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RESEARCH ARTICLE

COMPARATIVE EVALUATION OF ANTIMICROBIAL POTENTIAL OF GINGER, GARLIC AND CINNAMON EXTRACTS AGAINST STREPTOCOCCUS MUTANS AND LACTOBACILLUS ACIDOPHILUS.

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Key words:-

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Abstract

Aim and Objective: To evaluate the antibacterial potential of herbs and spices extracts in efficiently reducing cariogenic pathogens in oral cavity, thereby incorporating them into various dentifrices and topical preparations which are safe, economical, free from side effects and could act as the new source of antimicrobial agents.

Methods: Ethanolic extracts (10% each) of ginger, garlic and cinnamon were prepared and subjected to microbiological assay along with 0.2% chlorhexidine gluconate (CHX), to determine its zone of inhibition at volumes of 10 µl, 20 µl, and 30µl each using Agar disk diffusion test against Streptococcus mutans (S.mutans) and Lactobacillus acidophilus (L.acidophilus). One-way ANOVA test and Post hoc test were used to compare the antibacterial potential of herbs and spices extracts in efficiently reducing cariogenic pathogens in oral cavity by incorporating them into various dentifrices using SPSS software version 14. The significance level for all the statistical tests utilized in this study was set at $p < 0.05$ %.

Results: There was a significant correlation between the control and experimental groups. The highest antimicrobial efficacy was observed in positive control group and by 10% ethanolic Cinnamon extract in comparison to 10% ethanolic extracts of Ginger and Garlic.

Conclusion: The plant extracts such as Cinnamon extracts in 10% concentration could be used as an alternative antibacterial compound for effective reduction of cariogenic pathogens in oral cavity.

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Introduction:-

Dental caries is one of the most common infections of all oral diseases. Cariogenic micro-organisms, especially *S.mutans* plays an essential role in the pathogenesis of dental caries. Other microbes such as *Lactobacillus* species are also associated with dental caries by fermenting sugars into lactic acid and grow readily at low pH values. Among the chemotherapeutic agents, CHX is the “gold-standard” but has side effects like brown discoloration of the teeth, oral mucosal erosion, dryness, burning sensation and undesirable taste.¹ Thus there is a need for an alternative, safe, efficacious and cost effective treatment options and biologic products for oral diseases.

Natural products such as herbs and spices have been used since ancient times as antimicrobial agents that have fewer side effects, better patient tolerance, cost effective and readily available.^{2,3} Some common herbs such as cilantro, basil, ginger, turmeric, garlic, cinnamon etc., offer great health benefits by virtue of their powerful phytochemical and antioxidant properties.⁴

Thus, the aim of this study was to comparatively evaluate the antimicrobial potential of 10% ginger, 10% garlic and 10% cinnamon extract against *S.mutans* and *L.acidophilus*. To the best of our knowledge no study has been carried out to compare the antimicrobial potential of ginger, garlic and cinnamon extract against *S.mutans* and *L.acidophilus*.

Methods:-

The study was carried out in four steps:-

Phytochemical Standardization:-

According to the WHO guidelines⁵ the phytochemical standardization of the herbal drugs were performed by the Department of Pharmaceuticals, Rajiv Academy for Pharmacy, Mathura (U.P)

Preparation of Ethanolic Extracts:-

Fresh ginger, garlic and cinnamon (500 grams each) was procured from the local market and cleaned using distilled water, minced into fine pieces and suspended in sterile jars containing 1000ml of 70% ethanol each. They were subjected to the process of cold maceration for 48 hours in a sterile jar after which the process of filtration using sterile muslin cloth was done. The filtrates obtained were placed over steam bath apparatus for 5 days to facilitate evaporation of ethanol content. After 5 days, 25g of ginger, 25g of cinnamon and 28g of garlic extracts were obtained.

Preparation of 10% Ethanolic Extracts:-

For the preparation of 10% stock solution of ethanolic extracts, 10 grams of obtained extracts were dissolved in 100ml of dimethyl sulfoxide to obtain 10% ethanolic extracts of ginger, garlic and cinnamon respectively.

Determination of Zone of Inhibition:-

The stock solution of 10% ethanolic extracts prepared were subjected to agar disk diffusion test along with a positive control (0.2% CHX) at volumes of 10 μ l, 20 μ l and 30 μ l each to determine the zone of inhibition against *S.mutans* and *L. acidophilus* respectively. Interpretation of diffusion results were carried out by the presence or absence of zone of inhibition. The standard strains of microorganisms used in this study were: *S.mutans* (Microbial Type Culture Collection-MTCC NO. 890) and *L. acidophilus* (MTCC NO. 10307, Chandigarh, India).

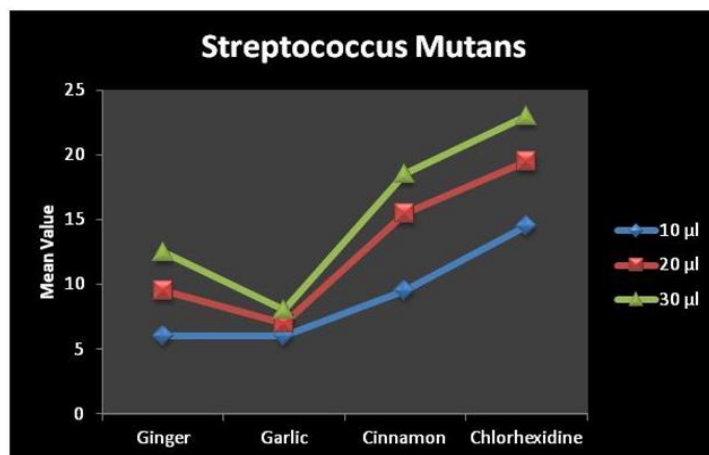
Statistical Analysis:-

One-way ANOVA test and Post hoc test were used to compare the antibacterial potential of herbs and spices extracts in efficiently reducing cariogenic pathogens in oral cavity by incorporating them into various dentifrices using SPSS software version 14. The significance level for all the statistical tests utilized in this study was set at $p < 0.05$ %.

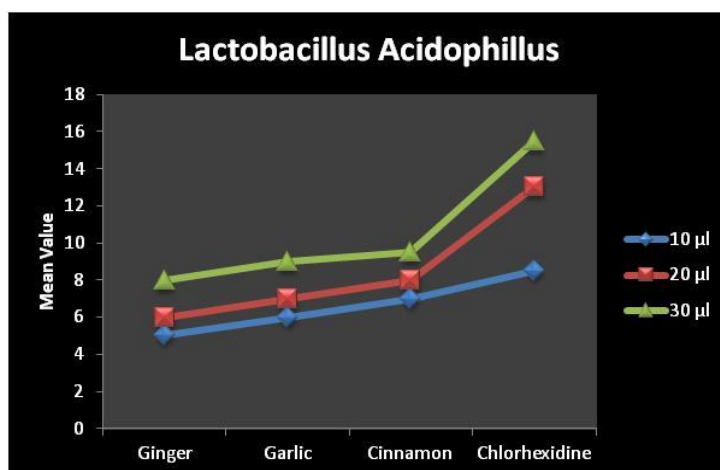
Result:-

Line diagram 1 showed the comparison of mean zone of inhibition values of 10% ethanolic extracts of ginger, garlic, cinnamon and 0.2% CHX at 10 μ l, 20 μ l, and 30 μ l volume measured against *S.mutans*. The highest zone of inhibition was seen in 0.2% CHX followed by 10% ethanolic extracts of cinnamon and lowest by garlic extracts. Also, the zone of inhibition increased when the volumes of the extracts increased.

Line diagram 2 showed the comparison of mean of zone of inhibition values of 10% ethanolic extracts of ginger, garlic, cinnamon and 0.2% CHX at 10 μ l, 20 μ l and 30 μ l volume measured against *Lactobacillus acidophilus*. The highest zone of inhibition was seen in 0.2% CHX followed by 10% ethanolic extracts of cinnamon, and lowest by ginger extracts. An increase in inhibition zone was observed as the volumes of extracts increased.



Line Diagram 1:- Shows the comparison of mean values of disk diffusion test against *S.mutans*.



Line Diagram 2:- Shows the comparison of mean values of disk diffusion test against *L.acidophilus*.

Discussion:-

Initiation of dental caries and the microbial composition of plaque involves *S. mutans* or *Lactobacilli*. A prevalence of 87.4% and 36.7% were recorded for *S.mutans* and *L.acidophilus* for dental caries⁶ hence, these bacterial isolates were selected for this research work. Currently, CHX is the most potent chemotherapeutic agent against dental caries but due to its various side effects, it discourages patient to use as a mouth wash.⁷ The use of natural products such as ginger, garlic and cinnamon could be considered as a potential source of novel antimicrobial agents, used extensively for the treatment of cold, nausea, diarrhea and dental infections.⁸⁻¹¹

The purpose for this research was to compare and evaluate antimicrobial efficacy of 10% ethanolic extracts of ginger, garlic and cinnamon each with 0.2% CHX (positive control) at various volumes (10 μ l, 20 μ l, 30 μ l) using agar disk diffusion test. Dissolution of solvent based extracts was done in dimethyl sulfoxide (DMSO) which acts as a surfactant and easily gets penetrated in the agar. It is an oxidizing agent that neutralizes the antiseptic effect of ethanol and showed no antibacterial activity in the agar diffusion test.¹²

The results showed that maximum antimicrobial activity was exhibited by 0.2% CHX and 10% Cinnamon extract and least by 10% ethanolic extracts of Ginger and Garlic against both bacterial isolates but their effectiveness

varied. A mean zone of inhibition value showed by 0.2% CHX against *S.mutans* at 10 μ l, 20 μ l and 30 μ l was 14.5 mm, 19.5 mm and 23 mm whereas against *L.acidophilus* it was 8.5 mm, 13 mm, and 15.5 mm respectively. The zone of inhibition was found to increase as the volume of extracts increased; this was in accordance with the findings of Nanasombat S.¹³

The mean zone of inhibition values of 10% ethanolic extract of Cinnamon against *S.mutans* was found to be 9.5mm, 15.5mm, 18.5mm at 10 μ l, 20 μ l and 30 μ l and against *L.acidophilus* it was found to be 7 mm, 8 mm and 9.5 mm respectively. The inhibition value was not significantly lower than 0.2% Chlorhexidine. Mechanisms, where by Cinnamon extract inhibit growth of *S. mutans* are still unclear. The antibacterial effect of cinnamon were related to the inhibitory effect of its hydrophobic essential oils (cinnamaldehyde, eugenol and carvacrol) that enable them to partition the lipids of the bacterial cell membrane, disturbing the cell structures and rendering them more permeable. Extensive leakage of critical molecules and ions from bacterial cells leads to its death.¹⁴ Asmi OH et al also proved that cinnamon had showed the highest antimicrobial effect at maximum concentration on the growth of bacterial strains followed by garlic, ginger and turmeric.¹⁵

The highest mean zone of inhibition values of 10% ethanolic extract of cinnamon when compared to 10% ethanolic extracts of ginger and garlic against *S.mutans* and *L.acidophilus* could be attributed to the presence of phytochemicals like alkaloids, saponins and tannins in abundance as observed in the phytochemical screening of the spices. The results of this study showed that although the extracts were less potent than Chlorhexidine, still they were relatively effective in inhibiting the growth of oral bacteria. Hence, 10% ethanolic extract of cinnamon extracts could be used in the form of a natural dentifrices as an alternative for patients who wish for natural, economic products without artificial preservatives, flavors and colors. The evaluation of toxicity and allergic potential of these plant extracts was not included in this study. Hence, a conclusive comment on the toxicity and allergic potential of these plant extracts cannot be made.

Conclusions:-

The highest antimicrobial efficacy was shown by 0.2% Chlorhexidine followed by 10% ethanolic Cinnamon extract and lowest by 10% ethanolic Ginger and Garlic extracts at 10 μ l, 20 μ l and 30 μ l against *S.mutans* and *L.acidophilus*. The antimicrobial efficacy increased with increase in volume. Thus, use of 10% ethanolic extract of cinnamon as an alternative antibacterial compound for effective reduction of cariogenic pathogens in oral cavity would not only reduce the clinical burden of drug resistance development but also lessen the side effects and cost of the treatment with allopathic medicine.

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