International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Comparison of pH of Different Types of Toothpastes Used in India

Pragya Soni[1], Namita Bende[2]

Govt. Holkar Science College, Indore
namitabende[at]gmail.com

Abstract: ***We studied the different types of toothpastes that are used in India, in which we found the pH of each toothpaste, With which we tried to find out which toothpaste is more useful for protecting our teeth and gums. pH is maintained by all toothpaste for teeth as well as Saliva. Saliva always maintain neutral pH in the mouth, so toothpaste should maintain pH according to saliva. Tooth decay starts if the mouth does not maintain pH either by using wrong toothpaste of food habits. If pH falls below 5.5, the medium become acidic and if it continues till long time, Cavity in tooth began to starts. Hence we choose to study pH of whatever toothpaste using generally in India using pH meter.***

Keywords: Cavity, Mouth, Acidic, Saliva and pH meter.

1. Introduction

We studied the different types of toothpastes that are used in India, in which we found the pH of each toothpaste, With which we tried to find out which tooth paste is more useful for protecting our teeth and gums.

pH is defined as the negative logarithm of H+ ion concentration. Hence the meaning of the name pH is justified as the power of hydrogen. pH of Acids and Bases Solutions having a value of pH ranging 0 to 7 on pH scale are termed as acidic and for the value of pH ranging 7 to 14 on pH scale are known as basic solution. Solution having the value of pH equal to 7 on pH scale are known as neutral solution. Solution having the value of pH equal to 0 are known to be strongly acidic solutions. Further, the acidity decreases as the value of pH increases from 0 to 7whereas, solutions with the value of pH equal to 14 are termed as strongly basic solutions. The basicity decreases as the value of pH decreases from 14 to 7. The strength of acids and bases depends on the number of H+ and OH– ions produced[1].

The concept of pH was first introduced by danish chemist sorensen in1909 in 1936 first commercial pH meter was made by arholdorvillebeakman In1937 jenco electronics design and manufactured the first portable digital pH meter. The Henderson-Hasselbalch equation provides a relationship between the pH of acids (in aqueous solutions) and their pKa (acid dissociation constant).2The pH of a buffer solution can be estimated with the help of this equation when the concentration of the acid and its conjugate base, or the base and the corresponding conjugate acid, are known[3].

The Henderson-Hasselbalch equation can be written as: pH = pKa +log10 ([A–]/ [HA]) Where [A–] denotes the molar concentration of the conjugate base (of the acid) and [HA] denotes the molar concentration of the weak acid. Therefore, the Henderson-Hasselbalch equation can also be written as: pH = pKa+log (conjugate base) / (acid) An equation that could calculate the pH value of a given buffer solution was first derived by the American chemist Lawrence JosepH Henderson. This equation was then re-expressed in logarithmic terms by the Danish chemist Karl Albert Hasselbalch. The resulting equation was named the Henderson-Hasselbalch Equation. Derivation of the Henderson-Hasselbalch Equation The ionization constants of strong acids and strong bases can be easily calculated with the help of direct methods. However, the same methods cannot be used with weak acids and bases since the extent of ionization of these acids and bases are very low (weak acids and bases hardly ionize). Therefore, in order to approximate the pH of these types of solutions, the Henderson-Hasselbalch Equation is used.

Let us take an example of ionization of weak acid HA:
HA + H2O ⇋ H+ + A−HA + H2O ⇋ H+ + A−

Acid dissociation constant, K a can be given as:
K a= [H+] [A−] [HA] [H+] [A−] [HA]Taking, negative log of RHS and LHS:
−logKa−logKa=−log [H+] [A−] [HA]−log [H+] [A−] [HA] ⇒−log Ka⇒−log Ka = −log [H+] – log [A−] [HA]−log [H+] – log [A−] [HA]

As we know, −log [H+]−log [H+] = pH
pH and −log Ka−log Ka =pKa
pKa,

The equation above can also be written as,
pKapKa=pH−log [A−] [HA]pH − log [A−] [HA]

Rearranging the equation, ⇒pH⇒pH = pKa+log [A−] [HA]pKa + log [A−] [HA]

The above equation is known as Henderson-Hasselbalch equation, popularly known as Henderson equation. It is very useful for estimating the pH of a buffer solution and finding the equilibrium pH in acid-base reactions.

From the equation we can infer when pH
pH =pKapKalog [A−] [HA]log [A−] [HA]=00 [A−] [A−]= [HA] [HA]
That is, when pH=pKa

Concentration of both the species are same or in other

words, acid willbe half dissociated. Similarly, for a weak base B:

B + H2O ⇋ OH− + HB+B +H2O ⇋ OH− + HB+ Base dissociation constant, Kb, of the base can be given as, KbKb= [BH+] [OH−] [B] [BH+] [OH−] [B] Taking negative log of RHS and LHS
−logKb−logKb=−log [BH+] [OH−] [B]−log [BH+] [OH−] [B]⇒−logKb⇒−logKb
=−log [OH−]−log [BH+] [B]−log [OH−]−log [BH+] [B]

As we know, −log [OH−]−log [OH−] = pOHpOH and −logKb−logKb = pKb
pKb, Above equation can be written as, pKb
pKb=pOH−log [BH+] [B]pOH−log [BH+] [B]
Rearranging the equation, ⇒pOH⇒pOH= pKb+log [BH+] [B][4]

pH is a measure of hydrogen ion concentration, a measure of the acidity or alkalinity of a solution. The pH scale usually ranges from 0 to 14. Aqueous solutions at 25°C with apH less than 7 are acidic, while those with apH greater than 7 are basic or alkaline. A pH level of 7.0 at 25°C is defined as "neutral" because the concentration of H3O+ equals the concentration of OH− in pure water. Very strong acids might have a negative pH, while very strong bases might have a pH greater than 14.5

Buffer Solution A buffer is an aqueous solution that consists of a mixture of a weak acid and its salt (acid buffer) or a weak base with its salt (basic buffer). Its pH changes very little when a small amount of strong acid or base is added to it and is thus used to prevent a solution 's pH change. Solutions with the stable concentration of hydrogen ions and thus typically with no change in pH which is almost independent of dilution and which change very little with small additions of a strong acid or alkali are called buffers. It can also be described in simple terms as a solution that prevents any pH change when a small amount of a strong acid or a strong base is applied to it, is called a buffer solution or simply as a buffer. Both buffers have acidity and alkalinity balance. Any compounds, such as ammonium acetate, tend to resist any change in their concentration of hydroniumions or pH, whenever a small amount of a strong acid or a strong base is applied to it[6]. Buffer solutions usually consist of a mixture of a weak acid and salt with a strong base like CH3COOH and CH3COONa, or a weak base with a strong acid like NH4OH and NH4Cl and salt.

Mechanism of Buffering Action Consider the example of a buffer solution made by dissolving sodium acetate into acetic acid, to consider how a buffer functions. As you can see from the name, acetate acid is an acid: CH3COOH, while sodium acetate dissociates in solution to yield the conjugate base, CH3COO-acetateions. The reaction equation is:
CH3COOH (aq) +OH-(aq) CH3COO-(aq) + H2O (aq)

If this solution is combined with a strong acid, the acetate ion can neutralize: CH3COO-(aq) +H+ (aq) CH3COOH (aq) It changes the original buffer reaction equilibrium, thereby holding the pH steady[7]. Preparation of Buffer Solution There are a few methods to prepare a buffer solution with a different pH.

Prepare a solution with acid and its conjugate base in the first approach by dissolving the acid component of the buffer in around 60percent of the amount of water used to produce the final volume of solution. Instead, use a pH detector to test the pH of the solution. Using a strong base like NaOH the pH can be changed to the desired value. If a base and its conjugate acid are used to make the buffer, the pH can be modified using a strong acid, like HCl. Dilute the solution to the final desired volume, once the pH is right. Additionally, you should prepare solutions for both the solution's acid type and base form. Both solutions must have the same quantity of buffer as in the final solution. Add one solution to the other while tracking the pH to get the final buffer. In a third method, using the Henderson-Hasselbach equation, you can determine the exact amount of acid and conjugate base required to make a buffer of a certain pH:

$$pH= pKa+ \log/|A-||HA|^{8.}$$

Safety of sanguinaria extract as used in commercial tooth and oral rinse product studied by VH Frankes and co-workers [09]. comparison of an herbal toothpaste with a fluoride tooth paste on plggue and gingivitis observed byJ moron and co-workers[10]. L shapira and co – workers[11]had studied effect of amine fluride stannous fluride cantinig toothpaste on plague ond gingivitis in adult caries and fluoros is prevalence study in a non-fluoridated brazilion community observed byantoniscarlos[12].

H. pontefract, and co-workers[13] had studied desensitizing toothpaste virus placebo for dentin hypersensitivity. Carries preventive effect of fluoride toothpaste observed by svantetwet man and co-workers[14]C moore and co-workers has discovered the dentine in vitro by toothpaste.

Osteoflurosis causes by excess use of toothpaste investigated by J Roos and co-workers[15]. Studies in vitro of abrasion of different manual toothpaste observed by “D Dyer” and co-workers[16]. Fluoride ingestion from toothpaste back ground to European Union founded multicentre project observedbyDennismullanceandco-workers[17].

Developmentofamethodinsitutostudytoothpasteabrasionofdentineinvestigatedbym Addy and et al[18]. Prevention of early child hood carries (ECC) discovered by svantetwetman[19]. RMDavies and co-workers[20] had studied the effectiveness of tooth paste containing tridoson and polylinesmethylethermaleic acid co polymer in improving plaque control and gingival health. Anas HAIMullaand et al[21]hadstudiedThe modified fluoride toothpaste technique reduces caries in orthodontic patient.

An unusal presentation of oropharynged cytosis realated to toothpaste observed by DcTang ans co-workers[22]. Evidence based toothpaste classification according to certain characteristics of their chemical composition studied by Iizemaldupa and et al[23].

2. Material and Methodology

We have taken different types of tooth paste which are used in India. Some of which are whitening toothpaste, Floride toothpaste, and herbal tooth paste.

Ingredient list of herbal tooth paste

Ingredient	Biological name	Use
Neem	Azadirachtaindica	Antibacterial
Babool leaves	Acacia Arabica	Astringent
Amrud leaves	Psidiumguajava	Anti Inflammantor
Kalmibark	Cinnamonum Zeylanicum	Flovaring agent
CompHor	CinnamonumcompHora	Antiseptic
Honey	ApisMelliferia	Sweetening agent

Whitening tooth paste ingredient list

Name	Use
Hydrogenperoxide	Bleaching agent
Sodiumlaurylsulp Hate	Foaming action
Hydratedsilica	Polishing agent
Sodium fluoride	Prevents diseases through specific function
Glycerin	Provides moderates moisture
Silica acid	Cleans the teeth without damaging.

pH meter The pH meter which we have used is digital pH meter. Whose model is Systonics-901. pH and emf value both are obtained from this pH meter.

We calibrated the pH meter with the buffer solution, Then we prepared the samples. For preparing samples we used 1 gm of each toothpaste in 40ml of water in different beakers. pH is determined with the help of pH meter for each toothpaste samples.

3. Result

pH

We used different toothpaste which are used in India. Determined pH with the help of pH meter. Close up toothpaste have very low pH of 7.13pH. (Table no 1). Which is approximately neutral. Amway glister having7.31 pH, Colgate max fresh having 7.41pH, wheras Patanjali dantkranti have 7.83. Some other herbal toothpaste like Vithoba have 7.21pH, Himalaya complex care have 7.37 pH value which shows the alkline property. where else Colgate Charcoal have 8.86pH and Vicco have 9.10 pH value. Sensitive tooth paste like Emo form-R have 8.69pH and Thermokind have 8.50pH. Dabur babool toothpaste have highest pH value around 9.15 which is highly alkaline in nature.

4. Observation

Table 1

S. No.	Name of toothpaste	pH
1.	Closeup	7.13
2.	Oriflame	8.05
3.	Colgate max fresh	7.41
4.	Patanjalidantkanti	7.83
5.	Colgate white	8.64
6.	Daburdantrakshak	9.08
7.	Pepsodent	8.94
8.	Colgate charcoal	8.86
9.	Viccovajradanti	9.27
10.	Amwayglister	7.31
11.	Himalaya complete care	7.37
12.	Sensodyne	7.66
13.	Vithoba	7.21
14.	Dabur Babool	9.15
15.	Emoform-R	8.69
16.	Thermokind-F	7.50

5. Discussion

pH In (Table no.1) close up have least pH of 7.13. Which is almost neutral and highestofdaburbaboolwhichispH9.15 (Tableno1) shows highly alkaline property. The tooth paste should have pH of between 7 to 10 which is good for our teeth as well as gums too. Dabur babool is a herbal toothpaste still have pH 9.15 which is highly alkaline which is good for our teeth. Rest of all tooth pastes have range 7.13 to 9.15 shows alkaline property.

More amount of chemical in our tooth paste cause side effect to our teeth and body

1) **Fluoride** – All the toothpaste contain fluoride, excessive use of this and using if for a long time can harm our brain, heart, digestive, system, and the enamel of our teeth. On the other hand there are certain toothpaste that do not contain fluoride example– EMOFORM–R
2) **Polishing agent**-polishing agent is added to every toothpaste, it work for the brightening of our teeth. Dehydrated silica gel and hydrated Aluminiumoxides are added to toothpastes as polishing agent.
3) **Detergent** –It is important to have detergent in toothpaste because they help forming to occur when you brush you teeth. one of the most common detergents placed in tooth paste is Sodiumlauryl Sulphate
4) **Xanthum Gum**- Xanthum gum used in toothpaste, it can cause some side effects such as intestinal gas and bloating.
5) **Tricloson ($C_{12}H_7Cl_3O_2$)**-Tricloson is an antibacterial and anti fungal agent, it is used in toothpaste. There are also concerns about Triclosan and its link with dioxin, Which is highly carcinogenic and can cause health problem as severe as weaking of the immune system, decreased fertility, miscarriage, birth defect and cancer. Recent work shows that triclosanpromotes liver cancer cell development in mice through pathway shared with humans.
6) **SodiumPyrophosphate ($Na_4P_2O_7$)** –Sodium pyrophosphate used in Toothpaste. Some of the side effects of sodium Pyrophospate are as follow. Example Irregular heartbeat, Vomiting, fainting, seizures, Itching.

6. Conclusion

On testing all toothpastes we found that Close up has lowest pH and Dabur babul has highest pH. The pH of remaining tooth paste are intermediate as compared to both.

This pH of the toothpaste directly affect our enamel because if this highly acidic, it will make the outermost layer of our teeth enamel, thinner. So our teeth can be sensitive. The pH of dabur babool toothpaste should be more than 7 as it is good for both our teeth and saliva and helps to kill the bacteria inside our mouth. basic property of toothpaste is good for our teeth and saliva. More amount of chemicals in

our toothpaste is good for our teeth and saliva. More amount of chemicals in our toothpaste causes side effects to our teeth and body.

References

[1] Andrea Salis, MauraManduzzi, Currentopianin Colloid and Interface Science, 23, 1-9, **2016.**
[2] 2. Ralph Gpearson, Science, 151 (4), 172-177, **1966**.
[3] Roger G Bates, and Ashok K Vijh, Journal of the Electrochemicalsociety, 120 (8), 26, **1973**.
[4] GergelyVolgyi,, KarlJbox, Johan EAcomerand Takacs Novok, AnalyticaChimica acta, 673 (1), 40-60, **2010**.
[5] Gergely Volgyi, EditBaka, Karl J box, John EA Comer, and Takas Novok, AnalyticsChimicaacta, 673 (1), 40-60, **2010**.
[6] PeterD Constable, Veterinary Clinical Pathology, 29 (4), 115-128, **2000**.
[7] GeradoSalinas, Bernado A Frantana-Vribe, Chem Electrochem, 6 (16), 4105-4117, **2019**.
[8] ZhenYuanXia, Alessandro, FabicTerzi, Carbon, 120 (8), 165-167, **2017**.
[9] JMoxon, M. AddyandRNewcombeclinicalpreventivedentistry, 13 (3), 12-15, **1991**.
[10] LShapira, MShapira, MTandlichs, and IGedalia, Journal of the International Academyperiodontology, 1 (4), 117-120, **1999**.
[11] AntonioCarlos, PereinFeernanda, LapesDaCunha, and Cwwerner, ASDCJournalof denstisteryfor childun, 67 (2), 132-135, **2000**.
[12] HPontefrout, SSheen, IMorn, Dental update, 28 (2), 61-14, **2001**.
[13] Svante twetman, Susanna Axelsson, HelonaDanlgren, Anna Karin holm, carinakalltell, Falke Lager & Peter lingstramIngegerdmajare, and birgittasoder, ActaodontalScandinavica, 61 (6), 347-355, **2003**.
[14] C Moore and M Addy, clinicalJournal ofclinical periodontology, 32 (12), 1242-1246, **2005**.
[15] J ROOS, A Dumoland, S Bourget Gruange, A Rausseau, P Grovding and J Colob, Juvinpressemedicale (PaursFrance: 1983), 34 (20pt1) 1518, 15-20, **2005**.
[16] D Dyer, M Addy, New combe, Journal of clinicalperiodontology, 27 (2), 99-103, **2006**.
[17] Denis M Omudane, Judith A Cochran and Hston P whilton, Community dentistryoralepidemiology, 32, 5-8, **2007**.
[18] MAddyJHughes, inIpicklesandAJoinn, HunlingtonJournalofClinicalperiodontologyof 2g (10), 896-900, **2007.**
[19] SvanteTwetman, EuropeanArchivesofpaediatricDentistry, 9 (1), 12-18, **2008**.
[20] RM Davies, RPEllwood, andGMDavies, Journalofclinicalperiodontology, 31 (12) 1029-1033, **2008.**
[21] Anash AI mulla, Saad AlKharsa and DawenBirkhed, AmericanJournalof orthodontics and DentofacialOrthopedics, 138 (3), 285-291, **2010.**
[22] DCTang, MRleoper, ANColehon, and A Mrich, ThejounierofLryungologyandoctology122 (10), 112-114, **2010.**
[23] UzeMaldupa, AndaBrinkmane, LengarendenieceandAnna Mihailana, stomatologija14 (1), 12-22, **2012.**