

Cranberry Effects 0.05% on the Dental Biofilme of Individuals with Disabilities

Efeitos do Cranberry 0,05% no Biofilme Dental de Pessoas com Deficiências

Efectos del Arándano 0,05% sobre el Biofilm Dental de Personas con Discapacidad

Jeisielle Alves da Anunciação **BARRETO**

Residência Multiprofissional em Saúde da Família, Fundação Estatal Saúde da Família – FESFSUS Fundação Oswaldo Cruz – Fiocruz - BA, Brasil
<https://orcid.org/0000-0002-0972-799X>

Karina Melo **TRINDADE**

Cirurgiã-Dentista, Faculdade Adventista da Bahia – FADBA, Cachoeira - BA, Brasil
<https://orcid.org/0000-0002-3326-7102>

Marcia Otto **BARRIENTOS**

Mestre em Ciências - CENA/USP, Farmacêutica - FAFABES/UFES, Doutora em Imunologia - UFBA,
Professora da Faculdade Adventista da Bahia – FADBA, Cachoeira - BA, Brasil
<https://orcid.org/0000-0001-5603-2448>

Samia Ramos Souza e **SOUZA**

Mestre em Odontopediatria SLMandic, Especialista em Odontopediatria - UEFS, Cirurgiã-Dentista - UEFS,
Professora da Faculdade Adventista da Bahia – FADBA, Cachoeira - BA, Brasil
ORCID: <https://orcid.org/0000-0003-2696-3203>

Abstract

In this study we investigated the effectiveness of a 0.05% cranberry gel formulation in controlling microbial biofilm on dental surfaces of individuals with disabilities. The study included 26 individuals with disabilities. Using revealing pads, the microbial biofilm of the index tooth surfaces was stained. This staining was performed before and after application of a 0.05% cranberry gel formulation, which was applied for 7 to 15 days. The microbial biofilm differences found in all stages were described as mean and standard deviation and statistically evaluated. The biofilm control evaluated before the intervention with cranberry 0.05% showed an average of 1.76 ± 0.70 . The formulated gel generated a positive mean drop to 0.98 ± 0.55 ($p < 0.001$). Cranberry gel 0.05% showed statistically significant improvements in microbial biofilm control.

Descriptors: Disabled Person; Vaccinium Macrocarpon; Oral Hygiene.

Resumo

Neste estudo, investigamos a eficácia de uma formulação em gel de cranberry 0,05%, para o controle de biofilme microbiano em superfícies dentais de pessoas com deficiência. O estudo incluiu 26 pessoas com deficiência. Utilizando pastilhas evidenciadoras, o biofilme microbiano das superfícies dos dentes índices foi corado. Esta coloração foi realizada antes e após a aplicação de uma formulação em gel de cranberry 0,05%, que foi aplicada por 7 a 15 dias. As diferenças encontradas no biofilme microbiano em todos os estágios foram descritas como média e desvio padrão e avaliadas estatisticamente. O controle do biofilme avaliado antes da intervenção com cranberry 0,05% apresentou média de $1,76 \pm 0,70$. O gel formulado gerou uma queda positiva da média para $0,98 \pm 0,55$ ($p < 0,001$). O cranberry gel 0,05% apresentou melhoras estatisticamente significativas no controle do biofilme microbiano.

Descritores: Pessoa com Deficiência; Vaccinium Macrocarpon; Higiene Oral.

Resumen

En este estudio, investigamos la eficacia de una formulación de gel de arándano al 0.05% para el control de la biopelícula microbiana en las superficies dentales de personas con discapacidades. El estudio incluyó 26 personas con discapacidad. Usando tabletas de evidencia, se tiñó la biopelícula microbiana en las superficies de los dientes índices. Esta coloración se realizó antes y después de la aplicación de una formulación de gel de arándano al 0.05%, la cual se aplicó durante 7 a 15 días. Las diferencias encontradas en la biopelícula microbiana en todas las etapas se describieron como media y desviación estándar y se evaluaron estadísticamente. El control de biopelícula evaluado antes de la intervención con 0.05% de arándano rojo tuvo una media de 1.76 ± 0.70 . El gel formulado generó una caída positiva de la media a $0,98 \pm 0,55$ ($p < 0,001$). El gel de arándano al 0,05% mostró mejoras estadísticamente significativas en el control de la biopelícula microbiana.

Descriptores: Persona Discapacitada; Vaccinium Macrocarpon; Higiene Bucal.

INTRODUCTION

Individuals with disabilities (ID) are individuals who experience temporary or permanent, progressive, regressive or stable loss or abnormality of one or more body structures or physiological function. According to the Brazilian Ministry of Health, approximately 10% of the world's population is composed of ID¹. In the Brazilian state, the highest percentage of these patients was observed in the Northeast Region (16.8%) and the lowest in the Southeast Region (13.1%)². Because they differ from the general conditions compatible with normality, social and health behaviors, including oral health, should be developed to meet the needs and adapt to the particularities of these patients³.

Oral conditions such as malocclusions, macroglossia, arch shape modification, irregular and improper masticatory activity, as well as

bruxism are commonly identified features in ID. These characteristics make oral hygiene difficult, favoring the retention of microbial biofilm and promote the appearance of diseases (caries, periodontal diseases). This fact is aggravated by the diet, usually rich in carbohydrates, pasty foods, in addition to the continuous intake of medicines, often with sugars and triggers of hyposalivation^{2,4,5}.

Faced with the difficulties of controlling dental biofilm in ID by mechanical means, there is the option of using chemical agents as adjuvants. There are several representatives of these substances on the market with proven effectiveness in helping to achieve and maintain oral health. However, the inability to rinse or spit, associated with manual difficulties, limits the use of most chemical agents by IDs and their caregivers⁶.

Optimizing a chemical agent that is compatible with the need for ID, with efficacy

comparable to mechanical control is still the subject of research⁷. One option that has been studied in the dental area is the cranberry, scientific name *Vaccinium Macrocarpon* belonging to the family *Ericaceae*. A fruit whose therapeutic effects have been shown to be satisfactory mainly due to its anti-inflammatory, antibacterial and antioxidant properties⁸. These effects are observed since the cranberry presents in its composition anthocyanidins, vitamin C, flavonoids, proanthocyanidins, and phenolic acids. The differential of cranberry is that it has proanthocyanidin type A (PAC), a substance that prevents bacteria from adhering, making it a great alternative for oral microbiota control. In addition, because it has no bactericidal effect, cranberry presents no risk of developing bacterial resistance^{9,10}.

Cranberry's role in bacterial adhesion to dental biofilm is effective in both gram positive and gram-negative species⁹. This non-stick feature has triggered further studies in the development of therapeutic techniques for infection prevention. Weis et al.⁹ evaluated the role of cranberry juice in the interspecies co-aggregation of bacteria, concluding that the fruit was effective in reversing the adhesion of oral streptococci, gram positive and gram-negative species to biofilm and in inhibit the action of fructosyltransferase and glycosyltransferase enzymes. Labrecque et al.¹⁰ also studied the effect of a material prepared from cranberry juice on the growth, biofilm formation and adhesion properties of *Porphyromonas gingivalis* species, and concluded that such microorganism had inhibited adhesion and reduced its ability to invade human cells and induce inflammation.

Thus, the aim of this research was to evaluate the effect of 0.05% cranberry gel on the control of microbial biofilm of ID dental surfaces.

MATERIAL AND METHOD

○ Study design and population

This is an uncontrolled analytical study, whose experimental convenience group consisted of 26 ID of both genders, aged between 3 and 40 years, who had deciduous, mixed, or permanent dentition. The patients were referred by the Bahia Adventist College Clinic School (FADBA) and Association of Parents and Friends of the Exceptional (APAE) in Governador Mangabeira, both located in the Recôncavo region of the state of Bahia. The patients were collaborative for the research steps and the informed consent (IC) were duly completed and signed by the legal guardians.

Trindade et al.¹¹, in their study, trace the characteristics of oral hygiene, as well as dietary habits and their syndromes of the sample of the present research.

○ Sample Record

It consisted of clarifying the research and obtaining the respective IC. At this stage, the researchers went in person to all the legal guardians of the ID and informed them about the research purposes and the steps that delimit it, including only patients registered in the institutions mentioned above and who had an IC signed by the respective legal guardian.

○ Chemical intervention

The quality of microbial biofilm control of the target population was evaluated prior to any intervention. Using evidencing tablets (Eviplac-Biodynamics), the visible and non-visible biofilm was stained with a contrasting color to the teeth (purple), facilitating its location for further analysis and classification¹². The tablets used have as composites: Basic Fuchsin (2%), Saccharin Sodium, Lactose, Sodium Cyclamate, and other excipients, Fuchsin being the main responsible for the coloration.

The process of disclosure of the dental surfaces of the studied group was adapted so that patients who could not chew or spit could be submitted to the procedure. The pellets were ground in a beaker and then diluted with water in the proportion of 3 drops of water for each pellet unit. Then, with the help of flexible nails, the contents were applied to the buccal surface of the following index teeth: right upper first molar, right upper central incisor, left upper first molar, first right lower molar, left lower central incisor and left lower first molar¹². The exam was developed in natural, ventilated light, and was performed by three examiners and annotators previously calibrated and trained in the laboratory. Intra-examiner agreement was made before the clinical examination with the intention of gauging the consistency obtained during the training.

Immediately after this process, each patient's Simplified Oral Hygiene Index (IHO-S) was obtained, such as Oliveira y Martine¹². Based on these authors, the surface area of the tooth covered by the previously stained biofilm was estimated by visual examination according to the following criteria: 0 - No plaque present; 1 - Plaque covering no more than one third of the surface being examined; 2 - Plaque covering more than one third but not more than two thirds of the surface examined; 3 - Plaque covering more than two thirds of the examined surface. The total IHO-S score was obtained by summing the values found by the examiner, divided by the number of counted surfaces. The averages found were classified as follows: average between 0 and 1.5 represents good oral hygiene, between 1.6 and 2.5, regular oral hygiene and greater than 2.6, poor oral hygiene¹².

Subsequently, approximately 10g of 0.05% cranberry gel (Farmö) was applied to the buccal surface of the anterior and posterior teeth, before bedtime. No need to rinse after application and without risk if swallowed. The choice of cranberry extract concentration used in the research was based on Tagliani's work¹³. As for the excipient selected for gel composition, glycerin was chosen, since it has no antimicrobial effect, nor interferes with the action of the selected extract, besides acting as a humectant preventing dehydration and dryness of the gel.¹⁴The gel was packed in a compressible plastic tube that did not allow the substance to reflux so as not to contaminate its interior. The applicator tip was composed of an ultra-soft and flexible bristle brush, thus chosen to prevent biofilm removal if it encountered the dental surface and to avoid trauma.

The technique for applying 0.05% cranberry gel was also previously oriented, so that when the tube was compressed, only the gel would meet the teeth. The gel should not be dragged, in contrast, each tooth surface should receive an individual portion of the substance. Caregivers who were responsible for applying the gel received these guidelines. For patients whose caregivers could not perform the application, this was done by trained researchers, following the same guidelines, but in the morning, two hours after the first meal. All patients used the chemical agent for a period of 7 to 15 days. After this period, a new evaluation of microbial biofilm accumulation (IHO-S) was performed, following the previously described criteria.

o *Statistical analysis*

Data obtained during all stages were tabulated and analyzed descriptively with the T test for paired data through the Program for Statistical Analysis of Sampled Data - PSPP®. The study was approved by the Research and Ethics Committee of the Adventist College of Bahia (FADBA), under registration number CAAE 642614179.0000.0042.

RESULTS

The IHO-S performed before the intervention with cranberry 0.05% showed an average of 1.76 and standard deviation of 0.70. These data classify the sample studied in the group of regular oral hygiene (average between 1.6 and 2.5), suitable for the development of oral pathologies.

After the intervention with 0.05% cranberry gel, new microbial biofilm index analyzes were performed for later comparison with the data obtained in the initial evaluation. It was observed that the performance of the chemical agent, even in the absence of changes in the patients' dental hygiene and diet routine, generated a positive decrease in the IHO-S average to 0.98 and a

standard deviation of 0.55 (p< 0.001). These data show an improvement in the dental biofilm index in approximately 70% of patients and reclassify the studied group in good oral hygiene (average between 0 and 1.5), thus minimizing the development and evolution of oral diseases. The individual IHO-S values of the patients in the sample and their oral hygiene classification, obtained before and after intervention with the 0.05% cranberry gel, were grouped and expressed in Table 1.

Table 1. Simplified oral hygiene index and respective classification for oral hygiene of individuals with disabilities (n = 26) obtained before and after intervention with cranberry gel 0.05%. Cachoeira, Bahia, Brasil, 2018.

ID	Initial IHO-S	Initial classification oral hygiene	IHO-S after CG	Classification oral hygiene after CG
1	2,16	Regular	0,66	Good
2	1,50	Good	0,83	Good
3	1,00	Good	0,50	Good
4	2,16	Regular	0,83	Good
5	2,16	Regular	1,50	Good
6	1,60	Regular	1,00	Good
7	1,40	Good	1,80	Regular
8	2,33	Regular	1,83	Regular
9	0,66	Good	0,50	Good
10	1,83	Regular	1,00	Good
11	2,00	Regular	0,50	Good
12	1,66	Regular	0,66	Good
13	2,33	Regular	2,33	Regular
14	1,00	Good	1,20	Good
15	0,33	Good	0,33	Good
16	2,25	Regular	0,50	Good
17	1,66	Regular	0,66	Good
18	2,20	Regular	1,00	Good
19	1,25	Good	1,50	Good
20	3,75	Poor	2,00	Regular
21	1,00	Good	0,50	Good
22	1,83	Regular	0,83	Good
23	2,50	Regular	0,83	Good
24	2,25	Regular	1,25	Good
25	1,50	Good	0,50	Good
26	1,33	Good	0,33	Good

ID: Individuals with disabilities. IHO-S: Simplified oral hygiene index. CG: 0.05% cranberry gel.

DISCUSSION

The oral health care of ID is included in the National Health Policy of Persons with Disabilities¹⁴. Studies show that the fullness of this right is a goal to be achieved, as verified by Pini, Frölich and Rigo¹⁵ in a study with 47 ID in the Passo Fundo-RS APAE, where IHO-S> 1.6 and CPOD> 10 were found in more than 40% of participants. The population of this study also had insufficient oral hygiene to prevent oral diseases arising from the accumulation of microbial biofilm, a fact found by the average IHO-S 1.76 and standard deviation 0.70. More serious situation was found by Veríssimo and collaborators³, who studied the dental health profile of ID assisted in a pediatric hospital and found poor oral health in 86% of the cases. Confirming the serious situation, Queiroz and collaborators¹⁶ evaluated the oral health status of ID and found high levels of CPOD, as well as poor dental hygiene. These findings suggest the need to promote oral hygiene guidelines, allied to the development of substances that enhance mechanical control.

Fluoride, chlorhexidine, and triclosan/zinc

citrate are antimicrobial and antimetabolic agents that selectively suppress dental biofilm microorganisms implicated in tissue destruction¹⁷. This action causes such chemical agents to act as mechanical aids in biofilm control and disease prevention. On the other hand, dental staining, swallowing poisoning and taste alteration are side effects that, combined with an inconvenient form of administration for patients with intellectual and motor disabilities, limit the use of these substances in their most common formulations and for an extended period^{18,19}.

To circumvent the limitations of commercially available chemical agents, there has been a growing interest in naturally derived biologically active compounds with similar or superior efficacy to gold standard antimicrobials. A study comparing the efficacy of the mouthwash with chlorhexidine mouthwash 0.2% based cranberry to 0.6% of *Streptococcus mutans*, concluding that the cranberry is equally effective and stress the fruit may be a better alternative than chlorhexidine in improving oral health with systemic benefits and minimal side effects.²⁰ For ID without oral motor coordination effective chemical agents are indicated that are easy to apply and do not require rinsing.

The choice of an active ingredient should be previously considered, considering the oral health conditions commonly found in the target population, as well as the microorganisms related to the pathologies that affect the oral cavity⁶. A commonly used chemical agent for this purpose is chlorhexidine, however, a study⁶ evaluated the effect of this chemical agent on the 0.5% gel formulation in superinfecting microorganisms of the ID dental biofilm. On the other hand, Tagliane¹³ evaluated the in vitro protective effect of cranberry-based gels at different concentrations (0.05%; 1%, 5% and 10%) on a previously eroded dentin, noting the inhibitory effect of gels especially at 0, 05%.

From the analysis of the IHO-S, it is noted that the cranberry gel 0.05% was able to perform microbial biofilm control even in the absence of routine changes, feeding and dental hygiene of ID. This improvement may be justified by the antimicrobial and non-stick properties mentioned above^{9,10} and agrees with the studies developed by Yamanaka et al²¹ and Sethi and Govila²². These authors identified a reduction in microorganism count, adhesion, and formation of the dental biofilm after cranberry actuation. Besides that, Sandros et al.²³ observed in their work that cranberry can contribute to the reduction of periodontopathogen proliferation in periodontal pockets and is able to decrease the production of virulence factors by oral bacteria and host-mediated destructive processes. Another study²⁴

found that extracts enriched with proanthocyanidin, a substance found in cranberry, were able to reduce dentin wear and collagen degradation and could be effective in preventing dentin erosion.

Koo et al.²⁵ verified the role of cranberry juice formulation in the in vitro development of *S. mutans* biofilm and acidogenicity, observing the inhibition of glycosyltransferase and bacterial adhesion on the glucan coated surface, as well as the reduction of development and acidogenicity of *S. mutans*. Feldman et al.²⁶ studied PAC A, resulting in reduced activity of *P. gingivalis* and secretion of inflammatory mediators (IL-1b, TNF- α , IL-6 and IL-8). The literature also shows benefits of cranberry in general health, reporting the reduction of glucose in patients with type II diabetes, improvement of vascular functions and reduction of total cholesterol and triglyceride levels^{27,28}.

The findings of the present study may be justified by the efficient performance of the chemical agent and the clear difficulty in achieving full collaboration of patients and caregivers. These data also suggest the need to study individual differences in microbial biofilm accumulation²⁹.

CONCLUSION

The use of 0.05% cranberry gel was promising as a chemical agent for dental biofilm control due to the significant improvement of IHO-S, even in the absence of changes in the routine of ID. The adequacy of oral conditions was not observed even after dietary guidelines and supervised oral hygiene, revealing in this study, cranberry 0.05% superior to mechanical intervention.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest.

CORRESPONDING AUTHOR

Jeisielle Alves da Anunciação Barreto

Avenida Industrial Urbana, Ponto Certo,
Jardim Atlântico Life,
Bloco 26, Apartamento 02,
42.800-31 Camaçari - BA, Brasil
E-mail: jeise.barreto@outlook.com.

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