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Vernonia Conferta oral gel for wound healing after simple tooth extraction: Formulation and *in vivo* evaluation

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Abstract

Tooth extraction can lead to complications such as bleeding and persistent pain, despite advances in dentistry. Conventional treatments are not always sufficient. *Vernonia conferta* Benth, a plant traditionally used for bacterial infections and skin conditions, possesses antimicrobial, hemostatic, and wound healing properties. This study aimed to formulate a healing gel based on an aqueous extract of its bark and evaluate its *in vivo* efficacy on wounds after simple tooth extraction.

The oral gel was formulated according to the method described by Nokam *et al*. A pilot study on 30 volunteer patients who underwent simple tooth extraction compared the gel's efficacy to standard antibiotic treatment. The 2% gel formulation had satisfactory physicochemical characteristics: dark brown color, pH 5.6 (compatible with saliva), soft consistency, mint odor, and slightly bitter taste. The results showed a more pronounced pain reduction with the gel. On day 2, 40% of patients in the gel group still felt pain, disappearing on day 3, compared to 66.70% for the antibiotic group. Regarding healing, the gel group showed a faster onset of healing. On day 3, 66.67% of patients in the gel group showed a reddish discoloration of the wound, a sign of granulation, compared to 26.67% in the other group. The beginning of closure of the extraction site was observed in 60% of patients in the gel group on day 3, while the antibiotic group reached this stage on day 7. At day 14, 66.70% of patients in the gel group were completely healed, compared to 40% in the other group.

In conclusion, the oral gel based on aqueous extract of *Vernonia conferta* Benth bark was relatively more effective for the healing of wounds following simple tooth extraction, offering a promising solution in dentistry.

Keywords: *Vernonia conferta*; Oral Gel; Tooth Extraction; Healing; Pain; Stomatology

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1. Introduction

Tooth extraction is a widely practiced procedure in dentistry, despite considerable progress in the prophylactic and therapeutic fields of dental conditions [1]. Following the procedure, complications such as bleeding and persistent pain may occur. Control measures include physical (compression), surgical (sutures), and medicinal (analgesics, antibiotics) methods. Sometimes, these measures are not sufficient, and it is then necessary to expand the therapeutic range.

Vernonia conferta Benth is a shrub of the Asteraceae family, reaching 6 m in height, composed of slender, tomentose branches. It is a plant traditionally used for bacterial infections and skin conditions such as wounds and ulcers [2,3]. Recent studies show that the bark of this plant contains bioactive compounds with antimicrobial, hemostatic, and healing properties; making it a promising candidate for the development of a healing oral gel [4,5].

The objective of this study was to formulate a healing gel based on an aqueous extract of the bark of *Vernonia conferta* and to evaluate its *in vivo* efficacy on wounds following simple dental extraction.

a) b)

Figure 1 a) *Vernonia conferta* plant; b) *Vernonia conferta* bark and stem [5]

2. Materials and Methods

2.1. Plant Material

This consisted of *Vernonia conferta* trunk bark collected in the Centre region, the Mefou and Afamba department, the locality of Nkolafamba. Authentication of our specimen was carried out at the National Herbarium of Cameroon by comparison with the material of Raynal J.A. under number 10046 of the herbarium collection no. 11111/HNC.

2.2. Equipment

For the formulation, we used, among other things: precision balance; beaker; spatula; magnetic stirrer; a pH meter; mortar and pestle; flasks; oven; and an autoclave.

2.3. Formulation of the 2% Oral Gel

The formulation of the 2% oral gel was carried out according to the method described by Nokam et al [4].

2.3.1. Extract Preparation

After harvesting, the *Vernonia conferta* bark was oven-dried at a temperature of 50°C and then ground into powder. Extraction was performed by aqueous decoction: 1000g of powder in 400ml of distilled water. The mixture was filtered and placed in an oven to dry for 48 hours at 50°C. The resulting dry residue will be the extract.

2.3.2. Formulation Development

- **Preparation of the Aqueous Phase:** 2g of Carbopol were slowly added to a clean, sterile container containing 95ml of water while stirring vigorously to avoid
- **Addition of the plant extract:** 2g of extract was pulverized and dissolved in 5ml of water. This mixture was then added to the Carbopol solution.
- **Gel formation:** Triethanolamine was added dropwise until a gel of the desired consistency was obtained.
- **Addition of other ingredients:** 0.5g of sodium benzoate was incorporated into the mixture, along with one drop of peppermint essential oil. The mixture was homogenized.
- **pH adjustment**: The pH of the gel was checked and adjusted, if necessary, with citric acid or triethanolamine to achieve the appropriate pH.
- **Packaging:** The gel was transferred into sterilized plastic jars.

2.3.3. Control of the formulated gel

The organoleptic characteristics, consistency, and pH were evaluated.

2.4. Evaluation of the *in vivo* efficacy of the formulated gel

2.4.1. Study Design

A small-scale pilot study was conducted on 30 volunteer patients aged 19 years and older who underwent simple tooth extraction, after obtaining informed consent and ethical approval. Patients were recruited from the Odontostomatology Department of the Yaoundé Central Hospital, Cameroon.

2.4.2. Treatment Protocol

Volunteers were randomly assigned to use either *Vernonia conferta* gel (3 applications per day) or antibiotics (Amoxicillin 1g/12h and Metronidazole 500mg/8h) for 7 days. No mouthwash or other treatment was permitted during the study.

2.4.3. Evaluation Parameters

Treatment efficacy was assessed by self-measuring pain intensity using the Simple Verbal Scale (SVS) on days 1, 2, and 3; and by evaluating healing progress using the POSAS scale (duration of pain, duration of inflammation, appearance of the extraction site) on days 3, 7, and 14.

2.4.4. Statistical Analysis

Data were entered using CSPro version 8.0 software and then imported into the software. SPSS version 25.0 analysis software. Categorical variables were compared using Chi-square, as well as the strength of the association using phi and Kramer's V. The significance threshold was set at 5% (p-value <0.05).

3. Results

3.1. 2% *Vernonia conferta* formulated gel

The formulated gel (Figure 2) exhibited acceptable physicochemical characteristics, which are summarized in Table 1.

Table 1 Composition and Physicochemical Characteristics of the Formulated Gel

Composition		**Characteristics**	
Distilled Water	**100 ml**	**Color**	**Dark brown**
Vernonia conferta extract	2%	pH	5,6
Carbopol 940	2 g	Consistency	Mild
Sodium Benzoate	0,5 g	Odor	Mint
Mint Essential Oil	1drop	Taste	Slightly Bitter

Figure 2 Gel Formulated

3.2. *In vivo* efficacy of the formulated gel

3.2.1. Pain duration

Clinically, a significant reduction in pain was observed in both groups, but it was more pronounced in the gel group. On day 2, only 40% of patients in the gel group still experienced pain, which disappeared by day 3, while 66.70% of patients in the standard treatment group still experienced pain until day 3, and 13.30% by day 4 (Table 2).

Table 2 Pain duration

Pain duration	**Group**		**p**
	G1 (%) N = 15	G2 (%) N = 15	
D1	9 (60,0)	1 (6,7)	0,010
D2	6 (40,0)	10 (66,7)	
D3	-	2 (13,3)	
D4	-	2 (13,3)	

G1= Gel Group; G2 = Antibiotic Group; D = day

3.2.2. Appearance of the extraction site

In terms of healing progress, the difference was more visible from day 3 to day 7, before reaching almost similar results in both groups.

Regarding coloration, 66.67% of patients in the gel group, compared to 26.67% in the antibiotic group, showed a reddish color to the wound, a sign of of the beginning of healing through the granulation phase (Table 3).

Table 3 Extraction site coloration after 3, 7 et 14 days

Extraction site coloration	**Group**		**p**
	G1 (%) N = 15	**G2 (%) N = 15**	
D3			0.028
Whitish	5 (33.3)	11 (73.3)	
Reddish	10 (66.7)	4 (26.7)	
D7			0.343
Whitish	-	1 (6.7)	
Pinkish	-	1 (6.7)	

Uniforme	15 (100.0)	13 (86.7)	
D14			0.309
Pinkish	-	1 (6.7)	
Uniforme	15 (100.0)	14 (93.3)	

G1= Gel Group; G2 = Antibiotic Group; D = day

On day 3, 60% of patients in the gel group had begun to close the extraction site, while this was the case for only 60% of patients in the antibiotic group on day 7. On day 14, 66.70% of patients in the gel group were completely healed with complete wound closure, compared to 40% in the other group (Table 4).

Table 4 Extraction site condition after 3, 7 jours et 14 days

Extraction site condition	**Group**		**p**
	G1 (%) N = 15	**G2 (%) N = 15**	
D3			0,001
Open	5 (33,3)	15 (100,0)	
Medium closed	9 (60,0)	-	
Almost closed	1 (6,7)	-	
D7			0,143
Medium closed	5 (33,3)	9 (60,0)	
Almost closed	10 (66,7)	6 (40,0)	
D14			0,143
Almost closed	5 (33,3)	9 (60,0)	
Completely closed	10 (66,7)	6 (40,0)	

G1= Gel Group; G2 = Antibiotic Group; D = day

4. Discussion

The objective of this study was to formulate a healing gel based on an aqueous extract of *Vernonia conferta* bark and to evaluate its *in vivo* efficacy on wounds following simple dental extraction.

We obtained a gel with satisfactory characteristics. The consistency was soft, thus promoting good application. The mint flavor masked the odor and provided a cooling sensation upon administration. The pH was 5.6, compatible with the pH of saliva (5.5-8.0); it allows sufficient contact time to ensure good diffusion of the active substances at the extraction site [6].

At the clinical level, we analyzed pain, the color of the extraction site, including the evolution of inflammation, and finally the state of the extraction site during the healing process. This allowed us to observe significant differences in the two groups of patients (gel group and antibiotic group).

Regarding pain, the gel group reported lower pain levels than the antibiotic group (p=0.010), this could be due to the presence of bioactive compounds such as phenols and flavonoids in the extract. Indeed, phenols have analgesic properties, hence the reduction of pain in them, while flavonoids have anti-inflammatory properties [7], which acts on the wound by reducing inflammation, hence the considerable reduction in pain from the first day. Regarding the appearance of the extraction site, we observed significant results occurring on the 3rd day, including a change in color and an accelerated healing process for the gel group. In this group, we see the budding phase from the second day, which is characterized by a red appearance with a granular wound; and on the third, a marked epithelialization phase, the beginning of wound closure. These results can be explained by the presence of tannins, which are known for their astringent and hemostatic properties. In addition, during the hemostatic process, there is added vasoconstrictor activity on the small vessels, which completes the healing activity. This property explains their use against hemorrhoids and superficial wounds [8]. The remodeling phase is already better observed on day 7 with a more significant closure for the gel group, which may be due to the regenerative action of antioxidants. Indeed, a study conducted by Inès Maria Comino-Sanz et al. demonstrated the role of antioxidants in wound healing [9].

5. Conclusion

This study highlights the advances that traditional medicine can bring to dentistry. Oral gel based on aqueous extract of *Vernonia conferta* Benth bark was found to be relatively more effective for the healing of simple post-tooth extraction wounds compared to standard treatment. Its accessibility and efficacy could be beneficial in dental practice.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

Approval was given by the Research Ethics Committee of the Faculty of Medicine and Biomedical Sciences (FMBS).

Statement of informed consent

Informed consent was obtained from all participants included in the study.

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