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A REVIEW ON POTASSIUM NITRATE, CHLORHEXIDINE GLUOCONATE AND HYDROGEN PEROXIDE TOOTHPASTE FORMULATION TO TREATSENSITIVITY, BLEEDING GUMS & WHITENING OF TEETH

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ABSTRACT

Toothpasteis the paste or gel dentifrice used with a tooth-brush to clean and maintain aesthetics and health of teeth. It is used to maintain or promote oral hygiene, since last ten years there has been a booming demand for aesthetic dentistry, consequently the bleaching and whitening products have made effective augmenting cosmetic,so a routinely used product and its efficiency in whitening play a major role in aesthetics.Toothpastes are complex mixtures of abrasives, surfactants, anti-carrier agents such as fluorides, tartar control ingredients, pH buffers, humectants to prevent drying out and increase the pleasant feeling in the mouth, binders to provide consistency and shape. Tooth sensitivity is a common problem that effects many people commonly, it involves experiencing pain or discomfort to teeth from hot drinks, cold drinks or ice creams,andalso from sweets. Bleeding gums is a sign that plaque has buildup where the teeth meet the gums, a condition that can leads to gingivitis and periodontitis.Potassium nitrate in toothpaste works by calming the nerves in the teeth.They desensitize nerves in tooth pulp. Formulations containing 5% potassium nitrate (KNO3) is clinically proven to reduce dentin hypersensitivity. Potassium ions travel into exposed dentin tubules from the tooth surface to reach internal nerves.

INTRODUCTION

Toothpaste has been used since the ancient past and one of main irreplaceable components of oral health care. The design of toothpaste formulation began in china and India, during 300 to 500 BC period. Squashed bone, pulverized egg and shells were utilized as abrasive as a part of tooth cleaning. Modern toothpaste formulation was developed in the 19th century. Later onchalk and soap was incorporated to those formulations. After 1945 several formulation advancements of different detergent had begun. Sodium laurel sulphate has been used emulsifying agent. In recent years the focus has shifted towards the use of active ingredients during formulation development to prevent and or treat oral illness.The objective behind the use of tooth paste is its ability to deliver preventive and therapeutically active agents such as fluoride, metal salts and pyrophosphates. Active pharmaceutical ingredients, abrasives, humectants, detergents, binders, sweetners, preservatives, antioxidants and flavors are the most commonly used ingredients of toothpaste. There are number ofmaterialsand their combinations used in the formulation of tooth paste today.

Toothpaste is a paste or gel dentifrices used with a toothbrush as an accessory to clean and maintain the aesthetics and health of teeth generally, it is thick, soft, moist substance used on brush for cleaning one's teeth. It is used to promote oral hygiene. Tooth paste or powders which came intouse in the 19^{th} century. Toothpaste contain typically fluoride, coloring agents,flavoring agents, sweetner and other ingredients that make the toothpaste smooth foam and it stays moist.Some therapeutic and cosmetic functions may be desired such as whitening, bleaching, desensitizing, inhibition of plaque formation and protection against periodontal problems.

Desensitizing toothpastes contain some active agents, such as potassium, fluorides, and strontium salts. Potassium nitrate and sodium fluoride are widely used to treat tooth sensitivity. Potassium nitrate decreases the fluid flow through the tubules by clogging them, decreases the level of activity of dental sensory nerves and prevents or reduces the sensation signals from reaching the brain.Build-up of potassium ions over time helps desensitize nerves in the tooth pulp, making them irresponsive to sensitivity stimuli (e.g. cold water, hot coffee, etc.)Potassium nitrate is known to interfere with the nerve impulse and is commonly found in desensitizing toothpaste. Potassium nitrate products raise the extracellular potassium ion concentrations and affect polarization. When the concentration is sustained over time, the synapse between nerve cells is blocked, the nerve excitation is reduced and the tooth is less sensitive to the stimuli. A number of studies, published since the early seventies, have investigated the use of potassium nitrate (KNO_3) as an effective active ingredient in treating dentinal hypersensitivity.

Potassium is the primary agent for common, over the counter de-sensitizing toothpaste that prevents the transmission of nerve endings to the teeth. Potassium salts, including potassium nitrate, potassium chloride or potassium citrate work by diffusion across the dentinal tubules, causing depolarization of the nerve cells. In turn, these cells become unresponsive to excitatory stimuli. The effect of the potassium nitrate accumulates over time, and it may take several weeks for patients to notice improvement of pain symptoms. Chlorhexidine is a cation which interacts with anionic components of toothpaste, such as sodium lauryl sulfate and sodium monofluorophosphate, and forms salts of low solubility and antibacterial activity. At physiologic pH, chlorhexidine salts dissociate and release the positively charged chlorhexidine cation. The bactericidal effect is a result of the binding of this cationic molecule to negatively charged bacterial cell walls. At low concentrations of chlorhexidine, this results in a bacteriostatic effect. The mechanism by which teeth are whitened by oxidizing materials such as hydrogen peroxide and carbamide peroxide are not fully understood but evidence points towards the initial diffusion of peroxide into and through the enamel to reach the enamel dentine junction and dentine regions.

Matthias Epple, Frederic Meyer et al., (2019): The aim of this review is to summarize and discuss frequently used whitening agents and their efficacy from a chemical view point. Therefore a comprehensive literature survey on teeth whitening agents and products was conducted.The current whitening methods are analyzed and discussed. Frequently used whitening agents are abrasives(mechanical removal of stains), antiredeposition agents(prevent deposition of chromophores),colorants (intendedto lead to a white color),proteases(degradation on proteins) and surfactants(removal of hydrophobic compounds from tooth surface.In-office bleaching using peroxides is effective, but side effects like tooth sensitivity or a damage of the natural organic matrix of enamel and dentin may occur, the applicability of abrasives in teeth whitening is limited due to tooth wear, especially when toothpaste with high RDA (Recommended dietary allowance) values are used, The effect of otherWhitening agents in vivo is often unclear because of a shortage of controlled clinical trials.

Syamsurizal, Uce Lestari, Nurhasanah (2019): In this article formulation of toothpaste activated charcoal from Palm Shell as teeth whitening for nicotine addicts was illustrated. Smoking is notably one of the most serious factors causing various periodontal problems

including bacteria in plaque buildup and yellow teeth, based on this study it was revealed that an activated charcoal frompalm shells has been proven as tooth whitening with an absorption ability of two times higher than other commercially active charcoals. This studyaim to determine four formula of toothpaste which is useful in teeth whitening. The results showed that all four formula were proven effective as teeth whitening with the VITAPAN level C1 (grayish shades) all which are similar to the positive control.The second formula was verified as the best the physical property compared with the other formula, with the quality standard at the concentration of carbomer 940 of 1% and tween 80 of 1.5%. The use of carbomer and tween-80 in the toothpaste gel base is a complement and has been proven to have good physical properties and stability.

Pallavi L. Phalke, Tushar G. RukariAnuradha S. Jadhav(2019): In this article the formulation and evaluation of toothpaste contain aloe Vera with the combination of sodium chloride was formulated . Aloe-Vera shows a number of uses either internally or externally and the number of uses also increases. In this formulation they tried to find out the antimicrobial activity of aloe-vera in tooth paste formulation.S.aureus culture was used. The batches were designed in the software Design Expert 10, the batches were formulated and evaluated. At the end of the work they found toothpaste shows considerable zone of inhibition which conclude its anti-microbial activity. The formulation shows correct foaming power for its cleansing action, the observed result was found to be concerning the cubic model in software design.Thus from collected results they concluded that the toothpaste containing a combination of aloe and sodium chloride possesses antimicrobial activity but for its practical use its necessary to determine its effect on oral cavities and probable side effects after its long term use of its oral application, as its future scope. This present work provides hint for those who prefer herbal formulation.

Asha M. Jagtap, Sudhir R. Kaulage, ShivamS.Kanse et al., (2018): In this article toothpaste was prepared and evaluated. Toothpaste are complex mixtures of abrasives, surfactants, anti-caries agents, such as fluoride, tartar control ingredients, pH buffer, humectants (to prevent drying out and increase the pleasant mouth feel) and binders to provide consistency and shape. Binders keep the solid phase properly suspended in the liquid phase to prevent separation of the liquid phase out of toothpaste. The dental paste preparation of herbal toothpaste designed using different bases for treatment of gingivitis, periodentitis and dental plaque. During the physiochemical evaluation studies all the formulation were found to have pH, good tube extrudability; good spreadability and viscosity characteristics.

Dr. Songa Vajra Madhuri, Dr. Lahari Buggapti (2017): An overview of dentrifices from past to present was described in this review. The health of the teeth and gums are maintained by cleaning of teeth regularly. Plaque is the main etiological factor for causing tooth decay,bad breath and gingival/periodontal diseases leading to tooth loss so an agent which removes plaque is used. From the ancient days agents either in the form of powder, paste or gel is used. This article mainly concentrates on evolution of tooth paste from past to present.

Selva Kumar, Prabu Duraisamy, Sunayana Manipal et al., (2016): The study was aimed at estimating the efficacy of commercially available whitening toothpaste in altering the color of the tooth using shade vision system. The study was conducted for one month with the teeth B2, B1, B3 shade, shade vision system was used. The toothpaste includes the Colgate visible white, Himalaya sparkling white, Pepsodent whitening toothpaste and ten drops tooth whitening solutions. Forty natural freshly extracted teeth was taken and divided into four groups of ten natural teeth and each teeth was regularly brushed and stored in the artificial saliva and variation in the shade was noted. Non- parametric Kruskal- Wallis test parameter is used.The p-value was set at 0.05.The statistical data showed that all the three brands had nearly same efficiency far better than the local brand ten drops.

Zainab MahmoodAljammali, AnnasAlyasiry(2015): In this review causes and treatment of bleeding of gums and sensitive gums was described.Tooth sensitivity is caused primarily by the nerves on the roots of teeth being exposed. Normally the roots of

our teeth are covered by the gum tissue as the gum disease progress unchecked, the gum tissue recedes andcauses the roots of our teeth to become exposed and unprotected. Due to the pain associated with tooth sensitivity, sufferers commonly stop brushing the exposed roots and with good reason.Unfortunately not applying gentle cleaning to the roots surface allows the disease causing bacteria along and under the gum line to continue their destructive ways. One of the reasons gums decade is due to poor brushing technique. Over the years of poor brushing technique, the gum tissue becomes so irritated that it recedes to the damage. The combination of gentle brushing with a solution that reduces nerve sensitivity is one effective way to stop the pain associated with sensitive teeth.

Siddharth Sharma, Dr. S.S Agarwal, Jai Prakashet al.,(2014): They formulated polyherbal toothpaste "ORAL S"and evaluated its antimicrobial activity. Methanol extract of polyherbal formulations was prepared. Standard cultures were used for e.g., Streptococcus mutants, Streptococcus oralis, Staphylococcus aureus, Candida albicans, Lactobacillus acidophilus andgram-positive bacteria were used for the study.The antibacterial test used was the agar well diffusion method. Methanol and Gentamicin were used as the negative and positive control respectively. Marked formulations were compared and also quality control parameters like physiochemical and HPTLC (for identification of compounds) were done on developed polyherbal formulations. The results showed the methanol extract of polyherbal formulation 2 showed maximum activity against streptococcus mutants and minimum activity against Candida albicans. Whereas ethanoextractpolyherbal formulation1 and 3 showed lesser activity than polyherbal formulation 2. the extract shows increasing inhibitory activity with increase in the concentration (50% -100%.Quality parameter were conducted on polyherbal formulation.The results of the study support the traditional application of the medicinal plants, suggest that various herbs which were used in poly herbal formulation possess antimicrobial properties that can be used as antimicrobial agents and toothpaste developed can be utilized to prevent dental diseases

Andrew Joiner(2010):A review of whitening toothpaste and review of literature was described in this article. To review and summarize the whitening agents contained within tooth whitening toothpaste formulations, their mode of action in tooth whitening and the in vitro and clinical methods used to evaluate and demonstrate their efficacy.Due to the reported consumers and the patient dissatisfaction with heir perceived tooth color, toothpaste manufactures have responded by developing a vast array of contemporary whitening toothpaste. One of the key functional ingredients in whitening toothpaste is the abrasive system. In general, these have been designed to give effective removal of extrinsic stains and help to prevent tooth stains from reforming without undue abrasivity towards the dental hard tissue. Whitening toothpaste may contain additional agents that augment the abrasive cleaning by aiding the removal and prevention of extrinsic stains for example peroxide,enzymes,citrates.

AdeyemiOluniyiOlusile et al., (2008): The authors in this article evaluated the effectiveness of four topical desensitizing agents in providing short term relief of dentin hypersensitivity.One hundred sixteen hypersensitive teeth with a positive response to intraoral for dentin hypersensitivity were included in this study. The four desensitizing agents tested were Duraphat 2% Fluoride iontophoresis, Copal Varnish (CV) and GlumaComfort Bond Plus Desensitizer. Following a determined desensitizing agent were applied in an alternating order when a patient presented in a clinical setting with a complaint of hypersensitive teeth. A visual analogue scale, the degrees of hypersensitivity at three points in time. The first being just before the treatment to establish a baseline, then at 24 hours post treatment, and the last at seven days post treatment.Mean pain scores (MPS) between the baseline and post treatment evaluation periods were used to determine the reduction in dentin hypersensitivity.

CLASSIFICATION:

There are different types of toothpaste available. The various function depends on the

active ingredients they contain.Following are the common types.

1. Fluoride toothpaste (anti-decay tooth)
2. Desensitizing toothpaste
3. Anti calculus toothpaste
4. Anti plaque toothpaste
5. Whitening toothpaste

USES:

- Tooth pastes are used to maintain dental health or oral hygiene.
- By tooth pastes we can prevent the risk of dental diseases.
- These helps in preventing and destroying germ build up in teeth.
- It helps in the prevention of gingivitis and tooth decay.

➢ **Anti-Decay Tooth Paste:** contains fluoride compounds like sodium fluoride, stannous fluoride etc. Adulttoothpaste contains 1,000 -1,450 ppm fluorides, children toothpaste contains500-1000ppm fluorides. Children tooth pastes is usually candy flavored, which is more appealing to children.

➢ **Desensitizing Tooth Paste:**

It contains compounds that help to shield nerve endings from irritants. The most active ingredient is potassium nitrate a compound that blocks pain signals travelling from a nerve in your tooth to your brain. After few uses sensitivity gets reduced.

➢ **Anti-Calculus Tooth Paste:**

They contain tetra potassium and tetra sodium, pyrophosphate, zinc etc. Dentifrices containing anti-calculus agents reduce the formation of calculus but do not reduce the levels of pre existing calculus.

➢ **Anti-Plaque Tooth Paste:**

They contain sodium laurel sulfate, stannous ions, zinc etc. They have anti-bacterial properties and prevent the formation of plaque.

➢ **Whitening Tooth Paste:**

They contain relatively coarse abrasive which function by abrading the stains on the tooth surface giving a whitening effect. The effects of the long-term use of this kind of tooth paste are still unknown.

FORMULATION

Active Pharmaceutical Ingredients:

Ingredients	Uses
Potassium nitrate	Desensitizing/Calming the nerves
Sodium monofluorophosphate	Anti-plaque/Remove stains
Chlorhexidine gluconate	Prevents bleeding of gums
Sodium bicarbonate	Anti-bacterial
Hydrogen peroxide	Whitening

Excipients:

Ingredients	Uses
Sodium lauryl sulfate	Foaming
Menthol oil	Anti-Bacterial
Calcium carbonate	Abrasive
Sodium carboxy methyl cellulose	Binder
Polyethylene Glycol	Humectant
Sorbitol	Sweetner
Titanium -di-oxide	Whitening
Sodium benzoate	Preservative
Mint	Flavouring

THEORY

1. TOOTH SENSITIVITY:

Tooth sensitivity is a common problem that affects many people commonly the tooth.Sensitivity involves experiencing pain or discomfort to your teeth from hot drinks, cold drinks or ice creams, cold air and also from sweets. Due to tooth sensitivity some people even experience discomfort from brushing and flossing. The common symptoms may be a sudden, sharp flash of pain when teeth are exposed to air, cold, sweat, acidic, or hot foods. Some people experience during brushing on flossing their teeth.

Causes of tooth sensitivity:

- Periodontal diseases
- Aggressive tooth brushing
- The common causes due to having thin enamel
- Tooth decay (cavities)
- Fractured teeth
- Gum disease
- Expose tooth roots
- Genes

This disease is common in the people with the age range of 20-50 years. However more common in the people with the age range of 30-40 and more common in female individuals that would probably be related to their dental hygiene and dieters.Based on the studies dent in hypersensitivity is developed in two phases:

Phase 1/Lesion localization: In the first phase dentinal tubules due to loss of enamels are exposed by attrition, abrasion, erosion and abfraction. The dentinal exposure mostly occurs due to gingival recession along with the loss of cementum on the root surface of teeth. It is said that not at all exposed dentins are sensitive however their calcified smear layer, as compared to non-sensitive dentin is thin and this leads to an increase in the fluid movement and consequently the pain response.

Phase 2/Lesion initiation: For the exposed dentin to be sensitized the tubular plugs and the smear layer are removed and consequently, dentinal tubular and pulp are exposed to the external environment.

Prevention:

- We can prevent sensitive tooth by using fluoride tooth and avoid using an abrasive tooth paste.
- By stopping teeth grinding some people experience by grinding their teeth consciously for relief of stress and unconsciously while sleeping if you grind your teeth ask your dentist about a mouth guard. Tooth grinding can fracture teeth and cause sensitivity.
- To prevent sensitive teeth from recurring brush your teeth twice a day with a soft bristled toothbrush and floss daily use gentle, rather than vigorous or harsh scrubbing.
- As we know that food also is one of the main causes of tooth sensitivity.
- We can prevent by using a straw when you drink acid liquid to limit contact with your teeth and after eating or drinking of acidic substances drink water to limit the acid balance.
- Hence, we might have to take care while eating and drinking acidic foods and drinks, such as citrus fruits, alcohol/wine, carbonated drinks –all of which can remove small amount of tooth enamel over time.

Treatment:

- By using desensitizing tooth paste we can treat the sensitivity we have to be sure to use fluoridated tooth paste for sensitive teeth, non-tartar-control tooth paste.
- By using a soft-bristled tooth brush (ultra – soft tooth brush).
- By using a fluoridated mouth wash daily.
- Surgical gum graft- If your tooth has lost gum tissue, a small amount of gum tissue can be taken from elsewhere in your mouth and attached to the affected site. This can protect exposed roots and reduce sensitivity.
- Root canal-The root canal treatment seems like a significant treatment it's considered the most successful technique for eliminating tooth sensitivity. It is only recommended if your sensitive teeth cause severe pain and other treatment aren't effective, your dentist might recommend a root canal – A procedure used to treat problems in the tooth soft core (dental pulp). Among these all the fluoride will help the teeth to strengthen tooth enamel and reduce pain.

2. GUM BLEEDING:

Bleeding gums is a sign that plaque has built up where the teeth meet the gums, a condition that can leads to gingivitis or periodontitis.The gum bleeding can be a sign that your gums are not being properly cared for and need more attention. Since so many people have gingivitis and bleeding gums, people often don't take it seriously enough. Gum bleeding can be not normal they can be asign of gum disease.Since nearly 60% of people experienced bleeding gums.1-in-3 people think that bleeding gums are normal the sign of gum diseases include bad breath, mouth sores, swollen gums, smoking, loose teeth, lump on gums, receding gum.

Causes of Bleeding Gums:

- The person with a disease gingivitis can cause a gum bleeding due to plaque buildup.
- Pregnancy can cause gum bleeding due to hormonal change in females.
- Some medication can cause gum bleeding like antibiotics, and blood thinners.
- Some disorder like leukemia can cause gum bleeding.
- The deficiency of vitamins like vit-K and vit-E can cause gum bleeding.
- One of the main causes of gum bleeding is use of hard-bristled tooth-brush or brushing your tooth too hard and improper flossing.
- The smoking is also one of the main causes of gum bleeding.

Prevention:

- By brushing teeth at least twice a day.
- By flossing teeth daily.
- By visiting your dentist at least twice a year.

Treatment:

- we can treat gum bleeding through by applying topical antibiotic gel, antiseptic chips, anti-microbial agents.
- By using anti gingivitis toothpaste by increasing intake of Vit-C and Vit-K.
- By stop smoking and rinse the mouth with hydrogen peroxide and by brushing twice dailywith a manual tooth-brush by using circular motion around the mouth and avoid brushing too hard.

3. TOOTH WHITENING:

Tooth discoloration is when the tooth color changes. They don't look as bright or white as they should. The teeth may darken, turn from white to different color, or develop white or dark spots in places. Colored compounds in the tooth are so called chromo pores, both of organic and in organic origin. Chromophores absorb light in the visible range and reflect mainly the complementary color that is recognized by the eyes, typically yellow or brownish in the case of teeth. Stains are of two types intrinsic and extrinsic, the intrinsic stains are localized inside the tooth, either in the enamel or in the underlying dentin. The extrinsic stains are localized on the tooth surface i.e. on enamel and exposed dentin, especially on tooth surface which are difficult to clean and on surfaces with a thick pellicle layer.

Causes of Discoloration of Tooth:

- Ageing.
- Enamel thinning.
- Faulty diet.
- Smoking due to nicotine substance the teeth form different color.
- Grinding of teeth.
- Certain diseases and medications.
- Cancer patients who undergo chemotherapy and radiation end up with discolored teeth due to the chemical reactions occurring in the body. Antibiotics like tetracycline and doxycycline can also stain chlorohexidine and acetyl pyridinium chlorides.

Prevention:

- Quit drinking tea/coffee and smoking.
- By improving dental hygiene by brushing, flossing, using mouth wash daily.

Treatment:

- Avoid the food and beverages that causes stain.
- By using OTC whitening agents.
- By using soft bristled tooth-brush and flossing techniques.
- Dental whitening like laser teeth whitening cosmetic or simple as peroxide–containing bleaching agents.

CONCLUSION:

A clean mouth will lead to clean body. One cannot be healthy without an oral health. Oral health and general health should not be interpreted as separate entities. For whitening, two major approaches can be distinguished, as follows: chemical bleaching by peroxides and mechanical cleaning by toothpaste abrasives chemical bleaching leads to good results, especially when it is performed with high peroxide concentrations in a controlled environment, i.e., in the dental practice. Maintenance of oral hygiene is always a necessary evil to eradicate the clinical occurrence of gingivitis and periodontitis as the accumulation of plaque and tartar can lead to accumulation of calculus which get mineralized to from a Substrate for the growth of pathogenic micro-organisms. Application of desensitizing dentifrice containing chlorhexidine or potassium nitrate always helps in forming a impermeable biofilm which can prevent the growth of periodontal pathogens and microbes.

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