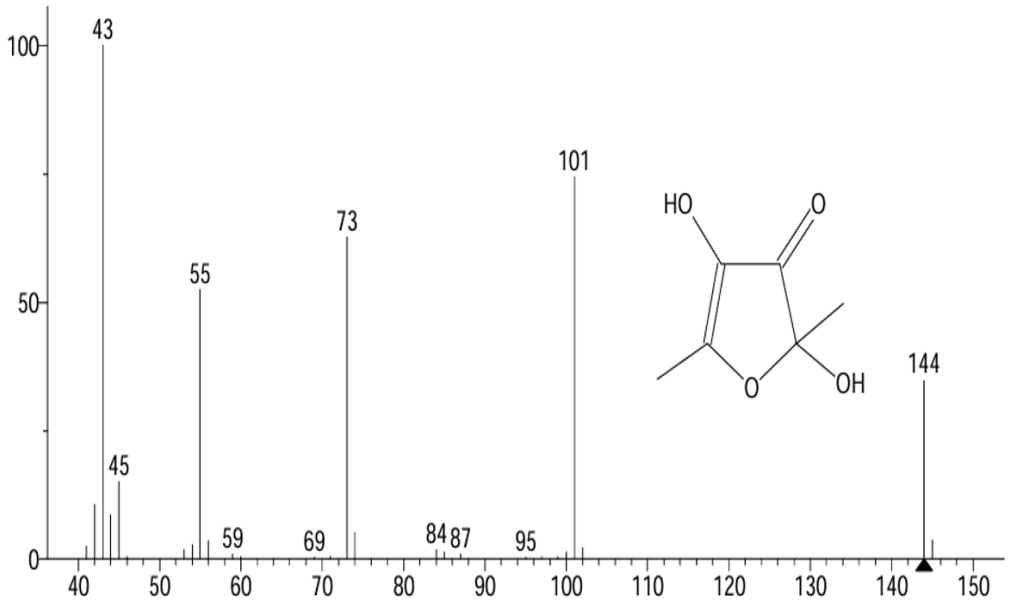

Figure 2: 2,4-Dihydroxy-2,5-dimethyl-3(2H)-furan-3-one.

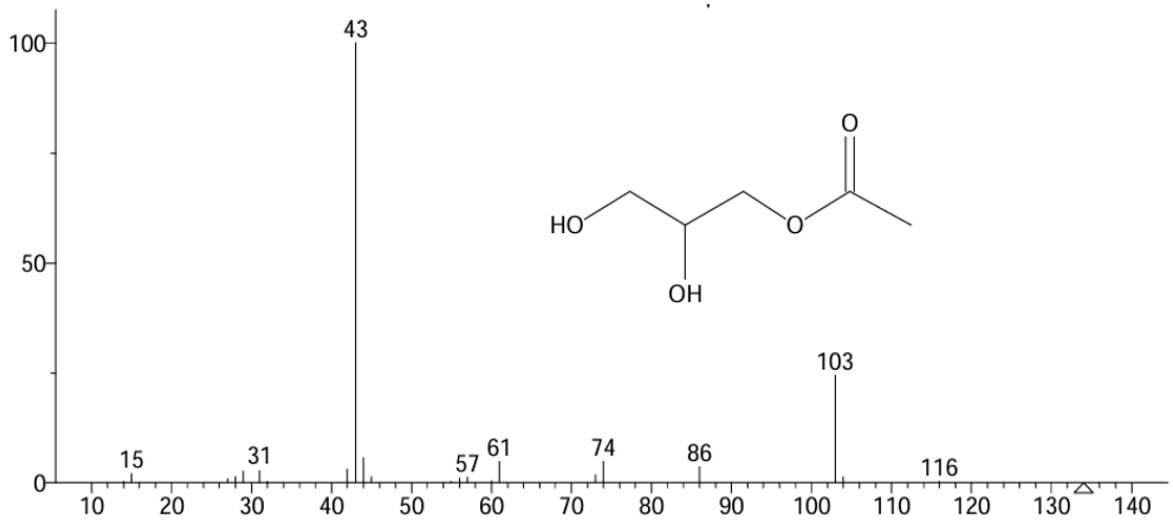

Figure 3: 1,2,3-Propanetriol, 1-acetate.

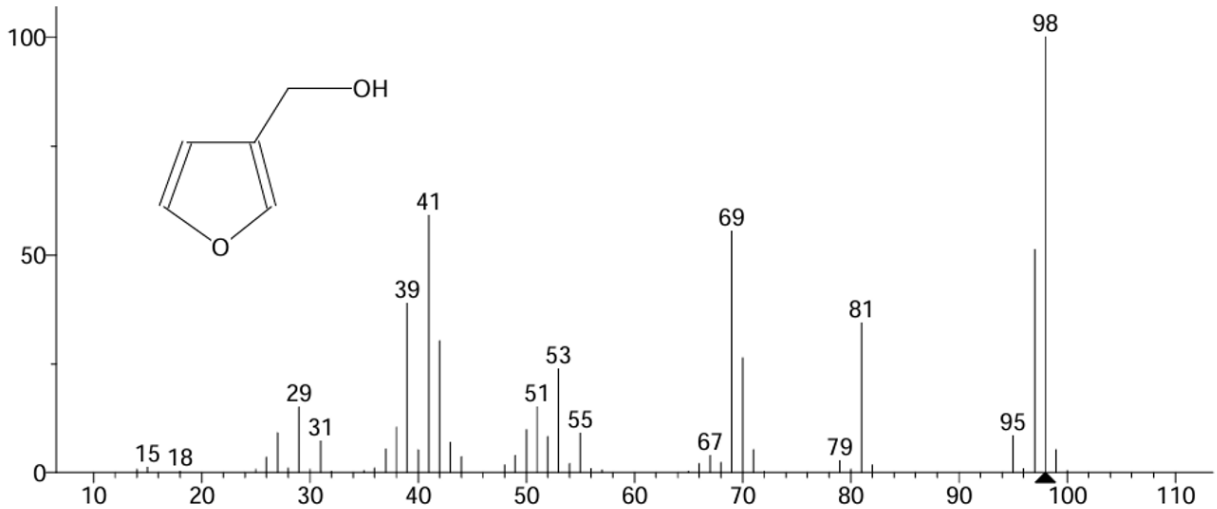

Figure 4: 3-Furanmethanol.

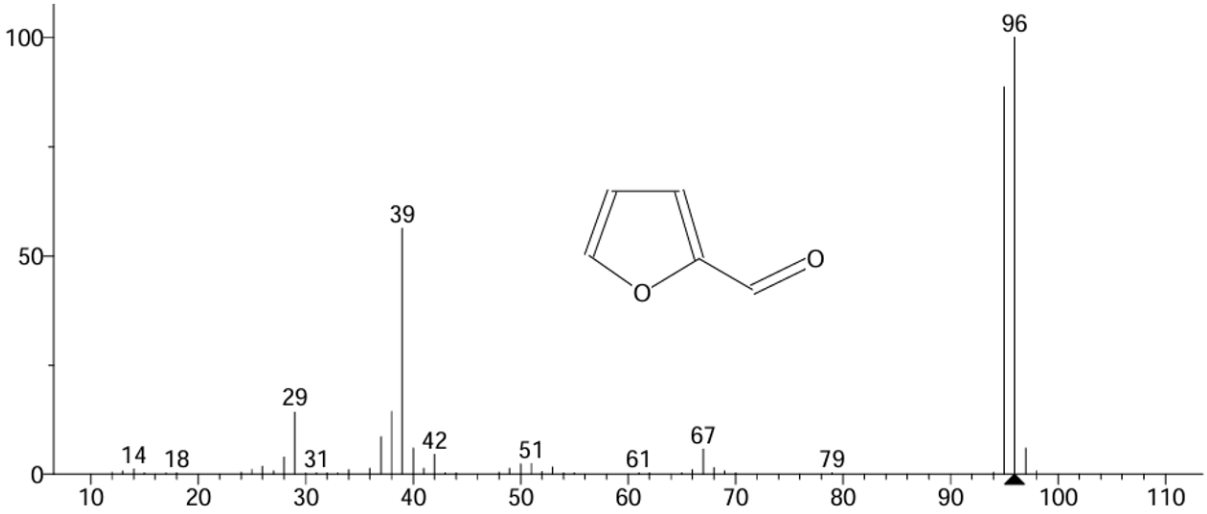

Figure 5: Furfural.

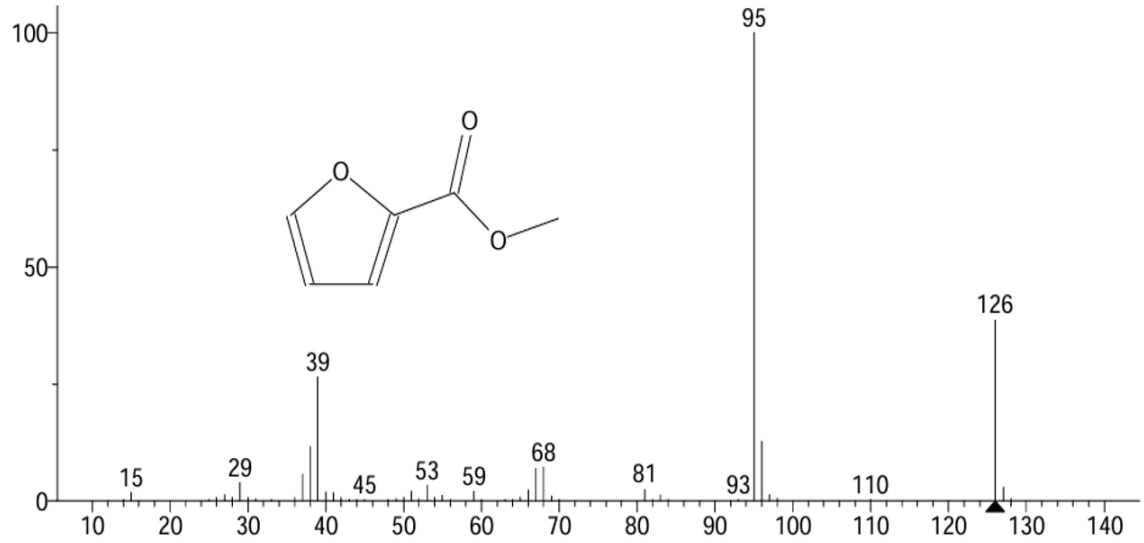

Figure 6: Methyl 2-furoate.

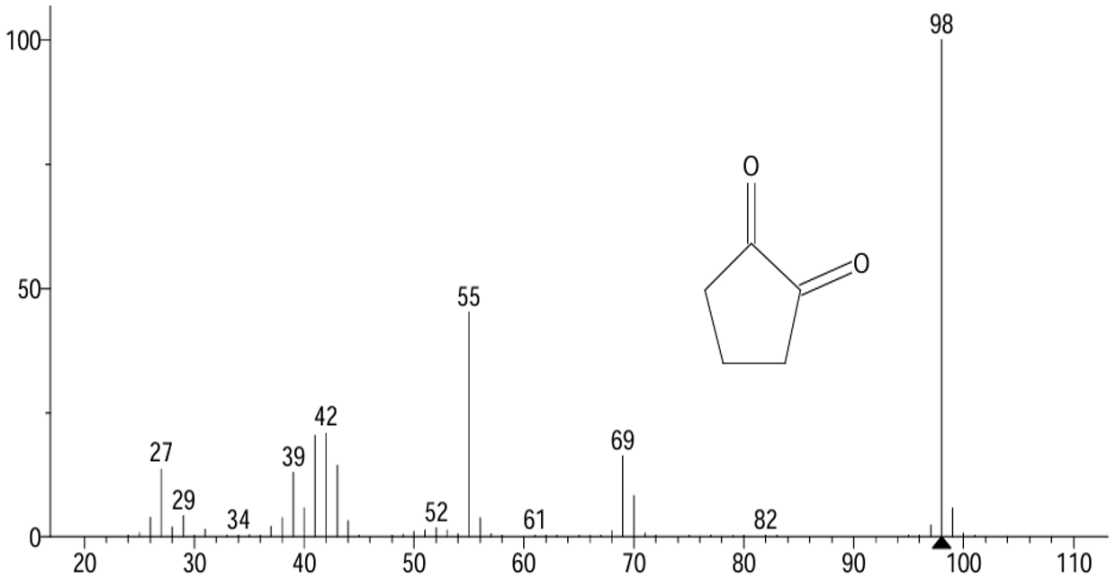

Figure 7: 1,2-Cyclopentanedione.

radical scavenging activity, helping to protect cells from oxidative damage. This property is useful in preventing neurodegenerative disorders.[11]

Furfural (Figure 5) is a compound present in honey, which exhibits properties like anti-inflammatory (Table 2), antioxidant, hepatoprotective etc., Furfuryl alcohol has been reported to inhibit pro-inflammatory cytokines such as TNF-α and IL-6, suggesting its role in treating chronic inflammatory conditions.[12]

Methyl 2-furoate (Figure 6) is an organic ester compound derived from furoic acid, present in madhu has diverse pharmacological activities which includes antibacterial (Table 2), antifungal, antiviral, anti-inflammatory, hepatoprotective, antioxidant. Though the immune system will respond to infection or injury, it will remain inactive in case of harmless compounds, food antigens, or microscopes of the gut flora. A deregulated chronic inflammation might lead in some cases to hay fever, atherosclerosis, and rheumatoid arthritis. 1,2-Cyclopentanedione (Figure 7) present in this *basti* formulation acts as natural inflammation inhibitor.[13] *Erandamula Niruha Basti* is a potent *Ayurvedic* remedy that is grounded in traditional knowledge due to lack of quantitative validation this study was undertaken and strengthened by contemporary research. Preclinical and clinical investigations could be conducted further to demonstrate its effectiveness.

CONCLUSION

Its numerous medicinal uses, *dosha*-balancing qualities, traditional formulation based on *Ayurvedic* principles, are what make *Erandamula Niruha Basti* significant. *Basti* is a pillar of the holistic approach to health and well-being with wide range of advantages. According to its GC-MS analysis, *Erandamula niruha basti* possess various important compounds which are mostly anti-inflammatory and antioxidant molecule that improves musculoskeletal Ailments or Conditions by lowering inflammation and discomfort. *Erandamula niruha basti* is often used in Ayurvedic to treat vata disorders.

Erandamoola niruha Basti's GC-MS study has identified a number of bioactive substances with significant therapeutic potential. The medicinal effectiveness of this traditional Ayurvedic composition may be attributed to the notable anti-inflammatory and antioxidant qualities of many of these ingredients. The discovery of these substances validates *Erandamoola niruha Basti's* traditional application in the treatment of inflammatory and oxidative stress-related disorders. These results not only support its conventional uses but also motivate more clinical and pharmacological research to fully understand its mechanism of action and therapeutic potential.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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