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RESEARCH ARTICLE

EFFICACY OF *DRACAENA CINNABARI* AS TOOTH WHITENING NATURAL PRODUCT: A SPECTROPHOTOMETRIC ANALYSIS

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Abstract

Objective: The aim of this study was to determine the efficacy of a homemade tooth-whitening recipe using *Dracaena cinnabari* (DC) resin, which is traditionally used for tooth decay treatment and cleaning in Soqatra. The study investigated the antioxidant activity of the resin extracts in methanol as tooth-whitening natural product.

Materials and Methods: A total of 40 bovine teeth with initial color B2 were selected and divided into four groups. One group was kept as a negative control, while the other three were stained with Yemeni coffee solution for one week. The first group was treated with 10% carbamide peroxide (CP) home bleaching, the second group was treated with 10% DC gel with rubbing movement (DC Ru), and the third group was treated with 10% DC gel without rubbing (DC) for 6 hours daily for 14 days. Color measurements were taken at different time points using a spectrophotometer device.

Results: All experimental gels resulted in greater color change compared to the negative control, with DC Ru showing the greatest ΔE* value (p<0.001) compared to the DC group (p<0.006) and the CP group (p<0.001). The second reading of stabilization of all gels resulted with resembled ΔE* values to the first reading of stabilization.

Conclusion: The study suggests that the experimental gels containing phenolic content with strong antioxidant effects may reserve significant clinical potential as active agents for tooth-whitening without using HP/CP. Further studies are needed to measure the effect on surface roughness and color stability.

Keywords: *Dracaena cinnabari*, natural product, spectrophotometric analysis, tooth whitening.

INTRODUCTION

Bleaching is One of the most aesthetic procedures in dentistry and a more conservative choice for vital teeth whitening than other procedures like ceramic laminates, it is a well-established technique, and it applied a high level of effectiveness[1,2]. The home-bleaching procedure with 10% CP gel has been considered the safest method for bleaching teeth accepted by the American Dental Association (ADA) with minimal adverse effects, however, since this tooth-bleaching modality is characterized by patient-applied, but there is a risk of gel application overexposed dentine in patients with gingival recession and abrasion lesions. Moreover, the incorrect use of the tray may result in gel overflow, with extended soft-tissue exposure which causes gingival irritation and material ingestion[3] Herbal and natural products have been used in dental practice for years and have become more common these days due to their biocompatibility, high antimicrobial activity, antioxidant, and anti-inflammatory properties[4]. *Dracena cinnabari* (*D. cinnabari*) resin approved its effectiveness as antimicrobial, antiviral[5], antioxidant[6], and anti-inflammatory[7].

According to our knowledge, none of the studies has steadily investigated the effects of *D. cinnabari* resin extract as a natural bleaching product. Therefore, the present study, which is aimed to highlight the potential possibilities of new material of a bleaching agent, evaluates its antioxidant effect and compares it with other commercial bleaching materials.

MATERIALS AND METHODS

Plant Material

The *D. cinnabari* plant was collected in its natural habitat on Soqotra Island. The botanical name of this endemic wild tree is *D. cinnabari* Balf. f. (Dracaenaceae). The English common name for both the tree and its resin is dragon's blood. The Arabic name "Dam Alakhwin" means "Brother's blood" and is also used for both the tree and its resin. The Soqotri resin (dragon's blood = Dam Alakhwin) is a high-quality, pure red blood resin that is known on the island as "Emzoloh." It is collected from the incision of the young stem bark of the female tree. This standard pure resin can be described as an authentic superior Soqotri resin[9].

Collection of plants:

The resin of *D. cinnabari* was collected from a young fresh stem female tree on Soqatra Island, Yemen. Dragon's blood resin was purchased from a wholesale supplier of traditional Unani medicine in March 2022. The plant samples were identified and authenticated by the Environmental Protection Authority of Yemen and have been deposited at the herbarium of the Department of Pharmacognosy, Faculty of Pharmacy, Sana'a University, Yemen.

Preparation of *D. cinnabari* resin methanol extract:

The powdered resin of *D. cinnabari* (50g) was extracted with methanol in a 1:10 ratio. The mixture was shaken at room temperature for 3 days, then sonicated at 45°C for 30 minutes to enhance the extraction. The methanol was then separated from the extract using a rotary evaporator under reduced pressure at 40°C, resulting in a gummy red resin extract[8,9].

Preparation of *D. cinnabari* Gel as tooth bleaching agent

The gel composition was presented in Table 1. The sodium saccharin and the EDTA were previously dissolved in water and the methyl paraben and the menthol in ethanol. The carbomer 940 was dispersed in water with the glycerin and the pH was adjusted to 7, In this study, the stock solution was prepared by using ethanol, it was found to be less toxic than the other solvents, hence it was safer, and favored to be used for preparing the bleaching gel, it contained 10% of resin extract.

Preparation of specimens

Forty freshly bovine incisors devoid of intrinsic stains, cracks, and fractures were selected with their initial color equal to B2, and had their roots sectioning using a carborundum wheel disk (Maxman, China), The dental pulp tissue was removed from the crown portions using an #80 K-file (Mani, Tokyo, Japan) The teeth received prophylaxis with Robinson brush (Escova, USA), with water coolant until flat surfaces were obtained[10]. The prepared specimens from extraction until use and during the treatment process the teeth were kept in Distilled water at 37°C[11].

Artificial staining procedure

The teeth were artificially stained to mimic natural staining in the mouth. The specimens were numbered from 1 to 40 and divided into two groups: 10 teeth were soaked in distilled water and 30 teeth were soaked in Yemeni coffee solution for one week. The solution was replaced daily. After seven days, the teeth were rinsed with water for 10 seconds and polished with a rubber cup and pumice stone/water solution to remove any undesirable external staining. The teeth were then fixed in a dense silicon paste (Zhermack, Italy) mold on a wooden plate to standardize the measurement angle[12].

Bleaching procedure

Before bleaching, the specimens were cleaned with an ultrasonic cleanser for 90 seconds. Since there was no standard application protocol for the experimental groups (*D. cinnabari* and *D. cinnabari* Rubbing), both materials were applied according to the manufacturer's instructions for home bleaching with carbamide peroxide (CP). After baseline measurements, all specimens were randomly assigned to four groups (n = 10) based on the bleaching gel used. The first group was treated with 10% CP Home bleaching (Whiteness Perfect 10% FGM, Brazil) (positive group) for 6 hours daily was bleaching gel was applied 1-mm a thick layer with a brush to the middle third of facial surfaces of the teeth, the gel then removed and the surface cleaned using gauze soaked in distilled water and then the specimen's surfaces were washed and dried with absorbent paper. Samples were not air-dried with any system that could dehydrate the sample, after that stored in distilled water for the remaining time (18 h). This process was repeated each day for 14 days to simulate recommended home use, in addition, While the gel is in contact with the specimen, the latter is kept in a wet environment placing it over a cotton pellet embedded in distilled water. At the end of 14-day bleaching procedure. All the specimens removed from the bleaching gel, cleaned under running water and then stored in distilled water for 24 h, Then three measurements at the middle third of the facial surface of the specimen taken as previously described for the baseline measurement. The second group (experimental groups=20) was treated with 10% *D. cinnabari* gel and divided into two subgroups (n=10). One group was applied by rubbing movement (*D. cinnabari* RU) on the central portion of the buccal surfaces and the specimen was brushed with hand pressure on an electrical brush (power flex- Jordan) for one minute. Third group applied without rubbing (*D. cinnabari*) only applied 1 mm of a thick layer of gel with the brush for 6 h daily as the same application of the positive group (CP) for 14 days.

The fourth group (negative group) did not receive any bleach treatments and was treated in the same manner as experimental groups in the rinsing and drying by drops of distilled water are applied to the facial surface. All of the procedure's steps are carried out by the same operator (specimen preparation, staining, and bleaching). For color reading, a Spectrophotometer device was employed (Easy Shade, VITA Zahnfabrik, Bad Säckingen, Germany), and the specimen was placed over a black background, Three color readings were performed for each sample at identical positions using the CIE L* a* b* coordinates and the mean of three color readings was considered the color value on the L*, a*, and b* axis, at baseline (T0), one-day post-staining (T1), 7-days post-staining (T2), immediately

after bleaching (T3), 7 days post-bleaching, (T4) and 14 days post-bleaching (T5).

Statistical Analysis

The data was collected and analyzed using IBM SPSS Version 25. The descriptive statistics were presented as means and standard deviations (SD) for L*, a*, and b*. A one-way ANOVA was used to statistically analyze the data. Repeated measures ANOVA was used to evaluate the effect of time on delta score (color change). Multiple comparisons of means were performed using the t-test with *p*-value adjustment, which was set at the significance level of $p \leq 0.05\%$. An independent t-test was performed to identify significantly different group means when the ANOVA test was significant.

RESULTS AND DISCUSSION

The duration of immersion time in coffee statistically significantly ($p<0.05$) increased the change in the color for experimental materials, DC Ru specimens were statistically significantly ($p<0.002$) more stable in color than (CP and DC groups) with *p*-value (.054 and .038) respectively after 1 week of immersion in coffee. While in the DW group, there was an insignificant difference (0.263) after 1 week of immersion in DW as shown in (Table 2). According to the statistical analysis with comparison as shown in (Figure 2), after one day of immersion in the coffee solution, DC Ru specimens discolored markedly from (1.74) to (3.44) after one week of immersion as same as CP specimens changing from (2.6) to (5.1) after one week of immersion, however, DC specimens in coffee showed slightly more color changes (3.73) compared to (2.57) after one day of immersion in the coffee. Figure 1 and Figure 2 shows the mean values and SD of all experimental groups according to the staining solution. In this study, ΔE values for the experimental groups were determined for DC Ru, CP, and DC specimens (7.09, 6.7, 4.6) respectively.

Table 1: Formulation of the *D. cinnabari* gel.

Component	Amount
Dragon's blood extract	10%
Carbomer 940	5%
Glycerin	3%
Sodium saccharin	1%
Methyl paraben	0.2%
EDTA	0.1%
Menthol	0.02%
Purified Water	81.5%

Based on the perceptibility thresholds defined in the literature, the overall color difference between the experimental groups is considered moderately perceivable. All gels resulted in greater color change when compared to the negative group, the highest value occurred at DC Ru gel with ($p<0.001$), than the positive group (CP) demonstrated greater ΔE* values ($p<0.001$) and after that DC experimental gels with ($p<0.006$) when compared to negative group DW in Table 2, Table 3 and Table 4). The main purpose of this study was to evaluate the effect of *D. cinnabari* used by the population to obtain tooth whitening, the resin is widely used in traditional folk medicine in Yemen for the treatment of dental diseases, and it is readily widely spread in the market with low cost. Furthermore, it has been found to have several pharmacological properties such as antimicrobial, antioxidant, anti-inflammatory, cytotoxicity and anti-tumor activities[13]. The *D. cinnabari* resin extract was prepared in this study by using absolute methanol (100%) as a solvent.

Table 2: Mean values and SD of all experimental groups according to the staining solution.

GROUP			N	Mean	SD	T-test	*p*-value
CP	Coffee	One Day	10	2.656130	2.9361182	2.215	0.054
		One Week	10	5.112230	4.4636632		
DC	Coffee	One Day	10	2.572570	1.9435405	2.437	0.038
		One Week	10	3.735810	2.2208448		
DC Ru	Coffee	One Day	10	1.744360	1.2360171	4.344	0.002
		One Week	10	3.448320	1.5729662		
DW	DW	One Day	10	5.369750	3.4682066	1.193	0.263
		One Week	10	6.453140	3.1471311		

N = Number of specimens, SD = Standard Deviation, CP = Carbamide peroxide, DC = *D. cinnabari* without rubbing, DC Ru = *D. cinnabari* with rubbing, DW = Distilled water

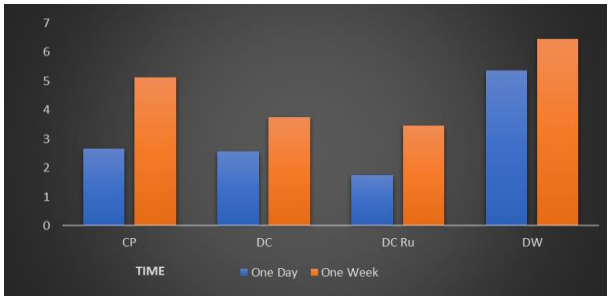

Figure 1: Mean color changes (ΔE*) of the different experimental groups over time.

Table 3: Multiple comparisons of mean color change (ΔE values) between all experimental groups and DW by using an independent t-test.

Group		N	Mean	SD
CP	T1_T0	10	4.565030	3.9272792
	T2_T0	10	5.369750	3.4682066
	T3_T0	10	6.751030	2.8149650
	T4_T0	10	6.121770	2.7157788
	T5_T0	10	6.190390	3.0087140
DC	T1_T0	10	2.572570	1.9435405
	T2_T0	10	3.206900	1.6220585
	T3_T0	10	4.647570	1.2595474
	T4_T0	10	4.266320	1.2653632
	T5_T0	10	3.532910	1.2188543
DC Ru	T1_T0	10	4.744360	3.2360171
	T2_T0	10	4.426730	3.1394743
	T3_T0	10	7.093210	1.4872108
	T4_T0	10	6.684370	1.5232603
	T5_T0	10	5.893280	1.3320478
DW	T1_T0	10	2.654330	2.9367385
	T2_T0	10	2.567670	1.6738546
	T3_T0	10	3.395460	3.0504153
	T4_T0	10	4.063950	3.6182684
	T5_T0	10	4.991270	4.1195389

CP = Carbamide peroxide, DC = *D. cinnabari* without rubbing, DC Ru = *D. cinnabari* with rubbing, DW = Distilled water, N = Number of specimens, SD = Standard Deviation, T0 = baseline, T1 = after 24 hours post-staining, T2 = 7 days post-staining, T3 = immediately after bleaching, T4 = 7 days post-bleaching, T5 = 14 days post-bleaching.

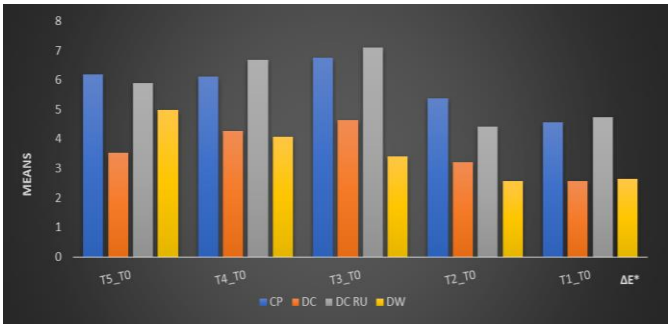

Figure 2: Mean color changes (ΔE*) of the different experimental groups over time.

Although there is no previous report of a natural bleaching agent containing *D. cinnabari*. The first null hypothesis was rejected because both experimental gels (DC and DC RU) groups were effective on tooth whitening. Considering *D. cinnabari* gel with the strong antioxidant activity of its high phenolic content[9], they can break down macromolecules/stains into smaller parts, thus increasing light reflection from the tooth surface, thereby increasing the lightness and thereby resulting in a whitening effect. While the second null hypothesis was true (No differences in color change between *D. cinnabari* and CP), regarding to the results, which demonstrated (DCRU) experimental gels produced color changes as same as the positive group (CP), this stain removal effect could be due to the mechanical rubbing of *D. cinnabari.*

Similar to this study Toothpastes containing activated charcoal showed better effectiveness in whitening teeth than toothpastes containing blue covarine and hydrogen peroxide[16].

Table 4: Multiple comparisons of mean color change (ΔE values) between all experimental groups and DW by using an independent t-test.

	Group	N	Mean	SD	T-test	*p*-value
T3-T0	CP	10	6.751030	2.8149650	4.039	0.001
	DW	10	2.567670	1.6738546		
	DC	10	4.647570	1.2595474	3.140	0.006
	DW	10	2.567670	1.6738546		
	DC Ru	10	7.093210	1.4872108	6.391	0.000
	DW	10	2.567670	1.6738546		

T0 = baseline, T3 = immediately after bleaching, CP = Carbamide peroxide, DC = *D. cinnabari* without rubbing, DC Ru = *D. cinnabari* with rubbing, DW = Distilled water, N = Number of specimens, SD = Standard Deviation.

Miswak, a natural product that is similar to the current study, has been shown to have antioxidant properties[17,18]. *Salvadora persica* paste, which is made from miswak, has the potential to be an effective, alternative teeth-whitening product, especially for removing extrinsic staining[19].

Limitation of the study

The present study tested only one concentration of the natural material used in this research is the same as commercial materials with 10% and the experimental gels were applied according to the directions for positive control. There was no artificial saliva to mimic the oral environment.

CONCLUSIONS

Within the limitations of this study, it could be concluded that successfully obtained *D. cinnabari* gel extract with 10 % concentration using methanol as a solvent. The results showed that coffee was a statistically significant effect on the pigmentation of the teeth. Specimens treated with *D. cinnabari* gel and its effectiveness in whitening the teeth, especially *D. cinnabari* RU specimen by rubbing, as is popularly known were significantly as same as affect those treated with Carbamid Peroxide due to the experimental gels (*D. cinnabari*) containing phenolic content with strong antioxidant effects.

CONFLICT OF INTEREST

No conflict of interest is associated with this work.

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DATA AVAILABILITY

Data will be made available on request.

AUTHOR'S CONTRIBUTION

Elaiwa WOA: preparation of specimens, bleaching procedure study design. **Shami IZA:** data collection, data analysis. **Hamzi MA:** editing, revision. **kholani AWA:** collection of plants. **Ghorafi MAAA:** field works, thesis writing. **Othman N:** writing, review, and editing, data curation.

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