ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 10 | October - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ANTIMICROBIAL EFFICACY OF HERBAL AGENTS AGAINST E. FAECALIS IN COMPARISON TO SODIUM HYPOCHLORITE

Dentistry

Dr. Chandani Adwani (Bhatia)
Dr. Manoj G. Chandak
Dr. Aditya Singh Patel
Dr. Abhalasha Dass
Dr. Rahul Adwani

ABSTRACT

Aim: To evaluate antimicrobial efficacy of herbal agents against E faecalis to sodium hypochlorite **Objectives:** To evaluate the antimicrobial efficacy of NaOCL and different irrigating herbal agents (Neem, Green tea, Sunthi, Tulsi, Aleo vera, Turmeric, Miswak, Triphala, Propolis) against E. faecalis **Material And Methods:** CAZ (1:1:1) , CAZ (1:2:1) , CAZ (2:1:2), CAZ (1:1:2), NAOCL , NEEM, TRIPHALA, SUNTHI, GREEN TEA, MISWAK, ALEO VERA, TURMERIC **Result :** CAZ (1:1:1) > CAZ (1:2:1) > CAZ (2:1:2)> CAZ (1:1:2)> NAOCL > NEEM> TRIPHALA> SUNTHI> GREEN TEA> MISWAK> ALEO VERA> TURMERIC.

KEYWORDS

Cissampelos pareira, Acorus calamus, Zanthoxylum alatum (CAZ), NAOCL , NEEM, TRIPHALA, SUNTHI, GREEN TEA, MISWAK, ALEO VERA, TURMERIC, antimicrobial.

INTRODUCTION

Herbal medicines are the upcoming modalities in dental procedure. In modern days herbal medicaments when used in the form toothpastes and mouthwashes help to reduce the accumulation of plaque reducing the microflora and overall improves the immune response of oral health.

Herbal substitutes are readily and affordably accessible. It has a long storage life and is not toxic.

Herbs that is Cissampelos pareira, Acorus calamus, Zanthoxylum alatum, AzadirectaindicaA.juss (neem), Camellia sinensis (green tea), Triphala, Zingiberofficinalis Rose (sunthi) had been tested as irrigating solution. They have exhibited antimicrobial property.

The study was in vitro experimental study. An approval was obtained from Institutional Ethical Committee DMIMS.

Aim

To evaluate antimicrobial efficacy of herbal agents against E faecalis to sodium hypochlorite

Objectives

1) To evaluate the antimicrobial efficacy of NaOCL and different irrigating herbal agents (Neem, Green tea, Sunthi, Tulsi, Aleo vera, Turmeric, Miswak, Triphala, Propolis) against E. faecalis.

II] Materials used for Preparation of herbal irrigants:

1)Cissampelospariera, Acorus calamus, Zanthoxylum alatum (1:1:1)
2) Cissampelospariera, Acorus calamus, Zanthoxylum alatum (1:2:1)
3) Cissampelospariera, Acorus calamus, Zanthoxylum alatum (2:1:2)
4) Cissampelospariera, Acorus calamus, Zanthoxylum alatum (1:1:2)
5) NAOCL
6) NEEM
7) TRIPHALA
8) SUNTHI
9) GREEN TEA
10) MISWAK
11) ALEO VERA
12) TURMERIC
13) TULSI
14) PROPOLIS

Properties of New herbal solution

Sr. No.	Herb Name	Scientific Name	Composition	Advantages
1.	Patha	Cissampelous pariera Family : Menispermaceae	isoquinoline are major constituents of C. pareira. Flavanoid, bisbenzylisoquinoline, benzylisoquinoline, tropoloisoquinoline, aporphine, azafluoranthene	The herb is as a medicament for cardiovascular diseases, dysentery and sores, rheumatism, ulcers and fevers, ulcer, wound, rheumatism, fever, asthma, cholera, diarrhoea, inflammation, snakebite, malaria, rabies, and also recommended for blood purification. C. pareira is also used to kill bacteria. The methanol root extract of Cissampelos pareira had a broad spectrum inhibitory activity against both bacteria that is gram positive and gram negative including K. Pneumonia, S. aureus, and E. coli.
2.	Acorus calamus	Acorus calamus (healing plant Family : Araceae	Flavanoid, A- and B-asarones, which are thought to be responsible for their antimicrobial activities. Methyl eugenol ether	Shows antibacterial, antifungal, antiyeast, insecticides and herbicides. It had no antibacterial activity except E.coli.
3.	Timur or Tejohawa	Zanthoxylum alatum Family: Rutaceae	The chief content of oil is beta-linalool,alpha-limonene, diepoxide, alpha- pinene, D- limonene spilanthol.	Small twigs of the plant are chewed and used as tooth stick for cleaning teeth. It is rated quite high for this purpose as it create a characteristic tingling sensation in the mouth and also activated the salivary glands. Also used in cough, asthma, difficult breathing,

				and rheumatism
4.	Sarjikshar	Impure Carbonate of Soda (Kshara)	Salt composed of sodium and bicarbonate ions.	• Reduces cariogenicity of these bacteria. Sodium bicarbonate also has bactericidal properties against bacterial cariogenic pathogens. Bicarbonates used in chewing gums as well as it enhances salivary flow to flush out food debris.
5.	Yavakshar	Impure Carbonate of potash (Kshara)	Salt composed of postassium and carbonate.	• It is an inorganic compound. Salts of tartar or pearl ash are more refined forms of potash, which is principally potassium carbonate. It has antibacterial activity of oils, free fatty acids, potassium salt and fatty acid methyl esters.
6.	Madhu	Honey	High concentration of sugar, Flavonoids and Aromatic acids, High Hydrogen peroxide,sugar.	• Natural honey is safe for the tissue. It is sterile in nature. Also, it has antibacterial, antiseptic and hygroscopic properties. • It provide relief from pain and smoothing effect on skin when it applied topically. There is an active enzyme in honey that remains active in the absence of saliva but is inactivated by salivary enzymes, which support s its effect on root canal dentine.

Preparation of Materials

1) Drugs were procured from Mahatma Gandhi Ayurvedic College and Hospital and Research Institute, Salod, Wardha (MGACHRC). All the drugs were authenticated from Department of Rasshstra and Bhaishajya Kalpana from Mahatma Gandhi Ayurved College, Hospital and Research Centre, Salod (Hirapur), Wardha.
2) Approved with a licence number NG/AYU/002/14 by Dattatrya Ayurveda Rasashala.

Culturing Method

Test microorganism

E-faecalis, the microbial strains that are used for the study. These strains were acquired from Microbiology Department (JNMC Wardha, Maharashtra).

Agar Medium

Media which were used are Brain heart infusion broth, Nutrient Broth, Mullerhinton, blood agar and Sabouraud's dextrose agar. For E-faecalis Blood agar was used as enriched media and Brain heart infusion broth for cultivation.

Agar Diffusion Assay

To determine antimicrobial activity of herbal irrigatin Agar well diffusion method was used. In this method Colonies of '**E faecalis'** was inoculated in nutrient broth overnight. All testing materials were placed in Petri dishes each with fast filer paper dip in it section. Freshly prepared herbal irrigants was placed in petri dishes than fast filter paper were keep on muller Hilton agar plate and incubation done than zone of inhibition was calculated (in specific culture media) for 24 hours.

Stastical Analysis

The data and the presence of F-values and P-values, it looks like an ANOVA (Analysis of Variance) test was applied to the first group (CAZ (1:1:1)).

ANOVA is used to determine if there are any statistically significant differences between the means of three or more independent groups. Here's why ANOVA might be used in this context:

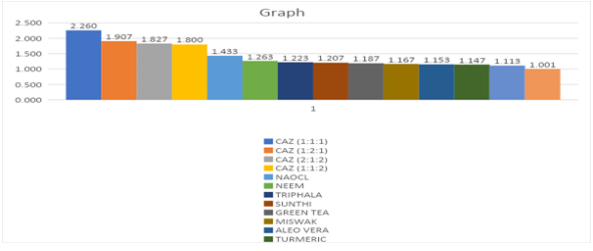
1. **Multiple Groups**: You have multiple groups (different treatments or conditions) and you want to compare their means.
2. **Variance Comparison**: ANOVA compares the variance between groups to the variance within groups to determine if the observed differences in means are statistically significant.

Why ANOVA Was Applied:

1. **Comparing Means Across Groups:** You likely want to assess if there are significant differences between the means of different groups or treatments.
2. **Statistical Significance:** ANOVA helps determine if the differences observed in the sample means are due to the treatment effect or just random chance.

Interpreting the Results:

- **F-value**: Represents the ratio of variance between groups to the variance within groups. A higher F-value indicates a greater likelihood that the group means are different.
- **P-value**: Indicates the probability of observing the data (or something more extreme) if the null hypothesis (that all group means are equal) is true. A P-value less than 0.05 typically suggests that at least one group mean is significantly different from the others.



The CAZ (1:1:1) group, the P-value is less than 0.01, indicating that the differences between this group and others are statistically significant.

Graph 1 - Antimicrobial efficacy of different herbal root canal irrigant against E faecalis.

Group	N	Minimum	Maximum	Mean	Std. Deviation	F-value	P-value
CAZ (1:1:1)	25	1.90	2.50	2.2040	.18592	167.33	<0.01
CAZ (1:2:1)	25	1.50	2.70	1.9240	.38974		
CAZ (2:1:2)	25	1.80	2.80	1.8720	.20108		
CAZ (1:1:2)	25	1.40	2.80	1.8480	.25351		
NAOCL	25	1.20	2.70	1.5920	.31480		
NEEM	25	.75	2.45	1.3140	.34747		
TRIPHALA	25	1.05	2.45	1.3060	.24678		
SUNTHI	25	.90	2.40	1.2892	.28314		
GREEN TEA	25	.70	1.90	1.2600	.27386		
MISWAK	25	1.00	1.40	1.1600	.14142		
ALEO VERA	25	.80	1.80	1.1560	.20224		
TURMERIC	25	.80	1.40	1.1520	.14468		
TULSI	25	.90	1.40	1.1200	.16583		
PROPOLIS	25	.70	1.40	1.0040	.14283		

Table of statistical data related to different groups or treatments, possibly from an experiment. The columns include the group name, number of samples (N), minimum and maximum values, mean, standard deviation, F-value, and P-value.

Here's a brief overview of what each term indicates:

- **Group**: The treatment or condition being tested.
- **N**: Number of samples in each group.
- **Minimum**: The lowest value recorded in that group.
- **Maximum**: The highest value recorded in that group.
- **Mean**: The average value of the measurements in that group.
- **Std. Deviation**: A measure of the variation or dispersion of the data.
- **F-value**: A ratio used in ANOVA to determine if there are significant differences between group means.
- **P-value**: Indicates the probability that the observed differences are due to chance; a value less than 0.05 typically indicates statistical significance.

The F-value and P-value are only provided for the first group (CAZ (1:1:1)), suggesting that statistical significance has been tested for this group, but not for the others. If you need to perform ANOVA or another statistical test for the remaining groups, you would calculate the F-value and P-value based on the variance between and within groups

Antimicrobial efficacy of different herbal root canal irrigant against E faecalis The "CAZ (1:1:1)" group had a minimum value of 1.90, a maximum of 2.50, a mean of 2.2600, and a standard deviation of 0.15946. In the "CAZ (1:2:1)" group, the minimum was 1.50, the maximum was 2.60, the mean was 1.9067, and the standard deviation was 0.33693. For the "CAZ (2:1:2)" group, the minimum value was 1.80, the maximum was 1.91, the mean was 1.8273, and the standard deviation was 0.04698.

The "CAZ (1:1:2)" group showed a minimum value of 1.50, a maximum of 2.10, a mean of 1.8000, and a standard deviation of 0.13628. In the "NAOCL" group, the minimum was 1.20, the maximum was 1.60, with a mean of 1.4333 and a standard deviation of 0.13973.

For the "NEEM" group, the minimum value was 1.15, the maximum was 1.35, the mean was 1.2633, and the standard deviation was 0.05164. The "TRIPHALA" group had a minimum of 1.10, a maximum of 1.35, a mean of 1.2233, and a standard deviation of 0.09232. The "SUNTHI" group showed a minimum of 1.00, a maximum of 1.30, a mean of 1.2067, and a standard deviation of 0.07988.

In the "GREEN TEA" group, the minimum was 1.00, the maximum was 1.70, with a mean of 1.1867 and a standard deviation of 0.20307. The "MISWAK" group had a minimum of 1.00, a maximum of 1.40, a mean of 1.1667, and a standard deviation of 0.14475.

The "ALEO VERA" group showed a minimum value of 1.00, a maximum of 1.60, a mean of 1.1533, and a standard deviation of 0.16417. For the "TURMERIC" group, the minimum value was 1.00, the maximum was 1.40, with a mean of 1.1467 and a standard deviation of 0.11872. The "TULSI" group had a minimum of 0.80, a maximum of 1.30, a mean of 1.1133, and a standard deviation of 0.17265.

Lastly, in the "PROPOLIS" group, the minimum value was 0.70, the maximum was 1.12, with a mean of 1.0013 and a standard deviation of 0.12082. Results shows highly significant value with F-value 167.4 & Pvalue ,0.01.

Pair comparison	Post -hoc test HSD test
CAZ (1:1:1) vs CAZ (1:2:1)	**<0.01**
CAZ (1:1:1) vs CAZ (2:1:2)	**<0.01**
CAZ (1:1:1) vs CAZ (1:1:2)	**<0.01**
CAZ (1:1:1) vs NAOCL	**<0.01**
CAZ (1:1:1) vs NEEM	**<0.01**
CAZ (1:1:1) vs TRIPHALA	**<0.01**
CAZ (1:1:1) vs SUNTHI	**<0.01**
CAZ (1:1:1) vs GREEN TEA	**<0.01**
CAZ (1:1:1) vs MISWAK	**<0.01**
CAZ (1:1:1) vs ALEO VERA	**<0.01**
CAZ (1:1:1) vs TURMERIC	**<0.01**
CAZ (1:1:1) vs TULSI	**<0.01**
CAZ (1:1:1) vs PROPOLIS	**<0.01**

Descriptive statistics for Antimicrobial efficacy of different herbal root canal irrigant against E. Faecalis.

Antimicrobial efficacy of different herbal root canal irrigant with sodium hypochlorite against E faecalis were observed. For all the herbal medicaments were selected. They are Acous calamus, Zanthoxylum alatum, Cissampelos pareira, Neem, Triphala, Sunthi, Green Tea, Miswak, Aleo vera, Turmeric, Tulsi and Propolis. These medicaments were tested against E. Faecalis.

DISCUSSION

Acorus calamus, Zanthoxylum alatum, Cissampelos pareira, Neem, Triphala, Sunthi, Green Tea, Miswak, Aleo vera, Turmeric, Tulsi and Propolis were selected for the study. These were tested in pure form for evaluating t he efficacy against E.faecalis.

The significant results were found to be with Acorus calamus, Zanthoxylum alatum, Cissampelos pareira, Neem, Triphala, Sunthi and Green tea and Non-significant results were found with Miswak, Aloe Vera, Turmeric, Tulsi and Propolis. Studies done on Aloe Vera by Sahebi S et al concluded that, the efficacy of aloe vera is same as that of normal saline with effective against E. faecalis biofilm. The aloe vera latex contains anthraquinone which is associated cytotoxicity, genotoxicity and carcinogenicity in humans. According to research on turmeric conducted by Prabhakar J et al, the antimicrobial activity of turmeric gradually declines over the course of 3 - 7 days. This result is a result of the dentin's capacity to buffer the curcumin's activity. Studies done on Miswak by Gazi M et al stated that Miswak decreases phosphate and Ph, saturation of the saliva with calcium; promotes demineralization of tooth enamel. Studies done on Tulsi by Chaurasia A et al concluded that Tulsi in its composition contains eugenol and essential oils. Our study already contains Eugenol so Tulsi was excluded from our study. Studies done on Propolis by Ahangari Z et al concluded that the use of propolis in root canal can change the colour of the clinical tooth crown. Resin is one of the active ingredients of miswak that will result in monoblock formation which is difficult for re-treatment.

Inference

Acorus calamus, Zanthoxylum alatum, Cissampelos pareira, Neem, Triphala, Sunthi, Green Tea, Miswak, Aloe vera, Turmeric, Tulsi and Propolis were evaluated for antimicrobial efficacy. They were evaluated through antimicrobial testing. These herbal medicaments were selected based on there antimicrobial properties. When evaluated Acorus calamus, Zanthoxylum alatum, Cissampelos pareira, Neem, Triphala, Sunthi, Green Tea showed statistically significant results with E. Faecalis. Whereas, Miswak, Aloe vera, Turmeric, Tulsi and Propolis showed

Statistically non-significant results. Medicaments which showed statistically non-significant results were excluded from the study. All drugs had comparatively better antimicrobial property. Therefore, these drugs were selected. The antimicrobial efficacy of different herbal root canal irrigant agints E.faecalis rank as, the superior most is in combination of CAZ (1:1:1) > CAZ (1:2:1) > CAZ (2:1:2)> CAZ (1:1:2)> NAOCL > NEEM> TRIPHALA> SUNTHI> GREEN TEA> MISWAK> ALEO VERA> TURMERIC.

REFERENCES

1. Gupta-Wadhwa A, Wadhwa J, Duhan J. Comparative evaluation of antimicrobial efficacy of three herbal irrigants in reducing intracanal E. faecalis populations: An in vitro study. J Clin Exp Dent. 2016 Jul;8(3):e230-235.
2. Rahimi S, Janani M, Lotfi M, Shahi S, Aghbali A, Vahid Pakdel M, et al. A review of antibacterial agents in endodontic treatment. Iran Endod J. 2014;9(3):161–8.
3. Violich DR, Chandler NP. The smear layer in endodontics - a review. Int Endod J. 2010 Jan;43(1):2–15.
4. Machado R, Garcia L da FR, da Silva Neto UX, Cruz Filho A de M da, Silva RG, Vansan LP. Evaluation of 17% EDTA and 10% citric acid in smear layer removal and tubular dentin sealer penetration. Microsc Res Tech. 2018 Mar;81(3):275–82.
5. Subramaniam P, Girish Babu KL, Tabrez TA. Effectiveness of Rotary Endodontic Instruments on Smear Layer Removal in Root Canals of Primary Teeth: A Scanning Electron Microscopy Study. J Clin Pediatr Dent. 2016;40(2):141–6.
6. Sisodia R, Ravi KS, Shashikiran ND, Singla S, Kulkarni V. Bacterial penetration along different root canal fillings in the presence or absence of smear layer in primary teeth. J Clin Pediatr Dent. 2014;38(3):229–34.
7. Rita WS, Swantara IMD, Utami GAP. Antimicrobial activity of Acorus calamus L. rhizome extract and its total flavonoid and phenolic contents. 2019;020054.
8. Dutta A, Kundabala M. Antimicrobial efficacy of endodontic irrigants from Azadirachta indica: An in vitro study. Acta Odontol Scand. 2013 Nov;71(6):1594–8.
9. Gupta A, Duhan J, Tewari S, Sangwan P, Yadav A, Singh G, et al. Comparative evaluation of antimicrobial efficacy of Syzygium aromaticum, Ocimum sanctum and Cinnamomum zeylanicum plant extracts against Enterococcus faecalis: a preliminary study. Int Endod J. 2013 Aug;46(8):775–83.
10. Bolhari B, Sharifian MR, Aminsobhani M, Monsef Esfehani HR, Tavakolian P. Assessing the efficacy of citrus aurantifolia extract on smear layer removal with scanning electron microscope. Iran Endod J. 2012;7(2):88–97.
11. Devi S, Ganjewala D. Antimicrobial activity of Acorus calamus (L.) rhizome and leaf extract. In 2009 [cited 2024 Sep 15]. Available from: https://www.semanticscholar.org/paper/Antimicrobial-activity-of-Acorus-calamus-(L.)-and-Devi-Ganjewala/8e87834d3da5fe9cad12f627a16228a173cde31f
12. Mehrotra S, Mishra KP, Maurya R, Srimal RC, Yadav VS, Pandey R, et al. Anticellular and immunosuppressive properties of ethanolic extract of Acorus calamus rhizome. Int Immunopharmacol. 2003 Jan;3(1):53–61.
13. Prakash B, Singh P, Mishra PK, Dubey NK. Safety assessment of Zanthoxylum alatum Roxb. essential oil, its antifungal, antiaflatoxin, antioxidant activity and efficacy as antimicrobial in preservation of Piper nigrum L. fruits. Int J Food Microbiol. 2012 Feb 1;153(1–2):183–91.
14. Kumar M, Prakash S, Radha null, Kumari N, Pundir A, Punia S, et al. Beneficial Role of Antioxidant Secondary Metabolites from Medicinal Plants in Maintaining Oral Health. Antioxidants (Basel). 2021 Jun 30;10(7):1061.
15. Ngoci N. Screening for Antimicrobial Activity of Cissampelos pareira L. Methanol Root Extract. EJMP. 2014 Jan 10;4(1):45–51.
16. Njeru S. Screening for Antimicrobial Activity of Cissampelos pareira L. Methanol Root Extract. European Journal of Medicinal Plants. 2014 Jan 10;4:45–51.
17. Kumari S, Anmol null, Bhatt V, Suresh PS, Sharma U. Cissampelos pareira L.: A review of its traditional uses, phytochemistry, and pharmacology. J Ethnopharmacol. 2021 Jun 28;274:113850.

18. Samanta J, Bhattacharya S, Rayat R. Phytochemical investigation and pharmacognostic standardization of Cissampelos pareira root. Anc Sci Life. 2012;31(4):181–4.
19. Martinotti S, Ranzato E. Honey, Wound Repair and Regenerative Medicine. J Funct Biomater. 2018 May 8;9(2):34.
20. Sundaram D, Narayanan RK, Vadakkepurayil K. A Comparative Evaluation on Antimicrobial Effect of Honey, Neem Leaf Extract and Sodium Hypochlorite as Intracanal Irrigant: An Ex-Vivo Study. J Clin Diagn Res. 2016 Aug;10(8):ZC88-91.
21. Mandal MD, Mandal S. Honey: its medicinal property and antibacterial activity. Asian Pac J Trop Biomed. 2011 Apr;1(2):154–60.
22. Israili ZH. Antimicrobial properties of honey. Am J Ther. 2014;21(4):304–23.
23. Sutrisno S, Hidayah SW, Sukarianingsih D, Rachman IB, Retnosari R. Antibacterial activity of peanut oil (Arachis hypogaea Linn) and its derivatives (K-soap, FFAs, and FAMEs) against Staphylococcus aureus and Escherichia coli. In Malang, Indonesia; 2021 [cited 2024 Sep 15]. p. 030040. Available from: https://pubs.aip.org/aip/acp/article/636979
24. Smith VJ, Desbois AP, Dyrynda EA. Conventional and unconventional antimicrobials from fish, marine invertebrates and micro-algae. Mar Drugs. 2010 Apr 14;8(4):1213–62.
25. Farha MA, French S, Stokes JM, Brown ED. Bicarbonate Alters Bacterial Susceptibility to Antibiotics by Targeting the Proton Motive Force. ACS Infect Dis. 2018 Mar 9;4(3):382–90.
26. Jaju S, Jaju PP. Newer Root Canal Irrigants in Horizon: A Review. Int J Dent. 2011;2011:851359.
27. Dioguardi M, Di Gioia G, Illuzzi G, Laneve E, Cocco A, Troiano G. Endodontic irrigants: Different methods to improve efficacy and related problems. Eur J Dent. 2018;12(3):459–66.
28. Ghogre P. Endodontic Mycology: A New Perspective of Root Canal Infection. Research & Reviews: Journal of Dental Sciences [Internet]. 2014 Dec 26 [cited 2024 Sep 15]; Available from: https://www.semanticscholar.org/paper/Endodontic-Mycology%3A-A-New-Perspective-of-Root-Ghogre/b39b69ab9e4fbac74b5af32f8ca11eb187cd694d
29. Van Tyne D, Martin MJ, Gilmore MS. Structure, function, and biology of the Enterococcus faecalis cytolysin. Toxins (Basel). 2013 Apr 29;5(5):895–911.
30. Hoffmann D. Medical herbalism : the science and practice of herbal medicine [Internet]. Rochester, Vermont : Healing Arts Press; 2003 [cited 2024 Sep 15]. 682 p. Available from: http://archive.org/details/medicalherbalism0000hoff
31. Signoretto C, del Mar Lleò M, Tafi MC, Canepari P. Cell Wall Chemical Composition of Enterococcus faecalis in the Viable but Nonculturable State. Appl Environ Microbiol. 2000 May;66(5):1953–9.
32. Karkare SR, Ahire NP, Khedkar SU. Comparative evaluation of antimicrobial activity of hydroalcoholic extract of Aloe vera, garlic, and 5% sodium hypochlorite as root canal irrigants against Enterococcus faecalis: An in vitro study. J Indian Soc Pedod Prev Dent. 2015;33(4):274–8.
33. Sharma V, Sharma R, Gautam DS, Kuca K, Nepovimova E, Martins N. Role of Vacha (Acorus calamus Linn.) in Neurological and Metabolic Disorders: Evidence from Ethnopharmacology, Phytochemistry, Pharmacology and Clinical Study. J Clin Med. 2020 Apr 19;9(4):1176.
34. Antioxidant and Antimicrobial Properties of the Essential Oil and Extracts of Zanthoxylum alatum Grown in North Western Himalaya - Guleria - 2013 - The Scientific World Journal - Wiley Online Library [Internet]. [cited 2024 Sep 15]. Available from: https://onlinelibrary.wiley.com/doi/10.1155/2013/790580
35. Choudhury Barua C, Buragohain L, Rahman F, Elancheran R, Rizavi H. Zanthoxylum Alatum Attenuates Chronic Restraint Stress Adverse Behavioral Effects Via the Mitigation of Oxidative Stress and Modulating the Expression of Genes Involved in Endoplasmic Reticulum Stress in Mice. Basic Clin Neurosci. 2022;13(5):647–60.
36. Lakshmi T, Krishnan V, Rajendran R, Madhusudhanan N. Azadirachta indica: A herbal panacea in dentistry - An update. Pharmacogn Rev. 2015;9(17):41–4.
37. Prakash S, Shelke AU. Role of Triphala in dentistry. J Indian Soc Periodontol. 2014 Mar;18(2):132–5.
38. Archana S, Abraham J. Comparative analysis of antimicrobial activity of leaf extracts from fresh green tea, commercial green tea and black tea on pathogens. In 2011 [cited 2024 Sep 15]. Available from: https://www.semanticscholar.org/paper/Comparative-analysis-of-antimicrobial-activity-of-Archana-Abraham/8a83fa3cd79092e69f04e1b7199df55d187dccc9
39. (PDF) Chemical Composition and Antimicrobial Activity of the Crude Extracts Isolated from Zingiber Officinale by Different Solvents [Internet]. [cited 2024 Sep 15]. Available from: https://www.researchgate.net/publication/283347401_Chemical_Composition_and_Antimicrobial_Activity_of_the_Crude_Extracts_Isolated_from_Zingiber_Officinale_by_Different_Solvents
40. Nair V, Das S, Kar M, Das K. Journal of Disease And Global Health TRIPHALA IN DENTISTRY-A HERBAL WONDER. 2016 Apr 4;7:164–8.
41. Deswal H, Singh Y, Grover H, Bhardwaj A. Curative Effect of Triphala in Medical and Dental Sciences : A Scientific Review. In 2016 [cited 2024 Sep 15]. Available from: https://www.semanticscholar.org/paper/Curative-Effect-of-Triphala-in-Medical-and-Dental-%3A-Deswal-Singh/69a581d7243c4fa0d52502bbc6740ccb5a317673
42. Bhavikatti SK, Dhamija R, Prabhuji M. TRIPHALA: ENVISIONING ITS ROLE IN DENTISTRY. In: International Research Journal of Pharmacy [Internet]. 2015 [cited 2024 Sep 15]. p. 309–13. Available from: http://www.irjponline.com/admin/php/uploads/2350_pdf.pdf