

# A Detailed Evaluation of the Quality and Consumer Acceptance of Marketed Toothpaste

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**Abstract:** *The Purpose of this study is to assess the quality of widely used toothpaste brands, both synthetic and herbal, that people rely on daily. It's crucial to test these products to ensure their effectiveness in maintaining oral health. Our analysis will cover a range of popular brands, examining key factors such as stability, abrasiveness, spreadability, homogeneity, foaming ability, pH levels, density, and the presence of heavy metals. By employing statistical data, we'll compare the performance of these toothpaste brands. The results of this comprehensive evaluation will provide valuable insights for consumers seeking the best products for their oral hygiene, guide dental professionals in making informed recommendations.*

**Keywords:** Marketed Toothpaste, Evaluation test

## 1. Introduction

Maintaining oral hygiene is crucial for overall health and well-being. Toothpaste plays a vital role in removal of plaque, food debris, promoting fresh breath and delivering beneficial ingredients to support healthy teeth and gums.

For centuries human have turned to herbs for medicinal properties, this tradition has extended to oral care where herbal toothpaste is emerging as a popular remedy for maintaining oral hygiene. In today's world the toothpaste industry is mostly focusing on herbal toothpaste to prevent dental plaque and prevent development of gingivitis which is a common problem nowadays. Herbal toothpaste is more effective as they contain some herbs - like neem which possess antibacterial and antifungal activities, aloe vera which prevents or cures mouth ulcers, and many other ingredients- which maintains our oral hygiene.

Other than herbal ingredients, toothpaste contains fluoride that strengthens tooth enamel; it works by demineralizing weakened enamel, making it more resistant to acid attacks from plaque bacteria. Many types of toothpaste contain mild abrasives that can help to remove surface stains from teeth, leaving them looking whiter.

These herbal toothpastes can be evaluated by different tests like Physical Examination, Relative density, Abrasiveness, Determination of spread ability, pH determination, Homogeneity, Foaming, Stability, Determination of moisture and volatile matter, Moisture content, Foaming character, Organoleptic evaluation, pH, Fragrance test, Shape retention, Storage stability, detection of flavonoid in Tooth paste, antimicrobial activity of toothpaste etc.

## 2. Materials

Ready-made formulations from markets were used in evaluation of toothpaste, different brands of toothpaste were considered for this research work.

Eight different toothpaste brands named vicco vajradanti®, colgate®, pepsodent®, colgate maxFresh®, dabur red®, dant kanti by Patanjali®, Himalaya complete care® and colgate maxfresh charcoal® were used in this evaluation and each brand was given an alphabetical code as given in the image below



Figure 1: Toothpaste brands used for the project.

### 3. Methodology Evaluation of Toothpastes

#### 1) Organoleptic evaluation:

- Colour: The colour was visually checked
- Odour: Odour was found by smelling the product
- Taste: Taste was checked manually by tasting the product.

#### 2) Spreadability:

A small quantity of toothpaste is placed at a centre of transparent plate and another transparent plate is placed over it carefully. At the centre of the plate a 1kg weight is placed for 10 minutes then the diameter of paste is measured in cm.

#### 3) Shape retention:

Tooth paste was squeezed out from the tube and put entirely of a tooth brush and the state of the toothpaste after it was allowed to stand for 10 seconds was evaluated based on the below-described criteria;

- Shape just after the toothpaste is squeezed out on the toothbrush is maintained.
- Shape just after the toothpaste is squeezed out on the toothbrush is almost maintained.
- The toothpaste squeezed from the toothbrush and cannot maintain its shape

#### 4) Abrasiveness:

Extrude the content 15-20 cm long on the butter paper. Press with the contents of the entire length with fingertip for the presence of sharp and hard edged abrasive particles. The criteria will be 1) Non-abrasive 2) slightly abrasive 3) highly abrasive

#### 5) Homogeneity:

The toothpaste shall extrude a homogenous mass from the collapsible tube or any suitable container by applying of normal force at  $32 \pm 2^\circ\text{C}$ , does every tubes takes the same amount of force for extruding the paste is checked.

#### 6) Extrudability:

Newly packed toothpaste were open and extruded on a butter paper, while a person experiencing the amount of force required to extrude the paste and the brands were given a numerical ranking based on the force applied from 1 to 8 with 1 being the least amount of force applied and 8 being the maximum force applied.

#### 7) Foaming:

The foamability of formulated toothpaste evaluated by taking small amount of formulation with water in measuring cylinder initial volume was noted and then shaken for 10 times. Final volume of foam was noted. Determination of froth power

$$\text{Foaming power} = V_1 - V_2$$

$V_1$ - Volume in ml of foam with water.

$V_2$ - Volume in ml of water only

#### 8) pH determination:

Take 10g of toothpaste in 150ml beaker mix it with distilled water to make a suspension and determine the pH using a pH meter.

#### 9) Relative density:

It was determined using RD bottle

Calculation:

$$\text{Relative density} = \frac{\Delta w'}{\Delta w}$$

$\Delta w = w_1 - w_2$  (where  $w_1$  is weight of empty bottle and  $w_2$  is bottle filled with water);

$\Delta w' = w'_2 - w_1$ , (where  $w'_2$  is bottle filled with paste)

#### 10) Determination of moisture and volatile content:

5 g of formulation placed in a porcelain dish containing 6-8 cm in diameter and 2-4 cm depth in it. Dry the sample in an oven at  $105^\circ\text{C}$ .

Calculation:

Percent by mass =  $100 * \frac{M1}{M}$  where M1 is the loss of mass on drying and M is the mass of material taken for test

#### 11) Tests for flavonoid:

Alkaline reagent test: two to three drops of sodium hydroxide were added to 2ml of solution of toothpaste. Initially a deep yellow colour appeared but it gradually became colourless by adding few drops of dilute HCl, indicating flavonoid is present.

#### 12) Tests for heavy metal:

**Table I:** Procedure to perform limit test of heavy metals

Test solution	Standard solution
Into a 50-ml Nessler cylinder place 25 ml of the solution prepared for the test dissolve the specified quantity of the substance under examination in a mixture of 20 ml of water and 5 ml of dilute sodium hydroxide solution. Dilute with water to 50 ml and mix	Into a 50-ml Nessler cylinder pipette 1.0 ml of lead standard solution (20 ppm Pb), add 5 ml of dilute sodium hydroxide solution, and dilute with water to 50 ml and mix.
Add 5 drops of sodium sulphide solution, mix, allow it to stand for 5 minutes and view downwards over a white surface.	Add 5 drops of sodium sulphide solution, mix, allow it to stand for 5 minutes and view downwards over a white surface.

*\*If the colour of test solution is less intense than the standard then it passes the test.*

#### 13) Stability:

The toothpaste in their tubes were kept at  $35^\circ\text{C}$  for one month and same was done at a temperature of  $5^\circ\text{C}$  and the condition of toothpaste were observed.

#### 14) Antimicrobial activity of toothpaste:

The antimicrobial activity of different concentrations of the dentifrices was determined by modified agar well diffusion method. In this method, nutrient agar plates were seeded with 0.5 ml. of 24 h broth cultures of each isolate (brain heart infusion agar was used for Streptococcus mutans strain). The plates were allowed to dry for 1 h. A sterile 8 nun cork-borer was used to cut one central and five wells at equidistance in each of the plates. 0,2 ml. of the dentifrice dilutions was introduced into each of the five wells while the same amount of sterile distilled water was introduced into the first well as control. The plates were incubated at  $37^\circ\text{C}$  for 24 h (48 h for yeast species). The antimicrobial activity was evaluated by measuring the diameter of zones of inhibition (in mm)

## 4. Results and Discussion

**Table II:** Results for the tests of colour, spreadability, and shape retention

Tests → Alphabetical code of toothpaste ↓	Color	Spreadability (Diameter in cm)	Shape retention
A	Yellowish- white	3.0	A
B	White	3.9	A
C	Pale pink	4.6	A
D	Bright red	6.1	A
E	Orange	4.8	A
F	Greenish-brown	5.3	A
G	Grey	5.8	A
H	Black	6.0	B

**Table III:** Results on tests regarding abrasiveness, homogeneity and extrudability

Tests → Alphabetical code of toothpaste ↓	Abrasiveness	Homogeneity	Extrudability*
A	Non abrasive	Non homogeneous	8
B	Non abrasive	Homogeneous	4
C	Slightly abrasive	Non homogeneous	6
D	Non abrasive	Non homogeneous	5
E	Non abrasive	Homogeneous	7
F	Non abrasive	Homogeneous	1
G	Non abrasive	Homogeneous	3
H	Non abrasive	Non homogeneous	2

\* Note that the readings of Extrudability are in terms of rank that means the smaller the number the higher the rank of the paste. These ranks were given on the basis of the result we obtained by performing the test (Refer methods to know about the test).



**Figure 2:** Abrasiveness of the toothpastes



**Figure 3:** Extrudability test of the toothpastes

**Table IV:** Results of the tests regarding foaming power and pH determination

Tests → Alphabetical code of toothpaste ↓	Foaming			pH determination at 27±1°C
	V <sub>1</sub> (ml)	V <sub>2</sub> (ml)	Foaming power	
A	16	19	3	8.37
B	18	29	9	9.43
C	19	25	6	9.14
D	15	20	5	6.97
E	16	21	5	8.96
F	17	24	7	7.96
G	14	22	8	6.11
H	17	27	10	7.03

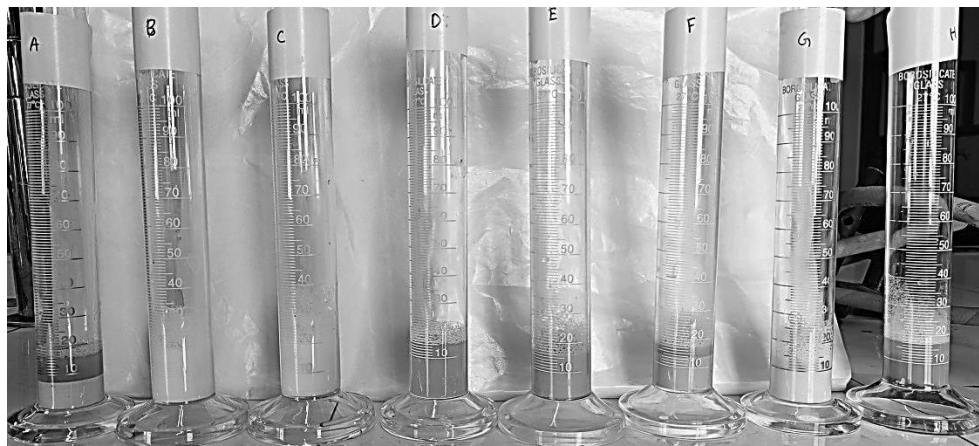


Figure 4: Foamability test of toothpastes

Table V: Results on the test of relative density

Tests → Alphabetical code of toothpaste ↓	Relative density					
	W1 (g)	W2 (g)	Δ w (g)	W2' (g)	Δ w' (g)	Δ w' / Δ w
A	12.7	22.5	9.8	28.5	15.8	1.6122449
B	12.7	22.5	9.8	28.6	15.9	1.62245
C	12.9	22.8	9.9	28	15.1	1.5253
D	14.6	24.7	10.1	27.8	13.2	1.30693
E	12.7	22.5	9.8	28.4	15.7	1.60204
F	12.7	22.5	9.8	28	15.3	1.561225
G	12.9	22.8	9.9	25.7	12.8	1.29293
H	14.6	24.7	10.1	27.9	13.3	1.31683

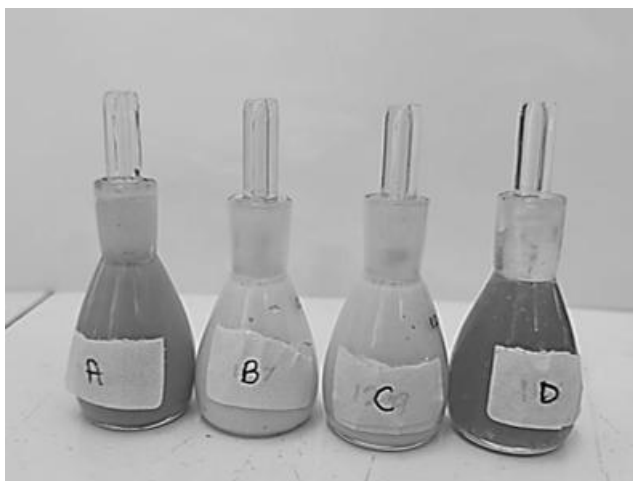


Figure 5 (a): Relative density test for toothpastes (Samples A -D)



Figure 5 (b): Relative density test for toothpastes (Samples E -H)

Table VI: Result on the tests of moisture content, flavonoid detection and heavy metal limit test

Tests → Alphabetical code of toothpaste ↓	Determination of moisture			Flavonoid detection test	Heavy metal limit test
	M1 (g)	M (g)	Percent of mass (%)		
A	8.9	10	89	Present	Pass
B	9.4	10	94	Present	Pass
C	9.3	10	93	Present	Pass
D	9.2	10	92	Present	Pass
E	9	10	90	Present	Pass
F	9	10	90	Present	Pass
G	8.7	10	87	Present	Pass
H	9	10	90	Present	Pass

5. Conclusion

All marketed toothpastes mentioned in the paper are crucial for maintaining oral hygiene and have been safe for use: they passed all required evaluations.

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