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CORRELATION OF ELEMENTAL PROFILE BY ICP-OES WITH OSWESTRY DISABILITY INDEX IN LUMBAR SPONDYLOSIS PATIENTS TREATED WITH KOMOOTHIRA SILASATHU CHOORANAM

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ABSTRACT

Background: Lumbar spondylosis is a degenerative spine disorder causing chronic low back pain and functional impairment. Komoothira Silasathu Chooranam (KSC), a traditional Siddha mineral formulation, is reputed for managing musculoskeletal conditions. This study aimed to analyze the elemental composition of KSC using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) and evaluate its clinical efficacy in lumbar spondylosis patients by measuring changes in Oswestry Disability Index (ODI) scores. **Materials and Methods:** KSC samples were procured and authenticated according to Siddha pharmacopeial standards. Elemental profiling was conducted at IIT Madras using ICP-OES. Forty patients diagnosed with lumbar spondylosis were treated orally with standardized KSC doses combined with cardamom decoction over 48 days. Disability was assessed using the ODI questionnaire pre- and post-treatment. Statistical analysis was performed using SPSS version 25 and paired t-tests are used to compare ODI scores. **Results:** ICP-OES revealed significant concentrations of carbon, Sulfur, and phosphorus, with no detectable toxic heavy metals. The paired t-test demonstrated a highly significant reduction in ODI scores post-treatment ($t = 24.50$, $p < 0.0001$). Most patients improved from severe to moderate disability or moderate to mild disability categories. Due to the single-batch nature of elemental data, direct statistical correlation between elemental levels and individual patient outcomes was not possible. **Conclusion:** The significant clinical improvement alongside the identified elemental profile of KSC suggests that mineral constituents such as calcium, phosphorus, and sulphur may contribute to its therapeutic efficacy in lumbar spondylosis. These elements potentially mediate anti-inflammatory, tissue repair, and bone mineralization processes. Further studies incorporating patient-specific elemental analyses and controlled trials are recommended to elucidate mechanisms and validate clinical benefits.

KEYWORDS: Lumbar Spondylosis, Komoothira Silasathu Chooranam, ICP-OES, Oswestry Disability Index, Siddha medicine.

INTRODUCTION

Lumbar spondylosis is a common degenerative condition affecting the lower spine, characterized by intervertebral disc degeneration, osteophyte formation, and facet joint arthropathy, leading to chronic low back pain and reduced mobility. Recent epidemiological studies indicate that lumbar spondylosis affects approximately 20–30% of adults over the age of 40 globally, with prevalence increasing due to aging populations and sedentary lifestyles.[1,2] This condition significantly impairs quality of life and functional capacity, necessitating effective treatment strategies. Traditional Siddha medicine offers several herbal and mineral formulations for managing musculoskeletal disorders, including lumbar spondylosis. One such remedy is Komoothira Silasathu Chooranam (KSC), a mineral-based compound historically acclaimed for its efficacy in treating spine-related ailments. According to Siddha texts, KSC is characterized by a slightly sour taste and possesses Karppu Pirivu (detoxifying property) and Veeriyam (heat-generating potency), which are believed to alleviate musculoskeletal stiffness and pain by restoring physiological balance.

Elemental analysis of mineral drugs like KSC is essential to ascertain their chemical composition and ensure

therapeutic consistency. Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) is a sensitive and accurate analytical technique widely used to quantify major and trace elements in pharmaceutical preparations.[3] Investigating the elemental profile of KSC can help elucidate potential bioactive components that contribute to its pharmacological effects or identify any toxic elements.

Clinically, the Oswestry Disability Index (ODI) is a validated and widely accepted tool for assessing disability and functional impairment in patients with lumbar spine disorders.[4] It quantitatively measures the impact of lumbar spondylosis on daily activities and provides an objective parameter to evaluate treatment efficacy. This study aims to analyze the elemental composition of Komoothira Silasathu Chooranam using ICP-OES and to clinically evaluate its efficacy in patients with lumbar spondylosis by measuring changes in ODI scores. Furthermore, the study seeks to correlate the elemental profile of KSC with clinical outcomes to understand possible pharmacodynamic mechanisms underlying its therapeutic effects

MATERIALS AND METHODS

Sample Collection and Authentication

The mineral drug Komoothira Silasathu Chooranam (KSC) used in this study was procured from a traditional Siddha medicine outlet located in Madurai, Tamil Nadu, India. The raw material was authenticated and purified as per Siddha pharmacopeial standards by medicinal botanists and gunapadam experts at the Government Siddha Medical College and Hospital, Palayamkottai, Tamil Nadu.

Elemental Analysis by ICP-OES

Elemental profiling of KSC was performed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) with the PerkinElmer Optima 5300 DV instrument.[3] The analysis was carried out at the Central Research Facility, Indian Institute of Technology (IIT) Madras, Chennai, India. Standard operating procedures were followed, including calibration with certified reference standards, to quantify the concentration of major and trace elements present in the sample.

Patient Selection and Clinical Assessment

A total of 40 patients aged between 30 and 65 years, both male and female, diagnosed with lumbar spondylosis based on clinical presentation and radiological confirmation, were recruited for this study. Inclusion criteria included patients presenting with pain, stiffness in the lumbar region, tenderness over the paraspinal muscles, and reduced range of motion. Patients with osteoarthritis of the hip, history of spinal surgery, tuberculosis of the spine, systemic lupus erythematosus (SLE), infections, fractures, chronic renal or liver diseases were excluded. Each patient received a standardized dose of KSC, dispensed in packets containing 130 mg of the powdered formulation. The drug was administered orally with 60 ml of freshly prepared cardamom decoction as the vehicle. Functional disability was assessed using the Oswestry Disability Index (ODI) questionnaire administered before treatment initiation and after a 48-day treatment period.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 25. The paired Student's t-test was applied to compare pre-treatment and post-treatment ODI scores, assessing the statistical significance of clinical improvement. Correlation analysis was performed to evaluate the relationship between elemental concentrations in KSC and changes in ODI scores. A p-value of less than 0.05 was considered statistically significant.

RESULTS

ICP-OES measures the characteristic light emitted by excited atoms and ions in a plasma, enabling simultaneous detection of multiple elements at trace levels.[13]

Procedure

0.5 g of KSC was accurately weighed into a clean decomposition vessel. Concentrated nitric acid was added to dissolve the sample. The solution was made up to 10 mL with deionized water. The sample was nebulized into the plasma of the ICP-OES. Emission intensities were recorded and compared with standards in Table 1.

Table 1: Elemental Composition.

Element	Wavelength(nm)	Concentration(mg/L)	Observation
Carbon (C)	193.030	774.120	High level – possible structural repair role
Sulfur (S)	180.731	601.101	High level – anti-inflammatory and cartilage protection
Phosphorus (P)	213.617	1.300	Supports bone mineralization and nerve health
Other metals	-	Below Detection Limit (BDL)	Safe from toxic heavy metals

The Oswestry Disability Index (ODI) scores of 40 patients were analyzed before and after treatment with Komoothira Silasathu Chooranam. The distribution of patients by disability category showed marked improvement post-treatment. Before treatment, the majority of patients were in the severe disability (25–34) and moderate disability (15–24) categories. After treatment, most patients shifted to lower disability categories, primarily from severe to moderate and moderate to mild (5–14). A Shapiro-Wilk normality test on the differences between pre- and post-treatment ODI scores showed a p-value of 0.16 (> 0.05), indicating that the differences were approximately normally distributed. Therefore, a paired t-test was conducted to compare the mean ODI scores before and after treatment. The paired t-test revealed a highly significant reduction in ODI scores after treatment ($t = 24.50$, $p < 0.0001$). This indicates that the treatment led to a statistically significant improvement in disability levels.

Category shifts summary

Disability Category Before	Disability Category After Mild	Disability Category After Moderate	Disability Category After Severe
Moderate	19	1	0
Severe	0	20	0

All patients initially classified as severe disability improved to moderate disability after treatment. The majority of patients initially in moderate disability improved to mild disability.

DISCUSSION

The significant reduction in Oswestry Disability Index (ODI) scores after treatment with Komoothira Silasathu Chooranam (KSC) demonstrates its potential clinical efficacy in managing lumbar spondylosis. The observed functional improvement, shifting patients from severe to moderate and moderate to mild disability categories, indicates meaningful alleviation of pain and enhancement of mobility. This clinical benefit can be understood in the context of the elemental composition of KSC revealed by ICP-OES analysis, which identified high concentrations of carbon, sulphur and phosphorus.

Carbon (C), found in high levels in KSC, is a fundamental component of all organic molecules and may contribute to the structural integrity of connective tissues. In the context of lumbar spondylosis, carbon-containing compounds can play a role in tissue repair and regeneration by serving as building blocks for collagen and other extracellular matrix proteins critical for spinal disc and cartilage health.[5] Additionally, carbon-based compounds have been implicated in modulating cellular energy metabolism, which is essential for tissue healing processes.

Sulphur (S), present at substantial levels, is a key element involved in the synthesis of sulphur-containing amino acids such as cysteine and methionine, which are vital for the formation of structural proteins like keratin and collagen. Sulphur also contributes to the production of glycosaminoglycans and proteoglycans, components of cartilage extracellular matrix that provide elasticity and resistance to compressive forces. Moreover, sulphur compounds possess well-documented anti-inflammatory and antioxidant properties, which can mitigate oxidative stress and inflammation in degenerated spinal tissues. By reducing inflammatory mediators, sulphur may alleviate pain and promote healing of damaged cartilage and ligaments in lumbar spondylosis.[7,8]

Phosphorus (P), although detected in lower concentrations compared to carbon and sulphur, is indispensable for bone health and mineralization. It combines with calcium to form hydroxyapatite crystals that provide mechanical strength and rigidity to bones. Adequate phosphorus levels support bone remodelling and repair, which is crucial in conditions like lumbar spondylosis characterized by osteophyte formation and vertebral degeneration. Furthermore, phosphorus is involved in cellular signalling pathways and energy transfer through adenosine triphosphate (ATP), facilitating cellular repair and regeneration.[5,6]

The synergy between these elemental constituents may underlie the pharmacodynamic effects of KSC. The mineral components could modulate biochemical pathways that reduce inflammation, support connective tissue repair, and enhance bone mineralization. From the traditional Siddha medicine perspective, KSC's Pulipu Chuvai (sour taste) is recognized for its ability to rapidly eliminate Vatham (a dosha associated with movement and pain) within approximately ten minutes, initiating detoxification of the body. Concurrently, the formulation possesses Veppa Veeriyam (heat-generating potency) which sustains the reduction of Vatham by generating internal heat, further restoring physiological balance and reducing musculoskeletal stiffness and pain. The synergistic action of Pulipu Chuvai and Veeriyam contributes to the elimination of Vatham, aligning with observed anti-inflammatory and metabolic improvements.

While the ICP-OES analysis provides valuable insight into the chemical profile of the medicine, it is important to note that the elemental composition was derived from a single batch and not individualized per patient. Therefore, direct statistical correlation between elemental concentrations and individual clinical outcomes was not feasible in this study. However, the

observed clinical improvements strongly suggest that these mineral elements contribute to the therapeutic action of KSC. Future research could explore patient-specific biochemical changes post-treatment, including serum mineral levels and inflammatory markers, to establish more direct mechanistic links. Additionally, controlled clinical trials with larger cohorts and placebo groups would strengthen the evidence base and help clarify the molecular pathways influenced by these elements.

CONCLUSION

The combined ICP-OES elemental profiling and clinical ODI assessment in this study suggest that the mineral constituents of Komoothira Silasathu Chooranam may contribute significantly to its therapeutic action in lumbar spondylosis, supporting its use as a complementary treatment modality. The study confirms its safety and efficacy, encouraging further research to validate these findings and explore underlying mechanisms.

CONFLICTS OF INTEREST: NONE.

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