TO EVALUATE THE EFFICIENCY OF NANO-CURCUMIN ORAL ADMINISTRATION AS AN ADJUNCTIVE THERAPEUTIC APPROACH WITH SCALING AND ROOT PLANNING IN TREATMENT OF GINGIVITIS.

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Abstract:

Background: To evaluate the efficiency of nano-curcumin oral administration as an adjunctive therapeutic approach with scaling and root planning in the treatment of gingivitis.

Methods: A total of 24 patients diagnosed with established gingivitis were divided into two groups with Group-I (n=12) are treated with Scaling and root planning along with oral administration of nanocurcumin capsules (500mg) once daily for 3 weeks and Group-II (n=12) were treated with Scaling and root planning with placebo capsules. Plaque index (PI), gingival index (GI), and sulcus bleeding index (SBI) were recorded at baseline and 3 weeks.

Result: The mean score of PI, GI and SBI scores in Group I at baseline were 1.75 ± 0.30, 1.37 ± 0.38, and 2.06 ± 0.61. At 3 weeks the mean scores were reduced to 0.77 ± 0.22, 0.74 ± 0.28 and 0.98 ± 0.29 respectively. Similarly, the mean scores in Group II at baseline were 1.70 ± 0.32, 1.36 ± 0.43 and 1.91 ± 0.51, whereas at 3 weeks scores were reduced to 0.84 ± 0.81, 0.86 ± 0.33 and 1.13 ± 0.45. A statistically significant ($P<0.001$) reduction in PI, GI and SBI scores was observed in both the groups from baseline to 3 weeks. Intragroup comparison showed PI, GI and SBI scores were reduced at 3 weeks in Group II than Group I, which was not statistically significant.

Conclusion: The use of nanocurcumin capsules was efficient in treating gingivitis by reducing its inflammatory components. Good patient acceptance was observed in Group I patients with use of nanocurcumin as adjunctive therapy.

KEYWORDS: Gingivitis, Nanocurcumin, Scaling and Root planning

Introduction

Dental plaque is regarded as the principal etiological determinant in the pathogenesis of periodontal disease, leading to the progressive breakdown of the periodontal ligament apparatus and alveolar bone, ultimately culminating in periodontal pocket formation[1]

The bacterial plaque biofilm is primarily composed of key periodontal pathogens, notably Porphyromonas gingivalis, Tannerella forsythia, Treponema denticola, and Aggregatibacter actinomycetemcomitans.[2] The onset of periodontitis is triggered by dysbiosis in the microorganisms of the periodontal biofilm, to which the host will react through nonspecific and specific defense systems, generating a cascade of inflammatory reactions, in which oxidative stress also plays an important role in sustaining the disease.[3]

Scaling and root planning (SRP) remains the foundation of periodontal therapy, aimed at disrupting pathogenic biofilms.[4] Adjunctive agents such as chlorhexidine, triclosan, povidone-iodine, and phenolic compounds can enhance outcomes, but their long-term use may cause side effects like allergies, tooth discoloration, and altered taste.[5]

Herbal medicines have been used for centuries in developing countries, with more than 80% of the population depending on them for their healthcare needs. In dentistry, commonly used herbal products include turmeric, neem, aloe vera, clove, and cinnamon. Among these, turmeric has a long history of traditional use in treating skin, stomach, and liver disorders.[6,7]Owing to its antimicrobial, antioxidant, astringent, anti-mutagenic properties, and other beneficial properties, turmeric holds significant value in dentistry, particularly in the field of periodontics.[8]

CMN is a major component of turmeric, an ancient dietary spice. CMN is widely used in Ayurveda, Unani and Siddha medicine for cosmetic and medical preparations as well as in the treatment of various diseases. It is derived from the rhizome of Curcumin longa, belonging

to the ginger family, Zingiberaceae. CMN is extremely safe, and it has low toxicity in animals and humans even at high doses.[9]CMN inhibits LPS-induced NF-κB cytokine gene expression in gingival tissues at both mRNA and protein levels.[10] It also modulates periodontal disease by reducing alveolar bone loss through downregulation of the IL-17/IL-23 axis and (ROR)γt.[11]

Advances in nanotechnology offer solutions to conventional material limitations, as nano-form particles (10–1,000 nm) enhance solubility and bioavailability of lipophilic compounds, improving drug delivery effectiveness.[12] Various nanomaterials, including nanogels, liposomes, polymeric nanoparticles, niosomes, micelles, solid lipids, cyclodextrins, and silver-based systems, have been developed to enhance CMN delivery.[13]Compared to free CMN, these nano-formulations improve water solubility and antimicrobial activity, resulting in superior therapeutic outcomes.[14]

CMN exhibits antimicrobial effects by disrupting bacterial membranes, inhibiting DNA replication, reducing motility, and altering gene expression.[15]However, its oral absorption in conventional forms (powder, tablets, capsules) is very low due to its lipophilic nature. NanoCMN overcomes this limitation by encapsulating the compound in nanomicelles (~10 nm), which dissolve rapidly in the stomach, remain stable for hours, and facilitate efficient absorption through the intestinal epithelium, thereby enhancing bioavailability.[16] CMN is transferred to other tissues by the bloodstream after absorption in the intestine, can easily reach to the inflamed gingiva tissue.[17]

Considering the high prevalence of inflammatory diseases, the adverse effects associated with chemical mouthwashes, the inflammatory nature of gingivitis and periodontitis, and the established anti-inflammatory properties of curcumin, the present study was designed to evaluate the effects of nanoCMN capsules on gingival inflammation in patients with gingivitis.

Patients and Methods

Study Population

Subjects aged between 35 to 55 years reporting to the outpatient Department of Periodontics, SIBAR Institute of Dental Sciences, Guntur were observed. 24 patients irrespective of gender diagnosed with established gingivitis were selected. The study was approved by institutional ethical committee (Pr.136/IEC/SIBAR/2023). An informed consent was taken from the subjects who were willing to participate in the study

Sample Size Calculation

Sample size was calculated using G* power software version 3.1.9.2 with the following parameters:

Effect size – 0.81

alpha- error probability – 0.05

Power (1-β error) – 80% or 0.80.

Total sample size – 24

2 groups - in each group – 12

A total of 24 patients diagnosed with gingivitis, comprising both males and females, were randomly allocated into two groups: Group I (n=12) received SRP along with oral administration of nano-CMN, while Group II (n=12) received SRP with oral administration of placebo. The study design is illustrated in the flow chart (Figure 1).

Inclusion criteria:

1. Patients aged between 35 and 55 years

2. Apparently healthy individuals
3. Patients diagnosed with gingivitis
4. Presence of a minimum of 20 natural teeth

Exclusion criteria:

1. History of any form of periodontal treatment within the past 1 year
2. Habitual use of any form of tobacco
3. Pregnant or lactating women
4. Use of antibiotics and/or anti-inflammatory drugs within the last 3 months
5. Known allergy to any medication
6. Presence of parafunctional habits

Evaluation criteria: Data will be collected by recording. Plaque index (PI), Gingival index (GI), and Papillary bleeding index (PBI) from all the subjects.

1.Plaque Index according to Silness and Loe (1964):[6] Measured by examining soft debris and mineralised deposits on the teeth with the help of explorer. Four surfaces (Buccal, Lingual, Mesial and Distal) of each tooth will be given a score from 0-3, PI score was obtained by dividing the total score obtained by number of surfaces examined.

2. Gingival Index according to Loe and Silness (1963):[6] Each of the four gingival areas of the tooth (Buccal, Lingual, Mesial and Distal) was given a score from 0-3, GI score was obtained by dividing the total score obtained by number of surfaces examined.

3. Papillary Bleeding Index [7]: It was determined by moving a standardised periodontal probe within the sulcus towards the papilla. With respect to the extent of bleeding and the time it

takes to occur after provocation scoring was done. Criteria followed is 0= no bleeding within 30 seconds of probing, 1= bleeding within few seconds of probing, 2= immediate bleeding on probing and 3= bleeding along gingival sulcus on slight touch. PBI score was obtained by dividing the total score obtained by number of papillae examined.

Study Procedure

In this study, SRP was performed for all participants, which included the removal of supragingival and subgingival calculus, elimination of altered cementum, and smoothening of root surfaces using supragingival ultrasonic scalers and area-specific curettes (Hu-friedy, IL, USA). Following SRP, participants were randomly allocated into two groups: one group received nanomicelles curcumin soft gel capsules (Sina Curcumin, Herbal Farm Life Care Pvt. Ltd., Delhi, India) at a dosage of 500 mg once daily after breakfast for 3 weeks, while the other group was administered a placebo. Both the test and placebo capsules were identical in shape, size, and packaging. Standard oral hygiene instructions were provided to all participants, and follow-up was scheduled after 3 weeks.

Statistical analysis: Statistical analysis was performed using SPSS version 20 software (IBM SPSS statistics for Windows version 20, Armonk, NY, USA). Descriptive statistics, one-way analyses of variance with Tukey's post hoc tests and pearson's correlation tests were done to analyse the study data. 95% Confidence Interval has been computed to find the significant features. All statistical parameters performed using a statistical software package. Statistical significance was accepted at $p \leq 0.05$.

Results:

The present study was conducted to evaluate the effect of oral administration of Nano-CMN as an adjunct to scaling and root planing (SRP) in the management of gingivitis.

The mean age of the study population was 43.8 years, comprising 13 males and 11 females. In Group I, the mean age was 44.1 years with 7 males and 5 females, whereas in Group II the mean age was 43.5 years, with 6 males and 6 females (Table 1).

For Plaque Index (PI), the mean score in Group I decreased from 1.75 ± 0.30 at baseline to 0.77 ± 0.22 at 3 weeks, showing a statistically significant reduction ($p < 0.001$) (Table 1, Figure 2). In Group II, PI scores reduced from 1.70 ± 0.32 at baseline to 0.84 ± 0.18 at 3 weeks, also statistically significant ($p < 0.001$) (Table 2, Figure 3). However, intergroup comparison at baseline and at 3 weeks revealed no significant difference (Table 3, Figure 4).

For the Gingival Index (GI), Group I showed a reduction from 1.37 ± 0.38 at baseline to 0.74 ± 0.28 at 3 weeks (Table 1, Figure 2). In Group II, GI scores decreased from 1.36 ± 0.43 to 0.86 ± 0.33 at 3 weeks (Table 2, Figure 3). Both reductions were statistically significant ($p < 0.001$). Intergroup comparison, however, showed no significant difference (Table 3, Figure 4).

For the Papillary Bleeding Index (PBI), Group I scores declined from 2.06 ± 0.61 at baseline to 0.98 ± 0.29 at 3 weeks (Table 1, Figure 2). In Group II, PBI reduced from 1.91 ± 0.51 to 1.13 ± 0.45 at 3 weeks (Table 2, Figure 3). The intragroup changes were statistically significant ($p < 0.001$), but intergroup comparisons showed no significant differences (Table 3, Figure 4).

Discussion

Gingivitis, a prevalent form of periodontal disease in both children and adults, often precedes periodontitis. While gingivitis is reversible, periodontitis involves progressive destruction of tooth-supporting structures and its progression is unpredictable. Therefore, prevention and early management of gingivitis remain critical in reducing the risk of periodontitis.[8] Pathogenic biofilm initiates gingival inflammation, and in susceptible individuals, the host immune response, characterized by excessive release of cytokines such as interleukins (ILs) and tumour necrosis factor-α (TNF-α) drives periodontal tissue destruction.[9]

The present study investigated the adjunctive effect of nano-CMN capsules with scaling and root planing (SRP) in gingivitis patients. Mechanical plaque control remains the gold standard for gingivitis management, but chemotherapeutic agents can enhance treatment outcomes. In this study, nano-CMN capsules were used alongside SRP to reduce the severity of gingival inflammation rather than to completely prevent or resolve gingivitis, and outcomes were compared with placebo.

Curcumin (CMN) has demonstrated potential in treating inflammatory diseases, including periodontal disease. Its clinical application, however, has been limited by low bioavailability. Nanomedicine-based approaches have been developed to improve absorption, reduce toxicity, and enhance delivery across biological barriers.[10] Incorporating these strategies, the present study utilized nano-CMN capsules for systemic administration.

Placebo capsules were included in the study design, as gingivitis generally improves with SRP through effective plaque control. The results revealed that nano-CMN supplementation contributed to greater reductions in gingival inflammation and bleeding compared with placebo. These findings are consistent with earlier studies highlighting the anti-inflammatory and antioxidant properties of CMN.[11,12] Furthermore, similar to prior reports, no significant influence of age or gender on CMN efficacy was observed.[13] Both nano-CMN and placebo groups showed significant improvements in clinical parameters following SRP, underscoring the effectiveness of mechanical therapy, but the nano-CMN group exhibited greater reductions in Sulcus Bleeding Index (SBI), consistent with Farjana et al. This difference may be attributed to the type and formulation of CMN used. [14]

Studies by Anuradha et al. and Farjana et al. demonstrated anti-inflammatory effects of turmeric gel in chronic periodontitis, with significant reductions in plaque index, findings compatible with our results.[14,15] In contrast, Izui et al. reported no significant benefit with

topical CMN application.[16] Similarly, CMN mouthwashes have shown anti-inflammatory effects comparable to 0.2% chlorhexidine mouthwashes, though Gottumukkala et al. and Jalaluddin et al. reported superior outcomes with chlorhexidine.[17,18] These discrepancies may be due to lower dosages or the topical nature of CMN delivery. In the present study, nano-CMN capsules offered advantages in solubility, gastrointestinal absorption, and prolonged plasma half-life, allowing for greater systemic bioavailability than topical turmeric formulations.

No adverse effects, including pain, hypersensitivity, or ulceration, were reported, supporting the safety and tolerability of nano-CMN. Although high-dose studies have occasionally reported mild effects such as diarrhoea, rash, or stool discoloration, none were observed in this study.[19,20]

The primary limitation of this study was the evaluation of only clinical outcomes, without assessing underlying biological markers. Future research should investigate the therapeutic effects of nano-CMN on gingivitis and periodontitis by analyzing inflammatory mediators such as TNF-α and interleukins (IL). Considering that periodontitis is a biofilm-induced inflammatory disease, microbiological evaluation of the biofilm could also provide valuable insights. Another limitation was the relatively small sample size, as fewer participants were enrolled compared to previous studies. In addition, nano-CMN capsules were administered at a dose of 80 mg once daily for 3 weeks; therefore, long-term follow-up studies with extended treatment durations are recommended to better compare and validate the therapeutic effects. This study did not employ a split-mouth design to avoid the Hawthorne effect, which could influence both intervention and control sides. Nevertheless, the parallel group design may still be subject to allocation-related bias.

Conclusion:

Within the limits of this study, oral nano-CMN capsules containing Curcuma longa extract proved effective as an adjunct to scaling and root planing in managing gingivitis. Participants receiving nano-CMN showed significant reductions in plaque, gingival inflammation, and bleeding scores compared to placebo, with good patient acceptance. These findings suggest that nano-CMN, owing to its anti-inflammatory and antimicrobial properties, may serve as a promising complementary therapy for gingivitis and mild periodontitis.

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Tables

Table 1: Intra group comparison analysis of clinical parameters at baseline and 3 weeks after SRP in Group I

GROUPS	MEAN	N	SD	t value	p value
PI at baseline	1.7583	12	.30289		
PI at 3 weeks	.7733	12	.22334	16.1	0.000*
GI at baseline	1.3717	12	.38595		
GI at 3 weeks	.7408	12	.28956	9.79	0.000*
PBI at Baseline	2.0608	12	.61349		
PBI at 3 weeks	.9842	12	.29537	7.26	0.000*

*Paired t test, *p<0.05 is considered a statistical significant

Table 2: Intra group comparison analysis of clinical parameters at baseline and 3 weeks after SRP in Group II

GROUPS	MEAN	N	SD	t value	p value
PI at baseline	1.7008	12	.32870		
PI at 3 weeks	.8417	12	.18349	10.51	0.000*

GI at baseline	1.3608	12	.43711	8.56	0.000*
GI at 3 weeks	.868	12	.3358		
PBI at Baseline	1.9108	12	.51936	11.08	0.000*
PBI at 3 weeks	1.1300	12	.45611		

*Paired t test, *p<0.05 is considered a statistical significant

Table 3: Inter group comparison analysis of clinical parameters at 3 weeks after SRP among Group I and Group II

PARAMETERS	GROUPS	MEAN	N	SD	t value	p value
PI	Group I at 3 weeks	.7733	12	.22334	-0.81	0.422
	Group II at 3 weeks	.8417	12	.18349		
GI	Group I at 3 weeks	.7408	12	.28956	-0.99	0.333
	Group II at 3 weeks	.8675	12	.33581		
PBI	Group I at 3 weeks	.9842	12	.29537	-0.93	0.363
	Group II at 3 weeks	1.1300	12	.45611		

* Un Paired t test, *p<0.05 is considered a statistical significant

Figures

Figure 1: Study flow chart

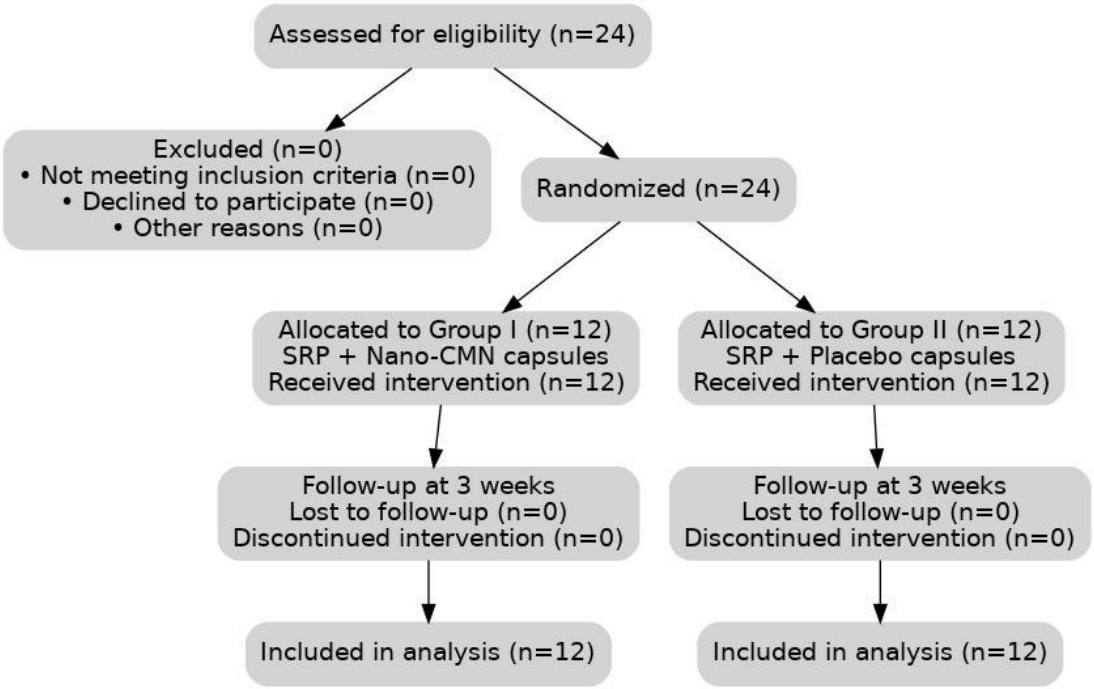

Figure 2: Intra group comparison of Group I

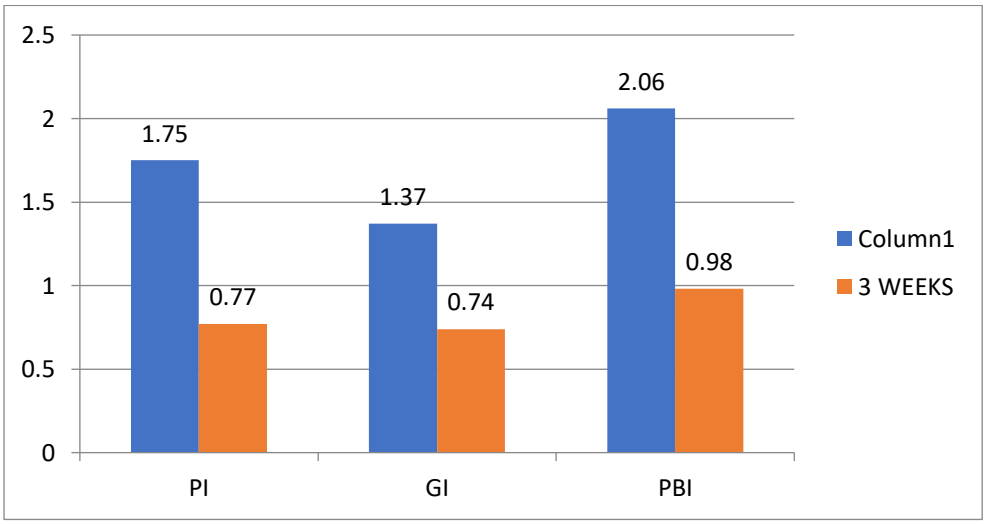

Figure 3: Intra group comparison of Group II

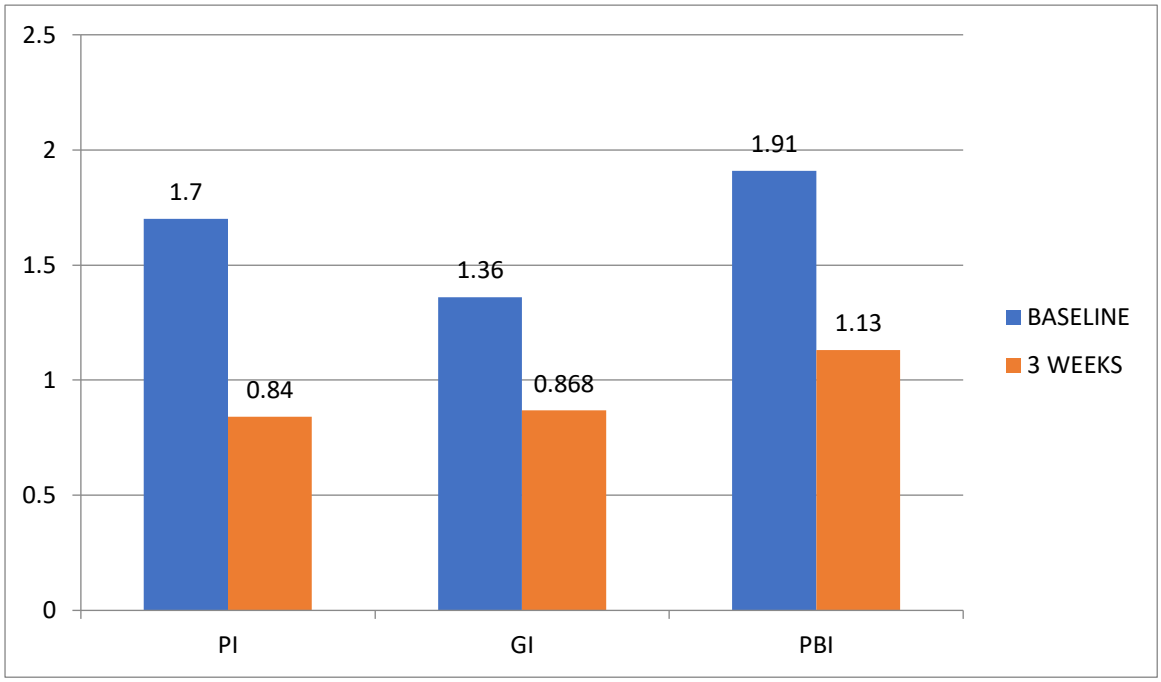

Figure 4: Inter group comparison of Group I and Group II