

INFLUENCE OF ENVIRONMENTAL CONDITIONS ON THE SURFACE FREE ENERGY OF VILLACRYL SV4 MATERIAL

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Introduction

The varying environmental conditions of oral cavity may influence on surface properties of dental prosthesis. The high value of surface free energy of dental materials may cause unsuitable processes of bacterial plaque adhesion. An analysis of surface free energy and levels of wettability, cohesive energy, parameter of surface solubility become key aspects in testing of biomaterials [1,3,4].

Materials and Methods

The object of the study was dental acrylic Villacryl SV4. The dimensions of samples were: 10.55 (± 0.83) x 30.10 (± 1.10) [mm] and thick 4.75 (± 0.21) [mm], all samples were made according to producer instruction. The changes of surface free energy (γ_s - SFE), its components (dispersive - γ_s^d , polar - γ_s^p) parameter of solubility (δ) and cohesive energy (e_c) by using analytical Owens-Wendt (OW) model were estimated. Two measurement liquids: (W) distilled water (Poch S.A.) and (D) diiodomethane (Merck sp.zo.o.) were used. The volume of liquid drop was 0.5 [μ l], each test was repeated ten times in room temperature 22 \pm 1°C. The contact angle values were measured with the use of sessile drop method by the See System computer-based instrument produced with Advex Instruments. The samples were storage in different environments and thus divided into groups (G): 1 day of storage in 22°C in „pepsi” (G1) and in orange juice (G2), 7 days of storage in 22°C in „pepsi” (G3) and in orange juice (G4) and in coffee (G5), 7 days in 0.9% NaCl solution in 60°C (G6), in milk 60°C (G7), in 0.9% NaCl solution in 40°C (G8), in milk 40°C (G9). The results were compared with reference sample.

Results and Discussion

The values of contact angle of acrylic material surface with deposits arising after storage were obtained (FIG. 1 and FIG. 2). The average values of angle were used to determine the SFE and its components, as well as the cohesive energy and solubility parameter (TABLE 1).

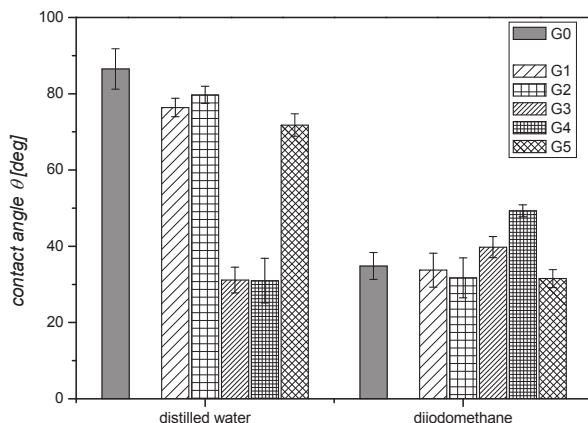


FIG. 1. The contact angle values for groups G1-G5 (room temperature of storage).

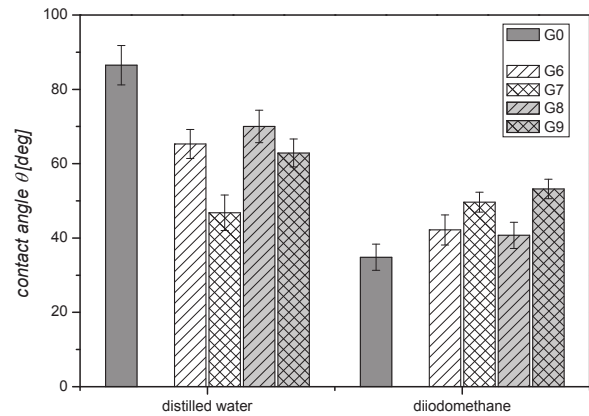


FIG. 2. The contact angle values for groups G6-G9 (temperature of storage 40 and 60°C).

TABLE 1. The comparison of surface properties.

No	γ_s	γ_s^d	γ_s^p	e_c	δ
	[mJm ⁻²]			[MJm ⁻³]	[mJ ^{1/2} m ^{-3/2}]
G0	43.5 (2.1)	42.1 (1.3)	1.4 (0.8)	442.9 (31.5)	21.0 (0.7)
G1	46.7 (1.9)	42.5 (1.6)	4.1 (0.3)	491.6 (31.5)	22.2 (0.7)
G2	46.3 (2.1)	43.4 (1.9)	2.9 (0.2)	485.7 (32.5)	22.0 (0.7)
G3	68.3 (1.8)	40.1 (0.7)	28.2 (0.9)	870.3 (31.7)	29.5 (0.5)
G4	66.1 (2.7)	34.7 (0.7)	31.4 (2.0)	827.7 (50.7)	28.8 (0.9)
G5	49.2 (1.6)	43.5 (0.8)	5.7 (0.8)	532.2 (25.7)	23.1 (0.6)
G6	48.5 (2.7)	38.5 (1.7)	10.0 (1.0)	521.7 (44.5)	22.8 (1.0)
G7	57.0 (3.0)	34.5 (1.2)	22.5 (1.8)	662.8 (51.6)	25.7 (1.0)
G8	46.8 (2.7)	39.5 (1.5)	7.6 (1.2)	493.6 (42.3)	22.1 (0.9)
G9	46.1 (2.5)	32.5 (1.2)	13.7 (1.3)	483.3 (38.8)	21.9 (0.9)

Analyzing the change of the surface energy and its components after the storage, the effect of the fluid nature on the sediment formed on the surface of the material can be clearly seen. The increase of a polar component in each of the tested group, including the largest - 20 times over 7 days of storage in orange juice (G3) and "pepsi" (G4) was observed. The changes of a dispersive component had a different trend, the greatest increase was approx. 4% in the G5 and the decrease was ca. 24% in the G9. The highest value of e_c was shown for G3 and G4.

Conclusions

The mechanisms inducing bacterial adhesion to dental material depends on many factors associated with a substrate, including SFE [2]. Some of consumed liquids influence on substantial increase of SFE value.

References

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