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Formulation and evaluation of herbal tooth paste by *Cajanus cajan* (L.) Leaf extract

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Abstract

The world market is also moving towards herbal medicines for health care. The main purpose behind this project was to develop a stable and functionally effective tooth paste by excluding all types of synthetic additives, which are normally incorporated in such formulations.

From this investigation we concluded that the formulated tooth paste by *Cajanus cajan* leaf extract, Formulation 2 have all good characters of an ideal tooth paste when compared with marketed close up tooth paste when compared with all evaluation parameters for all formulations like F1, F2 and F3 herbal tooth paste from *Cajanus cajan* leaf extract like moisture, volatile matter, cleaning ability, spreading, PH, abrasiveness and gritty matter so by all evaluation parameters its quit evident that presence of various active chemical constituents present in *Cajanus cajan* leaf extract specially flavonoids may be responsible, for it was found to be harmless, more effective and economic compare to synthetic close-up marketed tooth paste.

Keywords: *Cajanus cajan*, formulation 2, extract

Introduction

Medicinal plants and herbs have been identified and used from prehistoric times. Plants synthesizes many active chemical compounds which are used to treat various ailments, toothpastes are generally useful to maintain dental health, toothpaste aids in prevention against gingivitis and tooth decay, which leads to more severe dental issues. Toothpaste comes in many flavors and helps to leave your mouth and breath feeling fresh after brushing. It can also masks any scents from strong-flavored foods like garlic or onions. Gingivitis often resolves with good oral hygiene, such as longer and more frequent brushing, and flossing. In addition, an antiseptic mouthwash may help.

Most of synthetic tooth paste contain fluoride or sodium lauryl sulfate which cause adverse effect to tooth. So to devoid such effect we formulated herbal based tooth paste, nowadays natural sources remain attractive primarily when compared to the synthetic one, so herbal tooth paste are popular with the consumer when compared to the synthetic one which are devoid of side effect, minimum number of ingredients.

So keeping in the vive *Cajanus cajan* (L.) leaf traditionally using for clean the tooth³, strength the tooth and also bleeding in tooth also control but there is no scientific report available so we taken as a project for formulation and evaluation of herbal tooth paste from *Cajanus cajan* (L.) leaf extract, there is no such tooth paste available in combination in market so we formulated the herbal tooth paste and evaluated it for following parameters^[1, 2].

Materials and Methods**Collection and Authentication of plant materials**

Leaves of *Cajanus cajan* (L.) were collected in and around Chitaguppa town agricultural field, the collected plant material was identified by Plantix app.

Preparation of extracts

Fresh plant leaves of *Cajanus cajan* leaf were collected and washed with tap water. The collected material was shade dried, coarsely powdered, and stored in airtight container for further use. The coarsely-powdered material was subjected for extraction using cold maceration, macerated with distilled water with occasionally stirring for 3 days. The extract were obtained semisolid mass stored in airtight container for further use.

Preliminary phytochemical investigation

The extracts were subjected to preliminary photochemical investigation. For alkaloids (Mayer's, Dragendorff's, Wagener and Hager's test), Flavonoids (Shinoda, Ferric chloride, Sodium hydroxide, lead acetate, mineral acid and zinc reduction test), amino acid (millon test and ninhydrin test), Carbohydrate (Molisch's test, Barfoed's test, Selivanoff's test and Osazone formation test), proteins (Biuret, xanthoprotic test), mucilage (rethunium red test), Steroids (Lieberman Bucharad and Salkowski reduction test), Tannins (FeCl₃ test), and Saponin (foam test), for extracts etc. [4, 5].

Formulation of tooth paste

The weight of every ingredient was decided by reviewing previous herbal toothpaste formulations. The combination of percentage by weight of all the ingredients of this is 100%,

which means the sum of quantity of toothpaste will formulate 100gm of toothpaste. The ingredients of the toothpaste prepared in lab are given in table 1 and compared with marketed herbal tooth paste. Herbal tooth paste was prepared using *Cajanus cajan* leaf extract, neem leaf extract, calcium carbonate and sodium lauryl sulphate. *Cajanus cajan* extract gives relief from toothache, Neem leaf has antibacterial activity, clove oil gives analgesic and property and bad breath of mouth is prevented by clove oil itself, acacia to prevent gingivitis and also acts as gelling agent. Sodium lauryl sulphate was used as a foaming agent & Para hydroxy benzoic acid is used as a preservative. Saccharin sodium acts as sweetening agent.

Formulation of herbal toothpaste

Table 1: Herbal Toothpaste Formulation Ingredients

S. No.	Common name	Botanical name	Part used	Category	Quantity in parts F-1	Quantity in parts F-2	Quantity in parts F-3
01	Toot	<i>Cajanus cajan</i>	Leaf	clean the tooth, strength the tooth and also controls bleeding in tooth	8	12	10
02	Neem	<i>Azadirachta indica</i>	Leaf	Antibacterial	4	5	6
03	Lavang	<i>Eugenia caryophyllus</i>	Oil	Analgesic, Flavoring	3	4	5
04	Babbul	<i>Acacia arabica</i>	Gum	Gelling agent	2	3	3
05	Sodium lauryl sulphate	-	-	Detergent	1	1	1.5
06	Para hydroxy benzoic acid	-	-	Preservative	0.1	2	0.15
07	Saccharin sodium	-	-	Sweetening agent	0.3	0.3	0.3

Evaluation of formulated toothpaste

Moisture content

5g of toothpaste was heated in an oven at 105°C for 24 hours. It was allowed to cool and reweighed. The heating and reweighing process continued until a constant weight was recorded in consecutive checks. The weight loss was used to calculate the moisture content using the formula.

$$\% \text{ Moisture} = \frac{\text{Original sample weight} - \text{Dry sample weight}}{\text{Original sample weight}} \times 100\%$$

Cleaning ability

Eggshells contain high amount of calcium and most approximate tooth enamel for testing cleaning ability of toothpastes. One egg-shell was used for each toothpaste tested. 200ml of water was heated to boiling in a beaker. 15ml and 20 drops of vinegar and red food colouring were added respectively. A hard-boiled egg was immersed in the food colouring solution for 5 minutes until it is stained with red colour. Using a permanent marker, a line was drawn along the length of the eggshell dividing it in half. A tooth-brush moistens with distilled water and the water shaken off was used to brush one side of the egg for 10 strokes (each stroke was a complete back and forth motion). The egg was inspected for any colour removal. The toothbrush was rinsed with water and the water shaken off, a pea-sized amount of formulated toothpaste was placed on the toothbrush and the brush was used to brush one side of the egg for 10 strokes. The egg was rinsed and inspected for colour removal. The procedure was repeated for each toothpaste that was tested.

Foaming ability

5g of toothpaste was weighed into a 100ml glass beaker. 10ml of distilled water was added to it and allowed to stand for 30 minutes (this allows the toothpaste to disperse in the water). The contents of the beaker were stirred and the slurry was

transferred to a 250ml graduated measuring cylinder. The residue in the beaker was rinsed and transferred with further 5-6ml portion of water to the cylinder. The contents of the cylinder were stirred to ensure a uniform suspension. The cylinder was stoppered and subjected to 12 complete shakes. The cylinder was allowed to stand for 5 minutes and the volume of foam calculated as:

$$\text{Foaming ability} = L1 - L2$$

L1 = volume in ml of foam with water

L2 = volume in ml of water only

Spread ability

About 1 g of formulated toothpaste was placed in the centre of a glass plate and a second glass plate placed over it. A 1 kg weigh was carefully placed on top of the set up and allowed for 10 minutes. The weight was removed and the diameter of the paste was measured in cm.

Determination of PH

10 g of toothpaste was dissolved in 10 ml of deionised water, stirred well to make a suspension in a 100 ml beaker. The pH was measured with PH paper.

Abrasiveness

A pea size amount of formulated toothpaste was placed on a clean plastic microscope slide and a drop of distilled water added. A clean cotton swab was rubbed on the toothpaste sample in a back and forth motion 30 times using short strokes. The slide was carefully rinsed and dried with soft tissue. The slide was examined under a dissecting microscope illuminated from above. The number of scratches on the surface of the slide were determined and rated on a scale of 0 (no scratch) to 5 (high degree of scratches).

Gritty matter

Small amount of the toothpaste was rubbed into a piece of butter paper. The number and intensity of scratches that appear on the butter paper was recorded as absent or present.

Homogeneity

At room temperature normal force was applied on the tube containing the toothpaste at room temperature and observed if the paste extrude homogeneously from the tube.

Stability

Stability of toothpaste is checked by exposing the product at 45 ± 2 °C for a period of 28 days. After storage, no phase separation, fermentation and gassing was observed. Also exposed to refrigerator conditions at $2-8$ °C for 24 hours. The product was observed to be stable even at refrigerated conditions [6, 7].

Results and Discussion**Preparation of extract**

Plant material leaves of *Cajanus cajan* was extracted with water by cold maceration because most of active chemical constituents were dissolved in water, the percentage yield was calculated and found to be 10.13%.

Phytochemical tests: Phytochemical tests are carried out for *Cajanus cajan* leaf extract shows the presence of carbohydrates, amino acids, flavonoids, proteins, mucilage's, steroids and absence of alkaloids.

Formulation of herbal toothpaste

Herbal tooth paste were formulated by trial and error method, formulated three different formulations as shown in table no 02.

Table 2: Shows different ingredients used in the formulation.

S. No.	Common name	Botanical name	Parts used	Category	Quantity F-1	Quantity F-2	Quantity F-3
01	Toot	<i>Cajanus cajan</i>	Leaf	clean the tooth, strength the tooth and also controls bleeding in tooth	8	12	10
02	Neem	<i>Azadirachta indica</i>	Leaf	Antibacterial	4	5	6
03	Lavang	<i>Eugenia caryophyllus</i>	Oil	Analgesic, Flavoring	3	4	5
04	Babbul	<i>Acacia arabica</i>	Gum	Gelling agent	2	3	3
05	Sodium lauryl sulphateis	-	-	Detergent	1	1	1.5
06	Para hydroxy benzoic acid	-	-	Preservative	0.1	2	0.15
07	Saccharin sodium	-	-	Sweetening agent	0.3	0.3	0.3

Evaluation tests of toothpastes were carried out according to the standards specified by the Bureau of Indian standards IS 6356-1993 for Herbal tooth pastes samples three different formulations Lab made toothpaste compared with standard marketed Close up tooth paste.

Evaluation tests were carried out to view the different properties of Lab made and commercial toothpastes. All the results of evaluating parameters were given in table no 03.

The formula and their conventional version were comparatively studied for their different physicochemical properties and changes on the surface of the enamel.

All toothpastes have a sweet taste, due to the synthetic sweetener constituent. The odour and texture of all tested toothpastes are pleasant and smooth respectively. These properties of the toothpastes enhance marketability.

Several studies that evaluates the relationship between the abrasive potential of toothpaste and alteration on enamel have reveal that the less the abrasive potential of toothpaste, the less enamel get worn out, however the higher the abrasive potential the better the stain removal, in the present study the for-mulated toothpaste has the lowest abrasive potential. F1 is the only toothpaste containing Calcium Carbonate in its composition. (Table no 03) Toothpaste with this composition are less abrasive. Hydrated silica is the abrasive in C, O and D (table no 03). Reports from previous studies have shown that silica exhibit-it strong abrasive properties that can increase the roughness of the enamel.

Spread ability is a measure of how well the products can penetrate different areas following application. High spread ability guaran-tees high chances of wide range performance. F has the highest spreadability (table no 03). The pH values were different among the toothpastes, however the pH in all the four products were in the alkaline region. An alkaline pH causes less adverse change to the dental surface. This shows

that pH is a very important factor when formulating these products as shown in table no 03.

The foaming ability show different values among the toothpaste products, this suggest differences in concentration of the detergent (SLS) commonly used in toothpaste. While F1 whose composition is detergent free gave a low foaming value, F2 gave a high foaming value as shown in (table no 03), indicating it has higher concentration of detergent in its compare to other toothpastes. One major con-cern about detergent in toothpaste according to increased oral irritation among canker sores prone people and therefore toothpaste without SLS is a better choice.

All toothpastes showed ability of cleaning the enamel irrespective of the absent or presence of detergent in their composition. The stability test is a close approximate of the shelves life of the products. All products remain effective for months. Usually a sample stored at 45 °C for 8 weeks.

Moisture content test show that the composition of the toothpaste are different. F1 gave the lowest content (Table 03) indicating that this toothpaste on application to the teeth alters the surface of the enamel.

The gritty matter test helps to ascertain the presence of solid in the formulation. This is important as regular usage of formulation with gritty matter can wear off the teeth enamel and cause injury to skin. Gritty matters were absent in all tested toothpastes (Table 03).

All formulation tested for homogeneity pass. This indicated that obtaining the formulation from the tube by extrusion poses no difficulty.

Overall among all formulation F2 formulation formulated by using *Cajanus cajan* leaf extract shows near values compared with marketed tooth paste of close up.

Table 3: Shows result of all evaluation parameters.

Evaluation tests for Lab made and commercial Herbal toothpastes S.No.	Properties	F1	F2	F3	Close up tooth paste
1	Moisture and volatile matter(%by mass)	1.8	2.0		1.6
2	Cleansing ability	+	+	+	+
3	Foam (cm) 30 53 51 52	Foam (cm) 45	Foam (cm) 51	Foam (cm) 54	Foam (cm) 52
4	Spread ability (cm) 8.0	Spread ability (cm) 6.5	Spread ability (cm) 7.0	Spread ability (cm) 6.0	Spread ability (cm) 7.0
5	PH	8.8	7.5	5.8	7.3
6	Abrasiveness	2	2.5	3	2.5
7	Gritty matter	Absent	Absent	Absent	Absent
8	Homogeneity Pass	Pass	Pass	Pass	pass
9	Stability	Pass	Pass	Pass	pass

Conclusion

The world market is also moving towards herbal medicines for health care, health foods and for cosmetic purposes including tooth paste preparations. India is rich heritage for cultivation and production of herbal medicines due to its diversified climatic conditions. This study presents a number of plant drugs with proven efficacy as in tooth care preparations. In present investigations was carried out to formulate and evaluation of herbal toothpaste. Based upon traditional knowledge and to develop few parameters for quality and purity of herbal tooth paste. From this investigation we concluded that the formulation of tooth paste F2 have all good characters of an ideal tooth paste and it was found to be harmless, more effective and economic compare to synthetic close-up marketed tooth paste.

The main purpose behind this Project was to develop a stable and functionally effective tooth paste by excluding all types of synthetic additives, which are normally incorporated in such formulations.

When investigation data were assessed, it was quite evident that we formulated on trial and error based three formulation among three F2 formulation from development of stable, effective tooth paste compared to marketed close up may be due to presence of chemical constituents like amino acids, proteins, flavonoid [8], carbohydrates and steroids in *Cajanus cajan* leaf which may protect our clean and strengthen the tooth, which may be commercially replacing the existing toothpaste based on synthetic agents was possible. It will be essential to have a green revolution which may definitely help our society to survive healthier and long lasting.

This world believes in the concept of green pharmacy or green cosmetics, hence there is a huge scope for toothpaste developed from natural origin. But more radical approach in popularizing natural tooth paste, with emphasis on safety and efficacy has to be done among the consumers. Further long term studies may be recommended to prove the safety, stability and efficacy of this formulation to make it suitable as a commercial product.

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