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Effect of Manuka Honey against Dental plaque of School Children

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Abstract
Manuka honey,a monofloral honey derived from the manuka tree(Leptospermum scoparium)has greatly attained the attention of researchers for biological properties,especially its antimicrobial and antioxident capacities.As many of the medicine properties of plants can be transmitted through honey,so that honey could be used as a vehicle for transporting plant medicinal properties,Manuka honey is a type of monofloral honey,a dark honey has greatly attracted the attention of the international community.This honey is derived from the Manuka tree,Leptospermum scoparium of the myrtaceae family,which is a land and eastern Australia[19].
The aim of this study (Research work) is to develop the efficient use of mouthwashes Manuka honey (MH) a raw honey for the prevention of dental plaque forming bacteria in the young kids and teenagers.
This study was a double blind, randomized controlled field trial conducted in Patna city (Bihar), India.
MATERIALS AND METHODS–*Twenty-eight government school children aged 8–15 years were randomly selected and allocated into two groups MH and CHX mouthwash groups. Ten millilitres each of honey-based mouthwash and CHX mouthwashes were administered according to the group allocation twice daily for 35 days (5 weeks). The MH group participants were trained to apply the Manuka honey gently into the space between the tooth and gum tissue that surround all the teeth and wait for 5 minutes before rinse. All children were advised to do not eat or drink anything up to 30 minutes after rinse the mouth. All the children were examined at baseline (36th day). Just next to discontinuation of mouthwash and 42nd day (1 week after discontinuation of mouthwash) for plaque index.*
RESULTS –*Statistically significant reductions in dental plaque were observed in both the mouthwash group. Methylsyringate, methylglyoxal, syringing acid, Hydrobenzoic acid and leptosin are active compounds present in Manuka honey having efficient mechanism on the dental plaque forming bacteria.*
CONCLUSION *– Manuka Honey-based mouthwash showed a promising antimicrobial effect on dental plaque in the young kids and teenagers.*
Keywords*- Dental plaque, Honey, Mouthwash, Microbiota, Bacteria, Oral health.*

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I. Objective

Microbial biofilms are a type of complex communities of bacteria and very common in the human body as well as in the environment. The nature of the biofilms enhances the component bacteria's resistance to both the host's defence system and antimicrobials. Dental plaque is a kind of Microbial biofilm. If it is not removed regularly, the biofilm undergoes maturation and the resulting Pathogenic bacterial complex can lead to dental caries, gingivitis and periodontitis (the kind of poor oral health). The poor oral health can cause systemic disease, such as cardiovascular disease, rheumatoid arthritis and osteoporosis. The poor health is very common in the young kids as well as in teenagers. Regardless of the advancement of the modern medical science, satisfactory treatment of oral disease by newer drugs is not fully achieved yet, rather than the chemical compounds have exposed the kids and adults to its various kinds of ill effects. Due to this, there is an interest to find out effective remedy by harmless natural and easily available drugs that can be used by any age group of kids and adults. Our research paper is totally based on the development of the dental plaque forming bacteria and its isolation (prevention) method based on the efficient use of antiplaque natural remedies. For our research work, Manuka honey (kind of monofloral honey) is used for the prevention of Dental plaque.

II. Introduction

Oral health has the most important aspect in our lives. Oral health is a key indicator of overall health, well-being and quality of life. Our mouth is a kind of window into our body health. It can show sign of nutrition deficiencies or general infection such as Dental plaque, dental caries, periodontal disease, tooth loss, oral cancer,

oral manifestations of HIV infection, oro-dental trauma, noma and birth defects, such as cleft lip and palate and these kind of systemic diseases affect our entire body. Whether we are 80 or 8, our oral health is important. In most of the cases the oral health totally depends on the teeth [1],[12]. Teeth are the one of the hardest structure of the human body whose main function is chewing. Chewing is the most important part of the digestive system. Foods need to be broken down and chewed before entering to the digestive system, so that the body can easily absorb nutrients from them.

Dental plaque is a kind of structurally and functionally organized biofilm. Biofilms are a kind of complex communities of bacteria which typically enhances the component that's bacteria's resistance to both the host's defence system and anti-microbial. Bacteria live in a plaque, secrete acids, cause tooth decay, and irritate gums tissue. This irritation causes an inflammatory reaction by our body that can eventually lead to gingivitis and periodontal disease. If plaque is not removed regularly by tooth brushing and flossing, it hardens to create Calculus (also known as tartar)[17]. Calculus can't remove with a toothbrush, only a dental professional can remove it during an oral cleaning. The biofilm plaque can exist in any age group like kids, adults, old persons and even in the mouth of infant [17][20].

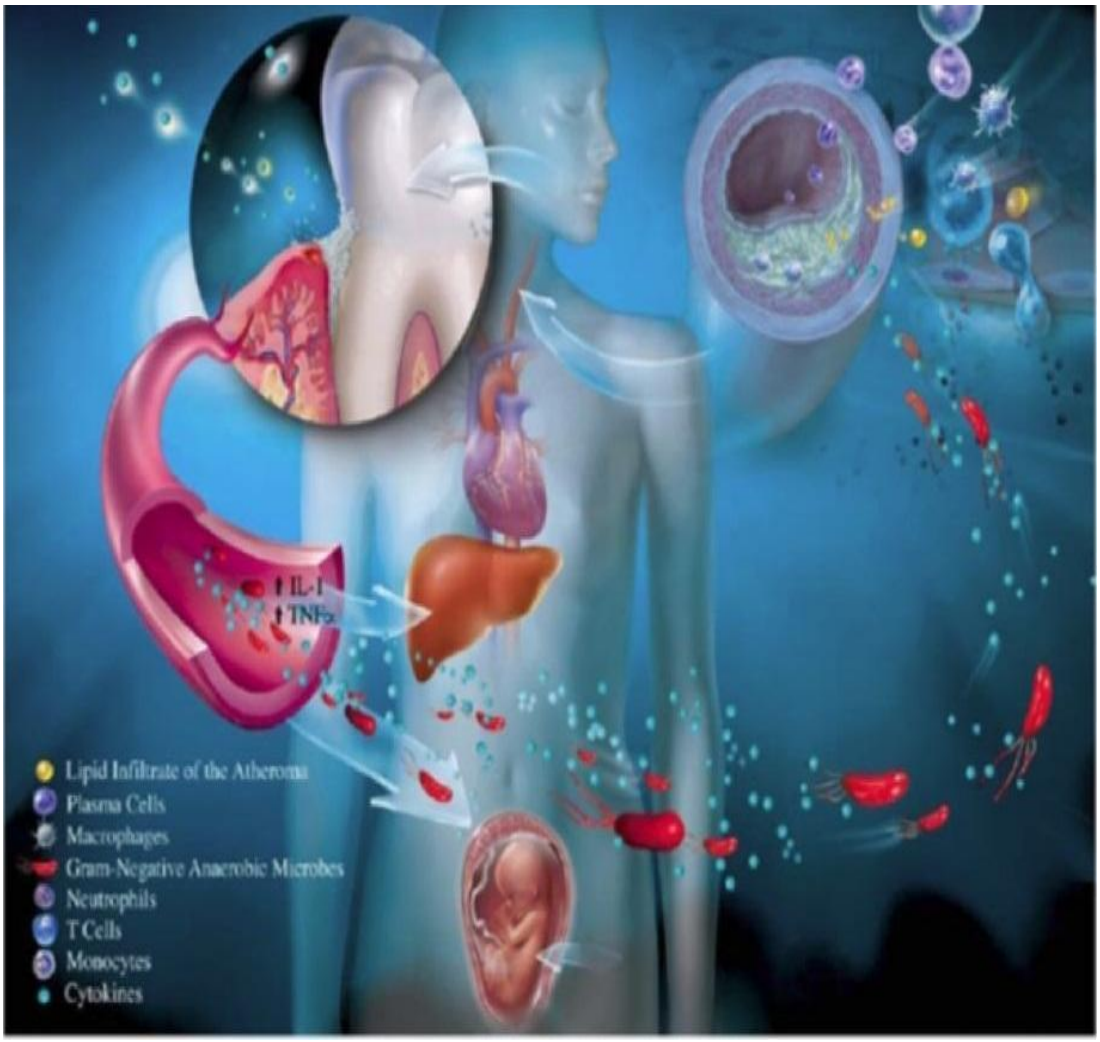

Figure 1. *Subgingival plaque bacteria and/or their products may gain access to distant sites in the body through the circulatory system and may potentially contribute to systematic inflammation; in this way, a dental biofilm infection may potentially contribute to various systematic disease and conditions.*

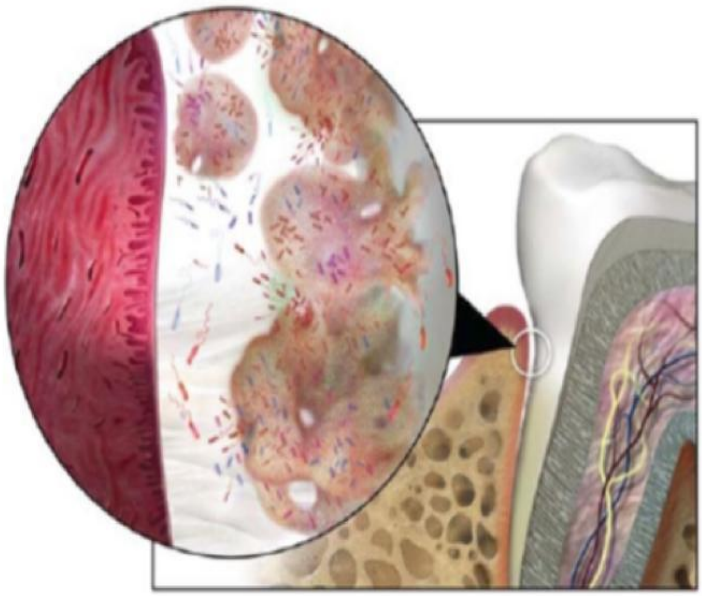

Figure 2. *Calculus (tartar)in tooth*

The earliest microbiota to colonize the mouth of the new-born infant is derived from mother's genital tract oral cavity and skin. Since the new-born infant has no teeth, the earliest microbial colonizers will be those that are able to adhere to the available surfaces: those lined by epithelium. If the mothers are treated so as to reduce their level of calculus (tartar), the rate of transmission of microbiota to their infant can be reduced by one third[20].

Actinomyces naeslundii, a predominant species of dental plaque, is recovered from 40% of young children. Actinomyses viscosus which is absent in infants, gradually increases in prevalence as the child grows older, with half the children colonized by age 7. This proportion of these organism and other +strict anaerobes increases in adolescence and adulthood but may show a great deal of site-to-site variability with local factors such as pH, eH and assorted bacterial interactions playing an important role[20]. Several chemical agents are commercially available as treatment options for oral diseases. These chemicals can attar oral microbiota and have undesirable side effects such as vomiting, diarrhoea and teeth staining. Other antibacterial agents used against oral pathogens, including Cetypyridinium chloride,chlorhexidine, amine fluorides or products containing such agents are reported to exhibit toxicity, cause staining of teeth or in case of ethanol (Commonly found in mouthwash) have been linked to oral cancer. The global need for alternative prevention, treatment options and products for oral diseases that are safe, efficient and economical comes from rise in disease incidence, increased resistance by pathogenic bacteria to currently used antibiotics & chemotherapeutics opportunistic infections in individuals & financial consideration in developing countries. It has been observed that honey products used against oral infection have more inhibitory effect on dental pathogen than synthetic drugs.

III. Materials And Methods

Nature has been a very good source of medicinal treatments since millennia and plant based systems continue to play an essential role. One such product is Honey.

Just give a sweet smile, not all the sweet foods are bad for your teeth. Scientific researches reveals that Manuka honey has real benefits for oral health and despite its high natural sugar contents behaves in very different ways to refined sugar. The research also shows that high grade Manuka honey inhibits the oral bacteria associated with plaque formation, teeth decay and gum diseases [8].

Unlike sugar, honey doesn't create an acidic demineralising environment in the mouth(that's how the tooth decay starts). Manuka honey is showing similar effectiveness of reducing plaque formation when compared with other pharmaceutical antibacterial mouthwash chlorhexidine, Being gentle on oral tissue and providing anti-inflammatory with healing properties are one of the added benefits of Manuka honey[15].

Depending on its origin, honey can be classified in different categories among which monofloral honey seems to be most promising and interesting as natural remedies [19]. Monofloal honey is a type of honey which has a distinctive flavour or other attribute due to its being predominantly from nectar of one plant species. Beekeeper learn the predominant nectar sources of their region, and often plan harvests to keep especially fine one separate.

Polyfloral honey types are produced by honey bees using nectar from many different flower sources. Polyfloral honeys, also known as wildflower honey. Such kind of honey do not display the pure characteristics of any of their production level nectar sources. One of the neatest thing about polyfloral honey is their uniqueness. Each wildflower honey is like an individual snowflake that will only be represented once and when it's gone ,it's gone!. Each wildflower hive is producing a honey that have no equivalent.

Blossom honey is a kind of honey that is produced from the mixed nectars of melliferous blossom, herbs,grasses and fruit trees. Fructose/glucose ratio, pH and specific rotation values indicate that the samples are Blossom honeys. Orange blossom honey is often made from mixed citrus nectars including oranges, grapefruits, lemons, mandarins, tangerines, limes and many others.

Honeydew honey is made exclusively from honeydew also known as bug honey, flea honey or tree honey and forest honey.it is generally dark, strong flavoured,less acidic, and less sweet than floral honey [15][16].

Types of Honey

Figure 3. *Manuka flower*[1]

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Figure 4. *RAW Monofloral Manuka Honey*

Manuka honey, a monofloral honeyderived from the manuka tree(Leptospermum scoparium) has greatly attained the attention of researchers for biological properties, especially its antimicrobial and antooxident capacities. As many of the medicine properties of plants can be transmitted through honey, so that honey could be used as a vehicle for transporting plant medicinal properties, Manuka honey is a type of monofloral honey, a dark honey has greatly attracted the attention of the international community. This honey is derived from the Manuka tree , Leptospermum scoparium of the myrtaceae family, which grows as a shrub or a small tree throughout New Zealand and eastern Australia [19]. MGO stands for methylglyoxal which is a chemical that occurs naturally in Manuka honey. MGO is the "Magic ingredient" in Manuka honey that grade the Manuka honey. MGO & K-factor standards ensure these following factors:-

- Raw and unpasteurized honey, purity and live enzymes.
- Free of antibiotics, glyphosate and pesticides.
- Non-GMO, pH levels and antioxidant levels.
- Traceability from hive to home.
- High antibacterial activity and good healing properties.

A-very common compound identified in Manuka honey:-

Phenolic Acid and Flavonoids	**Other Compounds**
Caffeic acid	Phenyllactic acid
Isoferulic acid	4 – Mythoxyphenolactic acid
p-Coumaric acid	Kojic acid
Gallic acid	5 - Hydroxymethylfurfural
4 – Hydrobenzoic acid	2 – Methoxybenzoic acid
Syringin acid	Phenylacetic acid
Quercetin	Dehydrovomifoliol
Leteotin	Leptosin
8 – Methoxykaempferol	Methylglyoxal
Pinocembrin	3 - Deoxyglucosulose
Isorhamnetin	
Kaempferol	
Chrysin	
Galangin	
Pinobanksin	

"The K-Factor is an independent grading system for Manuka honey. The system measures certain factors in the honey to determine its nature. It is used by the Wedderspoon Company of New Zealand." [15].
KFactor 16 is a monofloral honey that is "wholly or mostly" made from the Leptospermum scoparium (Manuka) plant. This means this honey is more of a single-plant extract. K-Factor 12 is a multifloral Manuka that is more of a "blend" of more than one Manuka plant [16].

Methyl Syringate(MSYR) and Leptosin are the active compounds from Manuka honey:-

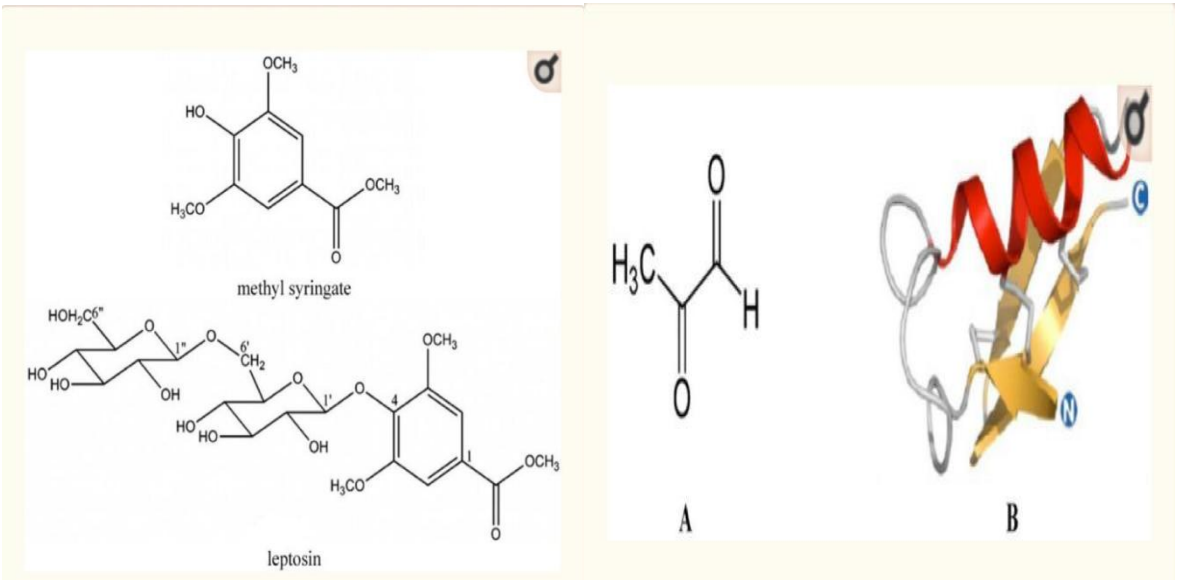

Figure 5. *Chemical structure of Methyl syringate and leptosin&Methylglyoxal, Syringing acid and hydro benzoic acid [19].*

The trail was conduct from Jan 2020 to Feb 2020 as a field trail in government school of Patna, Bihar. The present study was a double-blind, randomized controlled field trial conducted to evaluate the effectiveness of two types of mouthwash (MH and CHX) on plaque and gingival scores of 8–15-years. Permission was obtained to conduct the study from the principal of the selected school and their parents.

Before the start of the study, both the honey were tested for purity at \i Ayurveda Research Institute for Infectious Diseases, CCRAS, Ministry of Ayush, Govt. of India and all the values were within the permissible level.

The pH of mouthwash formulation was checked before conducting the study and the MH mouthwash was well above the critical pH of saliva (demineralizing action on teeth). pH of MH mouthwash was 5.9.

Streptococcus is the early colonizer of plaque and after its adherence to the tooth surface it is significant in providing attachment substrates for the subsequent colonizers and ultimately influencing the succeeding stages of biofilm formation. Therefore, both the mouthwashes were tested for their activity against it and final mouthwash formulations were made based on the findings of this result[4].

Purified water was deionized and distilled water was collected from distillation unit. 0.01g of sodium methylparaben and 0.01 g of sodium propylparaben were weighed separately and dissolved in 25 ml of purified water. Stirring was continued till a uniform mix was obtained. To this, 0.5 g sodium benzoate was added and stirred for 15 min. A weighed quantity of MH (40 g/35 ml), RH (20 g/35 ml), and glycerine (5g) was added to the above contents and stirred for 10 min. All this preparation is done in the supervision of dentist Dr. Ashish Kunal Chaurasia.
All the participants were selected from a single hermitage to remove any bias to dietary and lifestyle pattern.

INCLUSION CRITERIA

1. Participants who were free from systemic diseases.
2. Having moderate gingival.
3. All the index teeth completely erupted.
4. Parents of the participants who gave informed consent.
5. Participants who gave assent.

EXCLUSION CRITERIA

1. Any participant who was suffering from any disease which might affect the salivary flow.
2. Having the history of antibiotic therapy in the previous 1 month till the start of the study.
3. Presented with retained deciduous teeth.
4. Suffering from any physical disability.

Standardization of the oral hygiene practices was done before the start of the study by teaching the participants to brush twice-dailyusing Colgate toothpaste and toothbrush.

The MH group participants were trained to apply the Manuka honey mouthwash gently into the space between teeth and gum tissue and surround all the teeth and wait for five minutes before rinse. All the children wereadvised todo not eat or drink anything for 30 min after rinse the mouth. The procedure was repeated for 6 weekstwice a day for both groups MH and CHx. All of the children were examined at baseline (36^{th} day), just next to discontinuation of mouthwash and 42^{nd}day (1 week after discontinuation of mouthwash) for plaque index.All these procedure is done in the supervision of their parents.

IV. Results:-

Efficacy of CHx mouthwash on the reduction of dental plaque:-

Segment	Average baseline plaque score	Average experimental plaque score	Dental plaque reduction (%)
Anterior	2.92	1.22	41.780822
Posterior	2.95	1.26	42.711864
Facial	3.05	1.25	40.983607
Lingual	3.00	1.35	45
Upper	3.15	1.68	53.333333
Lower	2.85	1.45	50.877193

Efficacy of MH mouthwash on the reduction of dental plaque:-

Segment	Average baseline plaque score	Average experimental plaque score	Dental plaque reduction (%)
Anterior	2.92	1.20	41.09589
Posterior	2.95	1.24	42.033898
Facial	3.05	1.85	60.655738
Lingual	3.00	1.82	60.666667
Upper	3.15	1.94	61.587302
Lower	2.85	1.40	49.1228

V. Conclusion

Our research work and study evident that 'Manuka honey' has the potential to be developed into antiplaque agents and can be used as preventive or treatment therapies for oral disease. Our research work is encouraging to see a number of clinical trials of plant-basedproduct (Manuka honey), further studies of the safety and efficacy of natural agents will be important that can help to reduce the overall burden of oral diseases worldwide.

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