



# COMPARATIVE STUDY OF SOME MARKETED TOOTHPASTES AS PER BUREAU OF INDIAN STANDARDS

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**Abstract:** Toothpaste is a dental care product with a gel or paste formulation that is used to clean and maintain oral hygiene. The control of plaque and the reduction or prevention of oral illness are two benefits of a number of chemicals and preventative agents. However, some of these chemicals have negative side effects include stained teeth and changed taste. Hence the objective of this research is to formulate laboratory toothpaste using active compounds like clove and neem which have historically been used to clean teeth. According to Bureau of Indian Standards, the toothpaste formulation was evaluated for its organoleptic and physical qualities in comparison to commercial toothpaste formulations. To make laboratory toothpaste more stable, the proper chemicals were used in the formulation. Laboratory made toothpaste was equally patronising and engrossing as the commercial formulations, according to evaluation and comparison of outcomes with commercial toothpaste. Furthermore, the evaluation and comparative study is carried with 5 marketed samples obtained from different companies and containing the raw materials and actives that are used to formulate a laboratory sample.

**Keywords:** Toothpaste, evaluation, oral care, dental care, cosmetics.

## 1. INTRODUCTION

Since ancient times, people have used toothpastes, which are now one of the essential and indispensable parts of oral healthcare. From 300 to 500 BC, formulas for toothpaste were developed in China and India. In order to avoid dental problems, such as dental cavities, gingivitis, periodontal diseases, and bad breath, oral hygiene is the practice of maintaining a clean mouth and teeth. Plaque-forming bacteria and yeast found in the oral cavities are *Actinomyces*, *Actinobacillus*, *Streptococcus*, and *Candida Species*. Neem has been shown to have antibacterial properties against *S.mutans* and *S.faecalis*. By far the most popular way to consume fluoride is through toothpaste, and its growing use is mostly to blame for the drop in dental caries prevalence in developed nations.<sup>[1]</sup>

The function of toothpaste is two folds, first-it serves a cosmetic function to clean teeth (by removal of stain, plaque, and food debris) and second-to freshen the mouth also aiding to control caries, plaque, gingivitis, calculus, and sensitive teeth by acting as a delivery system for therapeutic agents. The first and the most vital function of toothpaste i.e. cleansing is primarily aided by abrasives and the process is enhanced with the help of surfactant, which aids in the penetration and removal of the adherent film and suspend removed soiling matter.<sup>[2]</sup> Since ancient time, neem oil has been used as oral care ingredient in India. Prolonged use of neem and clove oil has been known to lead to healthy teeth. It is most widely accepted by consumer as it has antibacterial property and protective property against micro flora.<sup>[3]</sup>

Market has flooded with numbers of toothpaste, all having different ingredients and claiming different effects. Customers are not aware about products they need. They run behind fancy Toothpaste and does not have knowledge that which product should be used, it is because that the packaging of toothpaste does not contain name of active ingredients, it mention base material but should mention which base is used. With the increase in the number of people opting for healthier lifestyles, including adopting organic products, a similar shift in trend is visible even in the beauty market.

The basic raw materials used to formulate toothpaste with there examples in each category are as follows, <sup>[4]</sup> Abrasive which is principal ingredient of dentifrice, Humectant which give moistness and plasticity to the powders in the dentifrice, Binding Agent which bind the powder and liquid ingredients, Preservative which prevent deterioration of dentifrice, Foaming agents which disperse the dentifrice throughout the mouth and clean away the dirt in the mouth, Flavours which make dentifrice more palatable by giving a refreshing taste and smell. Sweeteners which mask palatable taste.

Therapeutic agents are included in toothpastes in order to provide additional beneficial effects besides normal cleansing properties such as Whitening Agents, Anti-caries Agents, Anti-plaque Agents, Anti-tartar Agents, Sensitive Dentine Agents.<sup>4</sup> The qualities of toothpaste that are provided by the basic ingredients and additives are not all known to consumers. They are not aware of the toxicity levels of the additives or the suitable concentration level for the basic materials. On occasion, they are unaware of the distinctive traits that the brands tout. Unconcernedly, many consumers are using and buying these items.

Since they are ignorant of the restrictions imposed by the standards that the business must uphold, an effort is made to create toothpaste with calcium carbonate as a base.

Thus, the aim of research was to carry out the comparative study of five marketed toothpaste samples with the same base and formulation of laboratory sample with similar attributes and evaluating all the six samples of toothpaste as per the Bureau of Indian Standards.<sup>[8]</sup>

## 2. MATERIAL AND METHODS

### 2.1 Preparation of Extract of Neem Oil and Clove Oil.

Neem oil was prepared using water as a solvent and extraction method used was Clevenger Apparatus<sup>[5]</sup> and Clove Oil was prepared by Soxhlet extraction using alcohol as a solvent.<sup>[6]</sup>

### 2.2 Basic Raw materials used in formulation.

A laboratory sample was formulated with basic raw materials for comparison with the marketed product. The formulation of the laboratory sample of toothpaste is mentioned in Table No.1.

**Table.1: Formulation table of laboratory sample of Toothpaste.**<sup>[7]</sup>

| Sr. No. | Ingredient                    | The quantity given (100%)      | Use   |
|---------|-------------------------------|--------------------------------|---|
| 1.      | Calcium Carbonate             | 20-40%                         | Abrasive  |
| 2.      | Sodium carboxymethylcellulose | 0.9-2.0%                       | Binding agent   |
| 3.      | Glycerin                      | 5.0-10.0%                      | Humectant   |
| 4.      | Sorbitol                      | 5.0-10.0%                      | Humectant   |
| 5.      | Menthol                       | 1-6%                           | Flavour   |
| 6.      | Sodium Lauryl Sulphate        | 0.5-2.0%.                      | Foaming agent   |
| 7.      | Sodium Fluoride               | 1000 to 1500 parts per million | Anti-caries agent   |
| 8.      | Sodium Saccharin              | 0.05- 1.0%.                    | Sweetener   |
| 9.      | Propyl Paraben                | 0.01-0.6%                      | Preservative  |
| 10.     | Methyl Paraben                | 0.02-0.5%                      | Preservative  |
| 11.     | Neem Oil                      | 0.1-0.2%                       | Reduce deposition of plaque, prevent caries and tooth decay |
| 12.     | Clove Oil                     | 0.3-1.0 %.                     | It ensures strong teeth and healthy gums.                   |

### 2.3 Preparation of Toothpaste

All the apparatus were cleaned and dried properly. Sodium carboxymethylcellulose was taken in one mortar and triturated it with water, and allowed it to swell. In another mortar other ingredients like Calcium carbonate, Propyl Paraben and Methyl paraben were taken. These ingredients were triturated with Glycerine. Then side by side water was added to the above mixture to form a smooth paste. Then Sodium saccharin was dissolved in water and added to above mixture. Menthol and Sorbitol was dissolved in 3 ml of water and then added to the above mixture. Then sodium lauryl sulphate was added and triturated properly to avoid excessive foaming. Lastly neem oil and clove oil was added in above formulation. Toothpaste was collected and packed into suitable container and named it Laboratory Sample.



Fig.1: Laboratory Sample

### 3. EVALUATION

The Marketed and formulated Toothpaste was subjected to physical and biological evaluation as per Bureau of Indian Standards [8]. The parameters for which evaluation of all the six toothpaste was done includes Determination of Fineness [9], Determination of pH [9], Determination of Foaming Power [10], Determination of Fluoride Ion [11] and Determination of Heavy Metals (as Pb) [12]

#### 3.1 Microbial examination of Toothpaste [13]

Observation:

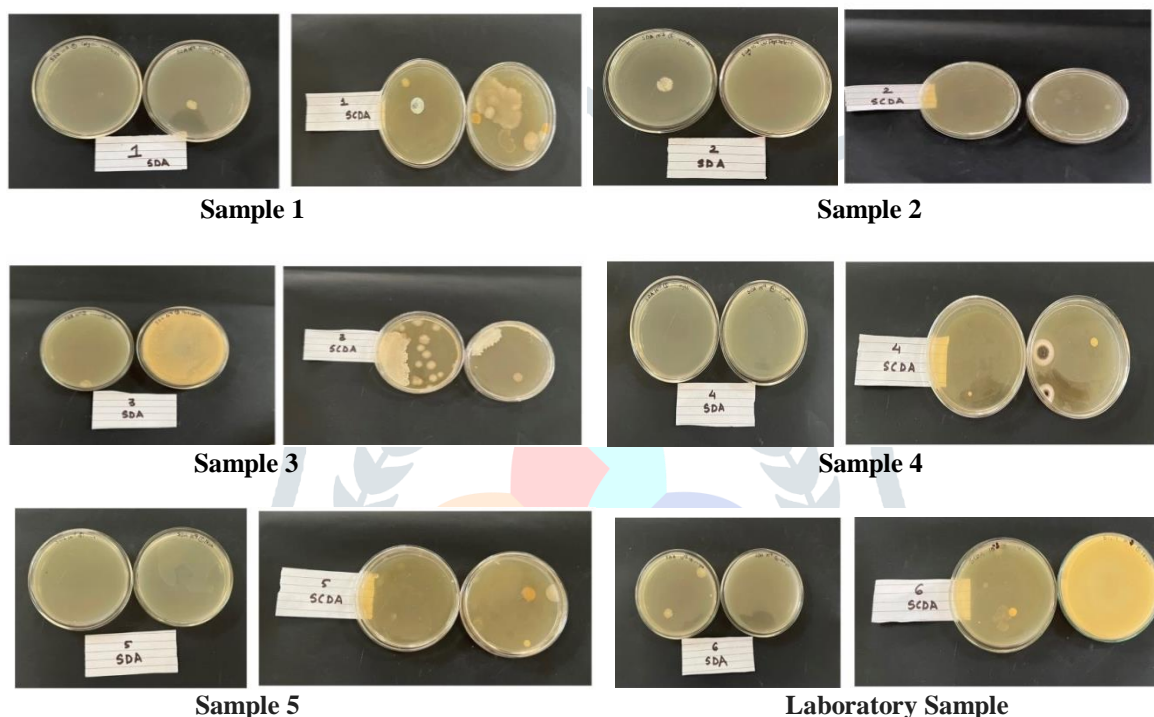


Fig.2: Observation of Microbial Examination for all six samples of Toothpaste

#### 3.2 Sharp & Sharp edged abrasive particle [9]

Procedure: The paste was extruded about 15 to 20 cm. length on a butter paper. The paste was then pressed and determine hard & sharp edged abrasive particles.

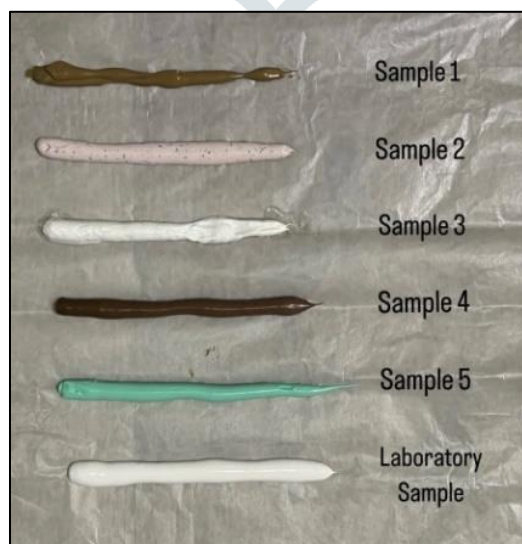


Fig.3: Observation of Sharp & Sharp edged abrasive particles.

### 3.3 Determination of Moisture content <sup>[14]</sup>

Procedure: The clean petri dish was heated in hot air oven for 15-20 minutes. Then it was place it in a desiccator for 20 minutes. The petri dish was weighed accurately. 2-3g of the sample was added into petri dish. The product was spread by rotating the petri dish. The petri-dish was weighed accurately and kept in oven at 105<sup>0</sup>C for three hours. It was then cooled in desiccator and was weighed.

### 3.4 Spreadability <sup>[14]</sup>

Procedure: 1gm of toothpaste was added at the centre of glass plate & another glass plate was over it. 2kg weight was placed at the centre of the plate. Then the diameter was measured of paste in centimetres. After 30 minute experiment was repeated thrice & the average was noted.

### 3.5 Stability <sup>8</sup>

Procedure: The prepared toothpaste along with all five marketed toothpaste was kept at 4°C, 27°C, and 45°C, and changes if any in its properties till 4 weeks (28 days) were observed.

### 3.6 Subjective Evaluation

To evaluate the nature of the products, all six toothpaste were given to 6 subjects each. They were asked to use daily one product. They were provided with Questionnaire and they were asked to fill their experience after the application of each product after 4 weeks and they were simply asked to rate the product on a few parameters. The parameters for evaluation were Quality, Healthy Tooth and Gums, Long lasting Freshness, Prevention of Tooth Decay, Whitening.

The form which was distributed among clients is as follows:

## QUESTIONNAIRE

### Personal Information

Name : \_\_\_\_\_

Age : \_\_\_\_\_

Sex : Male  Female

Occupation : \_\_\_\_\_

How many times you brush your teeth: \_\_\_\_\_

Sample 1

Sample 2

Sample 3

Sample 4

Sample 5

Laboratory Sample

1. Consistency : Bad  Good  Very Good  Better  Excellent

2. Healthy Tooth and Gums : Bad  Good  Very Good  Better  Excellent

3. Long Lasting Freshness : Bad  Good  Very Good  Better  Excellent

4. Prevention of tooth decay: Bad  Good  Very Good  Better  Excellent

5. Whitening : Bad  Good  Very Good  Better  Excellent

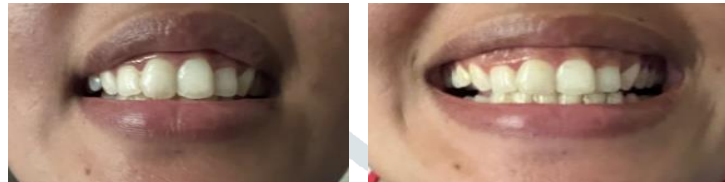
Observation:

Before

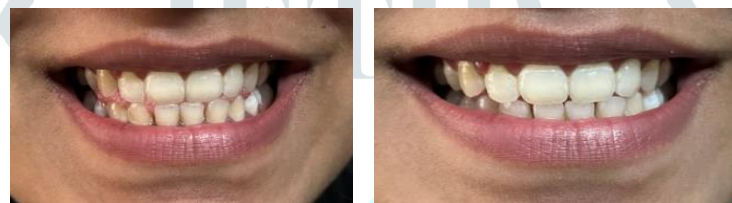
After



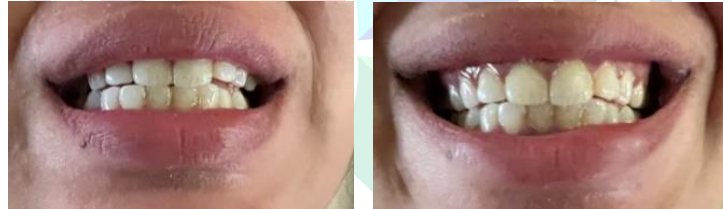
**Fig.4: Subjective evaluation of Sample 1**



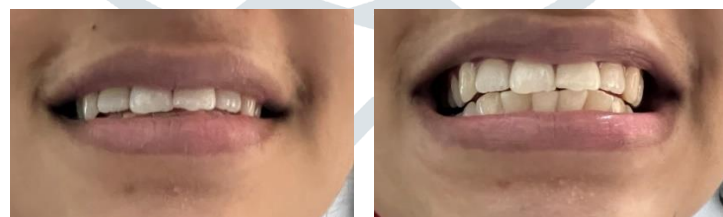
**Fig.5: Subjective evaluation of Sample 2**



**Fig.6: Subjective evaluation of Sample 3**



**Fig.7: Subjective evaluation of Sample 4**



**Fig.8: Subjective evaluation of Sample 5**



**Fig.9: Subjective evaluation of Laboratory Sample**

## 4. RESULT

Table.3: Combined results of parameter tested as per Bureau of Indian Standards. <sup>8</sup>

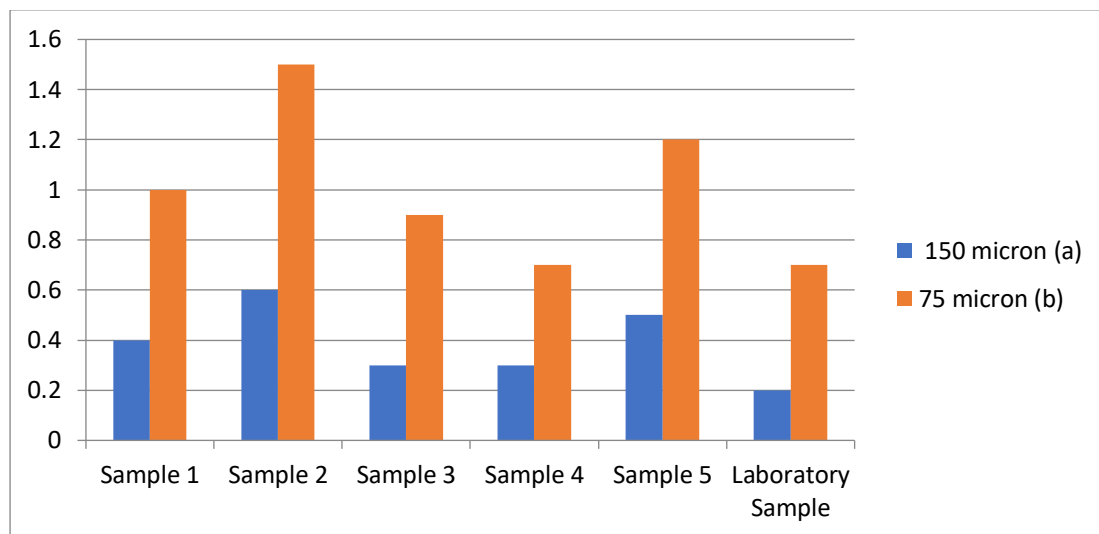
| Sr. No. | Evaluation Parameters                                   | Observation and Result |                     |                     |                     |                     |                     |                     |
|---------|---|------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|         |   | Requirement            | Sample 1            | Sample 2            | Sample 3            | Sample 4            | Sample 5            | Laboratory Sample   |
| 1.      | Fineness:<br>a. 150 micron sieve.<br>b. 75 micron sieve | 1.0                    | 0.4                 | 0.6                 | 0.3                 | 0.3                 | 0.5                 | 0.2                 |
|         |   | 2.5                    | 1.0                 | 1.5                 | 0.9                 | 0.7                 | 1.2                 | 0.7                 |
| 2.      | pH  | 5.5-10.5               | 8.48                | 8.16                | 8.29                | 8.08                | 8.06                | 8.29                |
| 3.      | Foaming Power   | 50                     | 45                  | 34                  | 22                  | 55                  | 45                  | 40                  |
| 4.      | Fluoride Ion  | 1000                   | 104.3               | 98.0                | 97.5                | 106.4               | 103.4               | 83.63               |
| 5.      | Heavy metal (as Pb)                                     | Less than standard     | Less than standard  | Less than standard  | Less than standard  | Less than standard  | Less than standard  | Less than standard  |
| 6.      | Microbial Examination                                   | 100                    | Cluster of colonies | Cluster Of colonies | Cluster of colonies | Cluster of colonies | Cluster of colonies | Cluster of colonies |
| 7.      | Sharp & Sharp edged abrasive particles.                 | Absent                 | Absent              | Absent              | Absent              | Absent              | Absent              | Absent              |
| 8.      | Moisture Content  | 7.0                    | 5.5                 | 5.3                 | 4.8                 | 4.9                 | 5.6                 | 5.3                 |
| 9.      | Spreadability   | Easily Spread          | Easily Spread       | Easily Spread       | Easily Spread       | Easily Spread       | Easily Spread       | Easily Spread       |
| 10.     | Stability test  | To pass the test       | Stable              | Stable              | Stable              | Stable              | Stable              | Stable              |

Table.4: Result of Subjective Evaluation of all six samples of Toothpaste

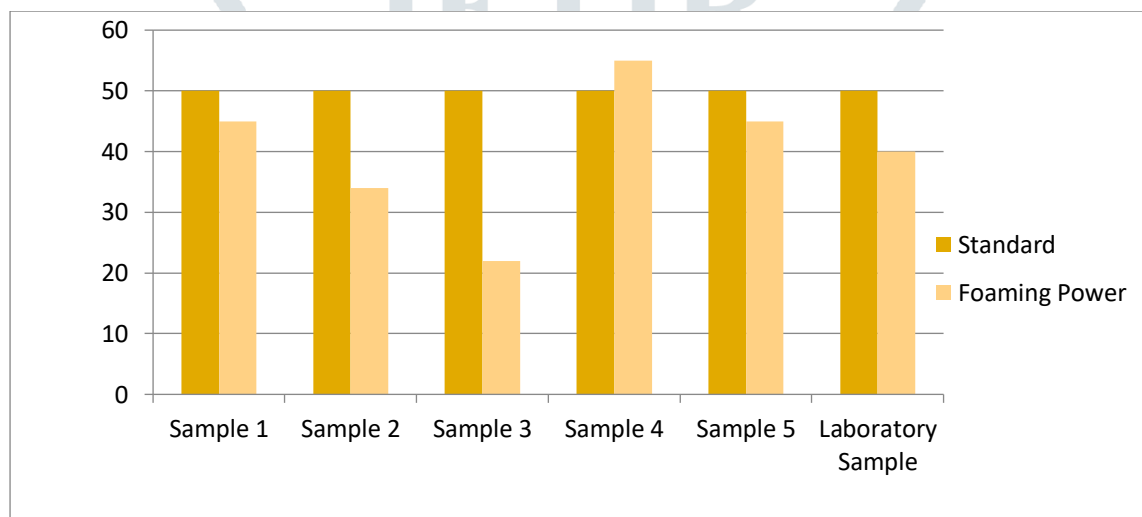
| Toothpaste        | Parameters  |                        |                        |                           |           |
|-------------------|-------------|------------------------|------------------------|---------------------------|-----------|
|                   | Consistency | Healthy Tooth and Gums | Long Lasting Freshness | Prevention of tooth decay | Whitening |
| Sample 1          | 5           | 4                      | 3                      | 2                         | 3         |
| Sample 2          | 5           | 4                      | 4                      | 3                         | 4         |
| Sample 3          | 5           | 4                      | 5                      | 4                         | 5         |
| Sample 4          | 5           | 4                      | 3                      | 2                         | 3         |
| Sample 5          | 5           | 4                      | 5                      | 3                         | 4         |
| Laboratory Sample | 4           | 3                      | 4                      | 3                         | 3         |

## 5. GRAPHICAL REPRESENTATION OF RESULTS

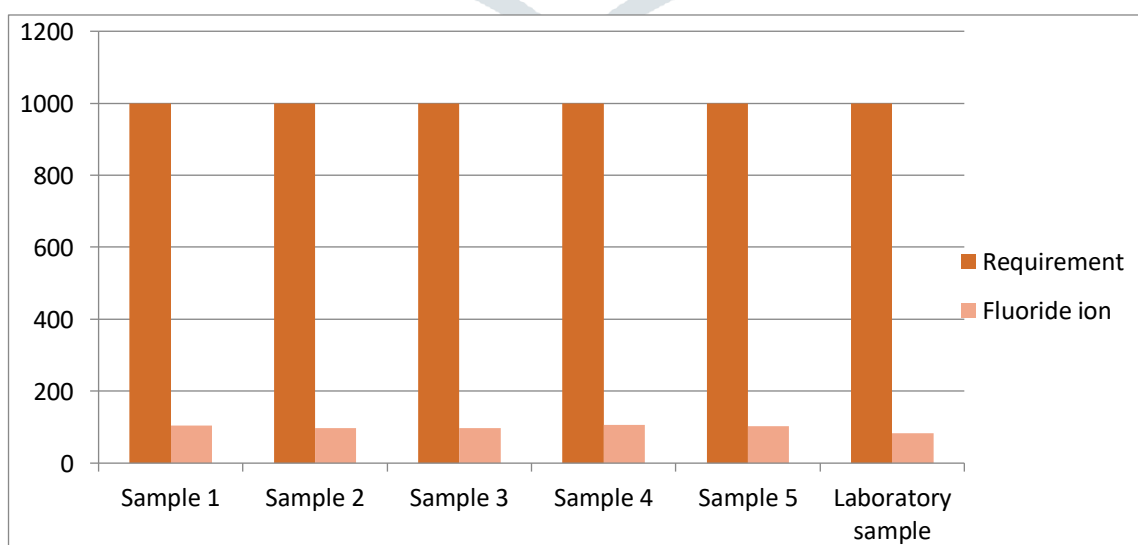
### 5.1 Graphical Representation of Fineness



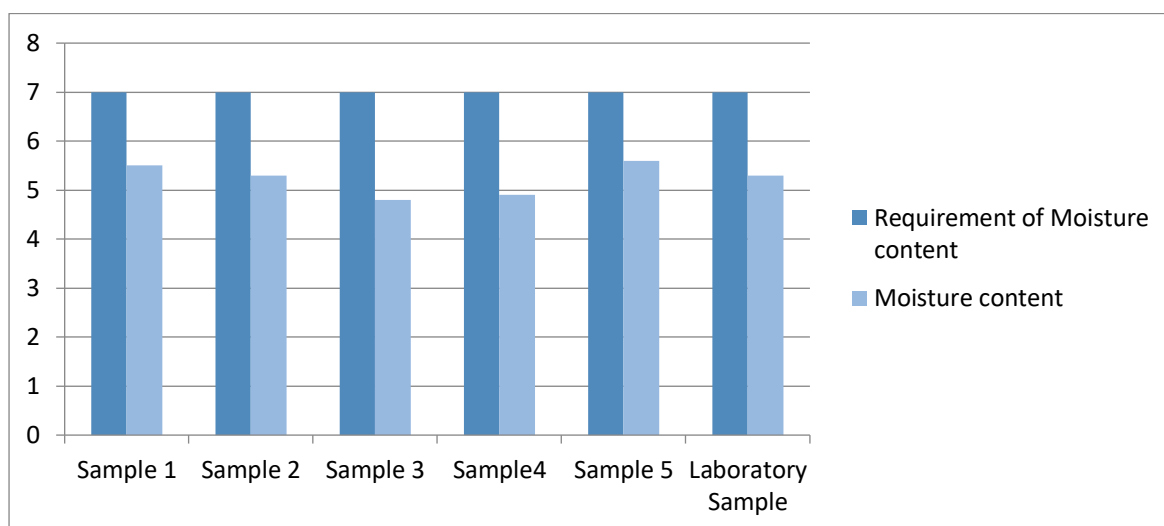
### 5.2 Graphical Representation of Foaming Power



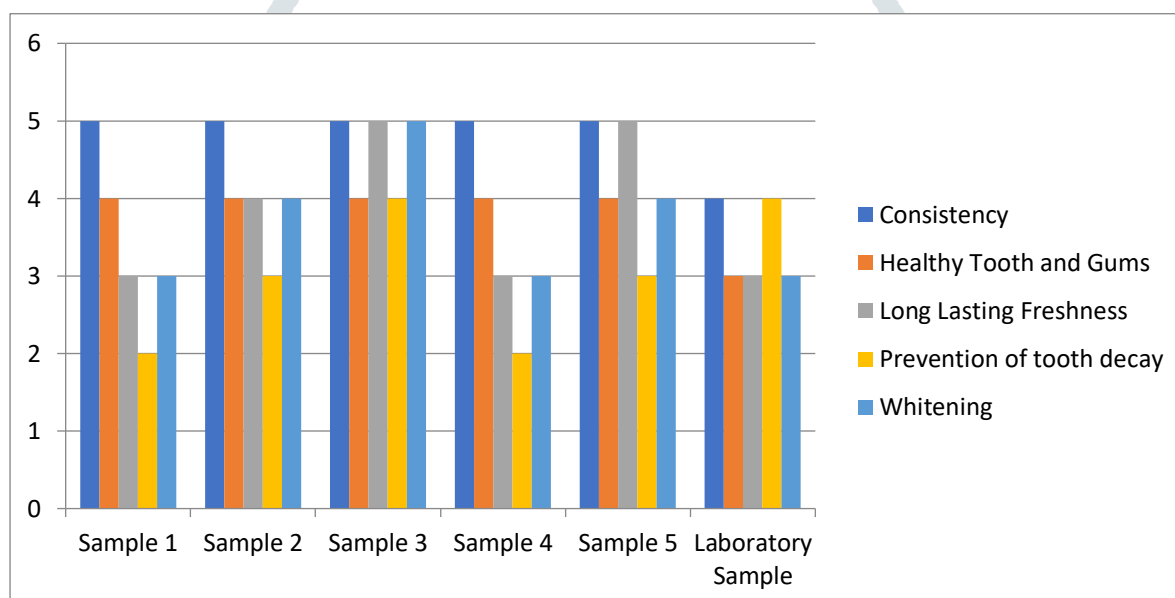
### 5.3 Graphical Representation of Fluoride ion



#### 5.4 Graphical Representation of Moisture Content



#### 5.5 Graphical Representation of the Result of Subjective Evaluation:



### 6. DISCUSSION AND CONCLUSION

Market is flooded with so many products that customers are confused that which product is suitable for them. Customers are unaware about the product they are using. Due to the wide range of products on the market, as well as the advertisements and claims made by the businesses, people frequently become confused when making purchases therefore customers run behind the fancy toothpaste. Consumers get confused while purchasing because of vast variety of products available in market and the aggressive advertisements and very towering claims done by the manufacturer. They often purchase a product which is popular in the market or the products which they have been recommended by someone. They usually are unaware of all the characteristics of toothpaste that are provided by the basic raw materials and additives, toxicity levels of the additives or the suitable concentration level for the basic materials and the limitations of the standards that the company must maintain.

In light of these considerations, five samples were collected from the market and laboratory sample was formulated. The toothpaste was prepared from the above-mentioned ingredients and it is subjected to the qualitative chemical analysis for identification of various plant constituents. The various parameters like Fineness, Foaming power, Fluoride ion, Heavy metals, Microbial, Moisture content test of all the six samples of toothpaste were evaluated as per the Bureau of Indian Standards specification and Indian Pharmacopoeia for Toothpaste.

Along with comparing it to commercial toothpaste that already has neem oil, clove oil, and calcium carbonate as a base, and evaluating it on several criteria.

It was concluded that Sample 2 has the highest fineness of 150 micron sieve and 75 micron sieve as compared to other samples. All six toothpaste samples passed its requirement. It was found out with the help of pH. Fluoride ion, Sharp and Sharp edged abrasive particles and Spreadability. The Foaming power test concluded that the sample 4 has a high foaming power of toothpaste as compared to requirement and others except sample 4 all toothpaste samples passed the test for its requirement. The Fluoride ion parameter of all the samples was determined and it concluded that all six sample of



toothpaste passed the test with the lowest value given by laboratory sample. All six toothpaste samples have neither hard nor sharp edge abrasive particles was found with the help of determination of sharp and sharp edged abrasive particles. All six toothpaste samples have Lead (as Pb) under the required specification as found out with the help of the determination of heavy metal. The microbiological examination concluded that all six toothpaste samples contain cluster of colonies were observed and hence they did not passed the test. Such situation may occur due to very relaxed ranges of parameters mentioned by BIS so at the time of exit from the manufactures outlet the samples passed the test. All six toothpaste sample had a good moisture content and sample 5 has the highest moisture content as compared to other samples hence all six samples has passed the test. The stability study concluded that all six toothpaste samples were stable under specific conditions along with their organoleptic properties for 28 days.

The subjective evaluation of all six toothpaste was carried out. All six samples had a great consistency. Sample 1 was accepted for Healthy Tooth and gums by subject. All six samples except laboratory sample had accepted for Healthy Tooth and gums lab sample was accepted for better long lasting freshness by the subject. Sample 3 was accepted for Whitening by subject. Thus, all six toothpaste samples were found to be useful and acceptable under the specification of Bureau of Indian Standard of Toothpaste specification.

Though all the six toothpaste samples were found to be useful and acceptable under the specification of Bureau of Indian Standards of Toothpaste specifications the role of manufactures is to create awareness amongst the consumers regarding their products. They should mention the merits as well as demerits of the products. On the other hand, consumer should educate themselves about their oral health and their causes what suits them or not. The customer should be aware of the specifics and effects of the active component in toothpaste as well as the base material used by mentioning it on the container. Customers should educate themselves about dental hygiene and the appropriate toothpaste for a certain parameter. This will simplify their choices and would be easier for them to pick a right fit.

## 7. ACKNOWLEDGMENT

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