WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 7.523
Volume 6, Issue 2, 534-543. Research Article ISSN 2277– 7105

FORMULATION AND EVALUATION OF TOOTHPASTE BY USING EGGSHELLS

Gaurav Balu Dafal* and Navin K. Khare

Department of Pharmaceutics, Dr. D.Y.Patil Institute of Pharmaceutical Science and Research, Pimpri, Pune, Maharashtra, India, 411018.

Article Received on
11 Dec. 2016,

Revised on 01 Jan. 2016,
Accepted on 22 Jan. 2017

DOI: 10.20959/wjpr20172-6975

***Corresponding Author**
Gaurav Balu Dafal
Department of Pharmaceutics, Dr. D.Y.Patil Institute of Pharmaceutical Science and Research, Pimpri, Pune, Maharashtra, India, 411018.

ABSTRACT

Toothpaste is defined as a dentifrice in the form of a smooth, semisolid, homogeneous mass containing acceptable ingredients such as abrasives/polishing agents, surface active agents, humectants, binding agent, and other appropriate substances for oral health maintenance. In the present work Eggshell powder has been used as abrasive in toothpaste. Various formulations were formulated and evaluated and the most suitable formulation was F3 which found to conform all statutory specifications. Eggshell based formulation is reported useful in treatment of dental caries and tooth hypersensitivity. Calcium plays active role in remineralization of enamel and eggshell powder has a very high percentage of bio-available calcium. For treatment of dental caries and tooth hypersensitivity many formulations are commercially available but eggshell based toothpaste is seems to be most effective and economic product. The composition of an eggshell is very similar to that of our bones and teeth. The main objective of this work is to prepare and evaluate eggshell powder suitable for toothpaste and to prepare toothpaste by using eggshell powder. Toothpaste was evaluated by various evaluation parameters such as pH, Hard and Sharp edged abrasive particles, Fineness, Foaming power, Spreadability.

KEYWORDS: Eggshell, Calcium, Abrasive, Dental caries, Hypersensitivity.

INTRODUCTION[1,2]

Toothpaste is defined as a dentifrice in the form of a smooth, semisolid, homogeneous mass containing acceptable ingredients such as abrasives/polishing agents, surface active agents, humectants, binding agent, and other appropriate substances for oral health maintenance. The

product can be opaque, transparent or combination thereof, coloured or white, packed in a suitable container from which it can be extruded in the form of a continuous mass.

Egg shells are one of the best sources of calcium, which is absorbed by organism in approximately 90% and it is easier for your body to digest and absorb. One whole medium sized eggshell makes about one teaspoon of powder, which yields about 750 – 800 mgs of elemental calcium plus other microelements, i.e. magnesium, boron, copper, iron, manganese, molybdenum, sulphur, silicon, zinc, etc. There are 27 elements in total. The composition of an eggshell is very similar to that of our bones and teeth. Eggshell also contains Calcium Carbonate. Eggshell presents healthy, balanced calcium due to trace amounts of other minerals contained in it. Eggshell is probably the best natural source of calcium. It is a much better source of calcium than limestone or coral sources. It is recommended that people with osteoporosis take 400-500 mg calcium per day to supplement dietary sources. Eggshells are waste materials from hatcheries, homes and fast food industries and can be readily collected in plenty. The composition of the egg shell is approximately 98.2, 0.9, 0.9% Calcium carbonate, Magnesium and Phosphorous (phosphate) respectively. Shell membranes comprises of 69.2% protein, 2.7% fat, 1.5% moisture and 27.2% ash.

Fig. 1: Eggshells

MATERIALS AND METHODS

1) Characterisation of Eggshells

i) Organoleptic Properties: Colour and Appearance of the eggshells was determined by visual inspection, odour and taste is also determined.

ii) Method of preparation of Eggshell Powder

- Collecting Eggshells
- Cleaning of Eggshells
- Drying of Eggshells

- Powder the Eggshells by grinding and passing through suitable sieve.
- Storage of Eggshell powder.

A) Collection of Eggshells

Eggshells were collected.

B) Cleaning of Eggshells

The eggshells were cleaned in distilled water then the eggshells were kept in a hot water bath at 100°C for 10 minutes followed by removing the membrane.

C) Drying of Eggshells

Eggshells were air dried.

D) Powdering of Eggshells

Then the eggshells were crushed using a mortar, pestle and sieved to collect the fine powder through 150µ I.S sieve.

E) Storage of Eggshell Powder

Powdered Eggshell was stored in air tight container.

2) Morphological Analysis of powdered egg shell by Optical Microscopy

The external morphology of powdered egg shell was studied by optical microscopy. The sample of powdered egg shell placed on transparent slide and observed under 10X. Afterwards, the powdered egg shell sample particle size is taken and the results were reported.

Formulation of Toothpastes (50 gm)

Table 1: Formulation data of Toothpaste

Sr.No	Ingredients	Category	F1	F2	F3
1	Eggshell Powder	Abrasive	19.75 gm	19.75 gm	19.75 gm
2	Glycerol	Humectant	10 gm	10 gm	10 gm
3	Sodium Lauryl Sulphate	Surface active agent	3.15 gm	3.15 gm	3.15 gm
4	Gum Tragacanth	Binder	0.55 gm	-	-
5	Xanthan Gum	Binder	-	0.6	0.65
6	Sodium Saccharine	Sweetener	0.05 gm	0.05 gm	0.05 gm
7	Peppermint Oil	Flavouring agent	0.6 gm	0.6 gm	0.6 gm
8	Distilled Water	Vehicle	q.s	q.s	q.s

Procedure[3]

- Eggshell powder and Binder are mixed as a dry powder on ointment slab and with the help of spatula it was mixed.
- Then a hot solution of Glycerol, Water and Sodium saccharine is added slowly with mixing of the dry powder.
- After that solution of peppermint oil and sodium lauryl sulfate was added to form homogeneous paste.

Evaluation of Toothpaste[1,4,5,6]

Determination of pH

Dispense 5 g of the toothpaste from the container in a 20-ml beaker and add 5 ml of freshly boiled and cooled water (at 27°C) to make 50 percent aqueous suspension. Stir well to make a thorough suspension. Determine the pH of the suspension within 5 min, using a pH meter.

Determination of hard and sharp edged abrasive particles

The paste was extruded about 15 to 20 cm length from collapsible tube on a butter paper. Then the paste was tested by pressing it entire length by a finger for the presence of hard and sharp edged abrasive particles.

Determination of Fineness

Place about 10g of the toothpaste, accurately weighed, in a 250-ml beaker. Add 100 ml of water and allow to stand for about 30 minutes with occasional stirring until the toothpaste is completely dispersed free of toothpaste/gel flocks trapping the agglomerates. Transfer the beaker in an ultrasonic bath. Fill the Ultrasonic bath (2 litre capacity) to about three-fourth height with water. Clamp the above beaker in the center of the bath keeping about 1 cm clearance from the bottom of the bath and subject ultrasonification for 10 minutes to completely loosen out the constituents.

Transfer this suspension quantitatively to a 150 micron IS Sieve and wash by means of a slow stream of running tap water and finally with a fine stream from a wash bottle until all the matter that can pass through the sieve has passed, Let the water drain out and then dry the sieve containing the residue in an oven. If there is any residue on the sieve, carefully transfer it to a tarred watch glass and dry it to constant mass in an oven at 105 ± 2°C.

CALCULATION

Material retained on 150-micron IS Sieve, percent by mass.

$$= \frac{M1 \times 100}{M}$$

Where,

Ml = massing of residue retained on the sieve, &

M = massing of the material taken for the test.

Determination of Foaming Power

Weigh about 5 g of the toothpaste accurately in a 100-ml glass beaker, add 10 ml of water, cover the breaker with a watch glass and allow standing for 30 min. This operation is carried out to disperse the toothpaste.

Stir the contents of beaker with a glass rod and transfer the slurry to the 250 ml graduated cylinder, ensuring that no foam (more than 2 ml) is produced and no lump paste goes into the cylinder. Repeat the transfer of the residue left in the breaker with further portions of 5 to 6 ml of water ensuring that all the matter in the beaker is transferred to the cylinder.

Adjust the contents in the cylinder to 50 ml by adding sufficient water and bring the contents of the cylinder to 30^{O}C. Stir the contents of the cylinder with a glass rod or thermometer to ensure a uniform suspension.

As soon as the temperature of the contents of the cylinder reaches 30°C, stop the cylinder and give it 12 complete shakes, each shake comprising movements shown in Fig. 2 in a vertical plane, upside down and *vice versa.* After the 12 shakes have been given, allow the cylinder to stand still for 5 minutes and read the volumes of:

a) foam plus water (V1 ml) and

b) water only (V2 ml) as shown in Fig. 3

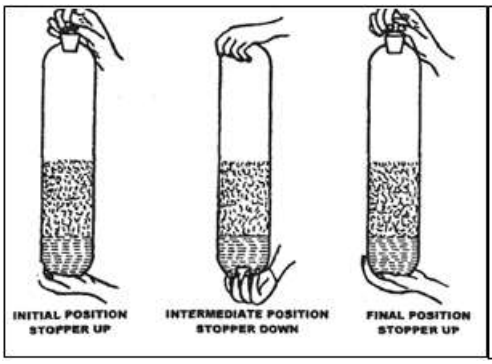

Fig. 2: ONE COMPLETE SHAKE OF CYLINDER

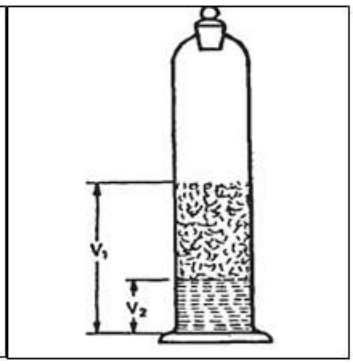

Fig. 3: MEASUREMENT OF FOAM

CALCULATION

Foaming power, ml= ***V1– V2***

Spreadability

About 1 gm paste was weighed and kept at the center of the glass plate (10 x10 cm) and another glass plate was placed over it carefully. 2 kg weight was placed at the center of the plate (avoid sliding of the plate). The diameter of the paste in cms, after 30 minutes was measured.

RESULTS AND DISCUSSION

Particle Size

Table 2: Particle Size Analysis

Size (µm)	Mean size	Log mean size	No. of particle	% frequency
0.0-15.0	7.5	0.87506126	0	0
16-30	31	1.49136169	7	7
31-45	53.5	1.72835378	35	35
46-60	76	1.88081359	21	21
61-75	98.5	1.99343623	15	15
76-90	121	2.08278537	10	10
91-105	143.5	2.1568519	7	7
106-120	166	2.22010809	4	4
121-135	188.5	2.27531135	1	1

Fig. 4: Microscopic Image of Eggshell Powder

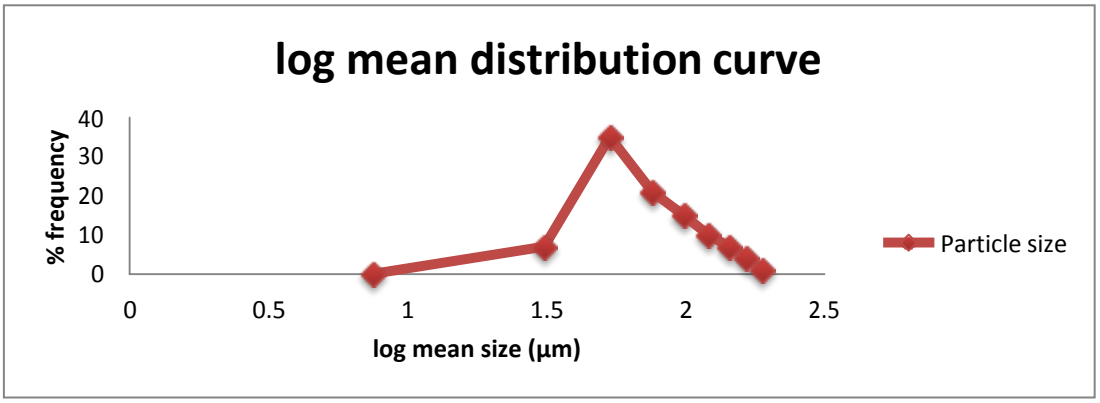

Fig. 5: Particle Size Analysis Graph of Eggshell Powder

No. of particles & % frequency of optimal size i.e. 31µm-45µm (log mean size 1.72) is higher.

Evaluation Tests for Toothpaste

Table 3: Evaluation tests for Toothpaste

Sr. No.	Evaluation Test	F1	F2	F3	Standard values
1	Appearance	Brown	White	White	Observed and write
2	pH	6.5	7.7	7.6	5.5 – 10.5
3	Hard and sharp edged abrasive particles	Little bit present	Absent	Absent	Absent
4	Fineness (% by Mass)	1.7%	1.3%	1%	NLT 1 %w/w
5	Foaming Power (ml)	57ml	56ml	51ml	NLT 50 ml(min)
6	Spreadability (cms)	9.1cm	8.6cm	8.5cm	NMT 8.5(max)

DISCUSSION

Three formulations i.e. F1, F2, F3 were formulated by using Heated Liquid Phase Process. In F1 formulation Gum Tragacanth was used as a binder. The pH of F1 formulation was found

to be 6.5 was within the standard range. There was little bit presence of hard and sharp edged abrasive particles due to the rough nature of Gum Tragacanth. The foaming power of F_1 formulation was within the standard value. The Spreadability of this formulation was more than the standard value. Thus, F_1 formulation does not comply with respect to evaluation test no. 3 and 6.

In F_2 formulation, Xanthan gum was used as a binder. The pH of F_2 formulation was found to be 7.7 was within the standard range. There was absence of hard and sharp edged abrasive particle because the Xanthan gum is smooth in nature. The foaming power of F_2 formulation was within the standard value. The Spreadability was found to be good and the consistency of paste was satisfactory.

In F_3 formulation same binder was used i.e. Xanthan gum only the concentration was changed for better Spreadability and consistency of paste. The pH of F_3 formulation was found to be 7.6 was within the standard range. There was absence of hard and sharp edged abrasive particles because the Xanthan gum is smooth in nature. The foaming power of F_3 formulation was within the standard value. The Spreadability was found to be within the standard value and the consistency of the paste was also better than other formulation.

Thus, F_3 formulation was found to be better than all other formulation because the evaluation test results were within the standard values.

SUMMARY AND CONCLUSION

- Toothpaste is defined as a dentifrice in the form of a smooth, semisolid, homogeneous mass containing acceptable ingredients such as abrasives/polishing agents, surface active agents, humectants, binding agent, and other appropriate substances for oral health maintenance.
- There are various types of toothpaste available in the market such as Anti-decay toothpaste, Desensitizing toothpaste, Anti-calculus toothpaste, Anti-plaque toothpaste, Whitening toothpaste, Herbal toothpaste, etc.
- Typical toothpaste formulation contains Abrasives, Humectants, Surfactants, Binders, Sweetener, Active therapeutic ingredients, Preservatives, Water, etc.
- The main objective of this work was to prepare and evaluate eggshell powder suitable for toothpaste and to prepare toothpaste by using eggshell powder.

- Egg shells are one of the best sources of calcium, which is absorbed by organism in approximately 90% and it is easier for your body to digest and absorb.
- One whole medium sized eggshell makes about one teaspoon of powder, which yields about 750 – 800 mgs of elemental calcium plus other microelements, i.e. magnesium, boron, copper, iron, manganese, molybdenum, sulphur, silicon, zinc, etc. There are 27 elements in total. The composition of an eggshell is very similar to that of our bones and teeth.
- Eggshell also contains Calcium Carbonate. Eggshell presents healthy, balanced calcium due to trace amounts of other minerals contained in it. Eggshell is probably the best natural source of calcium.
- The eggshells were collected and cleaned. Then they were air dried and were crushed using mortar and pestle and sieved to collect fine powder.
- Then toothpaste was formulated using eggshell powder (abrasive), glycerol (humectant), sodium lauryl sulphate (surfactant), gum tragacanth and xanthan gum (binders), sodium saccharine (sweetener), peppermint oil (flavouring agent) and water (vehicle).
- Toothpaste was evaluated by various evaluation parameters such as pH, Hard and Sharp edged abrasive particles, Fineness, Foaming power, Spreadability and Tube Extrudability.
- Thus the formulation and evaluation of toothpaste by using eggshell was done successfully.
- Various formulations were formulated and evaluated and the most suitable formulation was F3 which found to conform all statutory specifications.
- Eggshell based formulation is reported useful in treatment of dental caries and tooth hypersensitivity.
- Calcium plays active role in remineralization of enamel and eggshell powder has a very high percentage of bio-available calcium.
- For treatment of dental caries and tooth hypersensitivity many formulations are commercially available but eggshell based toothpaste is seems to be most effective and economic product.
- Thus, this claim needs to be confirmed after clinical trials.

REFERENCES

1) Indian Standards, Toothpaste-Specification (Third Revision), Bureau of Indian Standards, IS 6356 September 2001; 1-15.
2) A.M. King'ori; A review of the uses of Poultry Eggshells and Shell membranes;

International Journal of Poultry Science 2011; 10(11): 908-912.

3) Sanju Nanda, Arun Nanda, Roop K. Khar; Cosmetics Technology, Birla publication pvt.ltd.; first edition 2006-2007; 438-458.
4) Geethika Priscilla.M, Amareshwar Reddy B; Antibacterial activity of Syzygium Cumini in Herbal Toothpaste; International Journal of Inventions in Pharmaceutical Sciences; 2014 2(3): 724-729.
5) Patel Tarun K, Patel Vishnu M; Formulation and evaluation of medicated dental pastes for treatment of Periodontitis; International Journal of Pharmaceutical Innovations; Jan.-Feb. 2013; 3(1): 16-21.
6) S. Tejaswi, Rama Devi Bhimavarapu, Srinath Nissankar Rao; Effect of Hydrocolloids and Casein on *In-vitro drug* Release from formulated double antibiotic paste; International Journal of Innovation and Pharmaceutical Science; 2014; 2(5): 880-883.