COLOR VARIATION OF ACRYLIC RESINS IMMERSED IN PIGMENT BEVERAGES ACCORDING TO THE CONSUME HABITS: A PILOT STUDY

ABSTRACT

AIM: evaluate the color changes in acrylic resins immersed in two pigmented beverages in different time periods, proportional to the frequency and volume of consume by the population with and without the use of artificial saliva. **MATERIAL AND METHODS:** Thirty thermo-polymerizable resin disks were confectioned with 3.0 +- 0.1 mm thickness, initially immersed in distilled water for 24 hours and randomly divided into 2 groups (n=15): GC – with artificial saliva and GS – without artificial saliva. They were, then, subdivided into 3 subgroups (n=5): G1 – distilled water (control); G2 – red wine; G3 – black tea. These groups were daily immersed inside beverages for 15 days, with daily immersion frequency equal to the beverage ingestion and the period of each immersion equal to 1 minute/10 ml of beverage per capita. Between each immersion the disks were stored inside distilled water. The color of resins was measured according to the CIE-Lab scale before and after the immersion periods, and the color variation was calculated (ΔE). The values ΔL*, Δa* e Δb* were also evaluated. **RESULTS:** Analysis of variance was performed, and have shown significant difference (p<0.05) among G1 and the other solutions, without significant difference between G2 and G3 for ΔE, ΔL, Δa and the module Δb. There was no difference between GC and GS. **CONCLUSION:** It was concluded that the use of artificial saliva did not change pigmentation degree and that wine presents similar changes to the tea, considering the parameters used.

WALDEMARIN, Renato Fabrício de Andrade*
CLEFF, Lucas Brum**
SANTOS, Lauren Grandi**
CAMACHO, Guilherme Brião*
PINTO, Luciana de Rezende*

INTRODUCTION

Partial or total removal prostheses present acrylic resin base in order to provide support and/or join, and maintain artificial teeth in position[1]. These bases present aesthetic effects and can interfere in the patient's acceptance to the rehabilitation presented by the surgeon dentist[2]. Acrylic resin is considered a good base material because of the low cost, easy confection, allowing reline, presenting appropriate aesthetic and low density[3,4]. Despite acrylic resin advantages, the polymerization technique may generate in higher or lower degree, inner porosities[3,5,6], which can lead to the absorption of solutions and pigments present in them, like tea, wine, juice, cola base beverages and coffee.

Among the ways to process acrylic resins, it is possible to highlight the conventional techniques to process self-polymerizable and thermo-polymerizable resins because of their widespread usage, and the processing through microwave energy of thermo-polymerizable resins, for their relative low investment required from the professional and the speed of the technique, furthermore, there is also the possible reduction in the quantity of porosities. These porosities inside acrylic resins allow the sorption of liquids during the ingestion of pigmented beverages, like tea, wine, grape juice, distilled beverages, coke and coffee[2,7-9]. However, it is important to notice that clinical relevance of the used beverages may also depend on the frequency and quantity ingested; when compared to other studies, they might not necessarily affect a prosthesis like described in the literature.

Determining the color through visual methods is an unreliable activity. Thereunto, in 1976, the International Commission on Illumination (ICI) developed a tridimensional color space based on the "L" axis (diffuse black-white axis); "a"(red / magenta-green axis) and "b" (yellow-blue axis) (CIEL-Lab) [10], which tries to reproduce the human perception of color, and allow studies about color difference of dentistry materials[11]. This scale has been used in several studies of pigmented liquids in contact with acrylic resins[2,8,9,12-14]; however, the saliva effect in this pigmentation is not clearly explained. Also, the relation between quantity and frequency of pigmented liquids average ingestion, and the pigmentation degree caused in resins, need further clarification. This study aims to help in the measurement of the pigmentation capacity of red wine and black tea in acrylic resins, considering the presence or not of saliva and the quantity and frequency of ingestion of these beverages.

MATERIAL AND METHODS

OBTAINING ACRYLIC RESIN DISKS:

Thirty thermo-polymerizable acrylic resin disks were confectioned. The disks were divided randomly into 2 groups (n=15): GC – with artificial saliva and GS – without artificial saliva. Next, each group was subdivided into 3 subgroups (n=5): G1 - distilled water (control); G2 - wine; G3 - black tea.

The acrylic disk resins used in this experiment were confectioned from Zeltabor condensation silicone patterns for laboratorial use (Zhermack, Badia Polesine, Italy). These patterns were confectioned with the help of a cylindrical matrix of 18mm length and 4,0 mm height, pressed between two glass plaques (JON Com. de *produtos odontológicos Ltda*, *São Paulo, SP,* Brazil) previously isolated with solid Vaseline (*Hemafarma Com. e Ind. Farmacêutica Ltda, São Gonçalo, RJ*, Brazil), under 5 kg weight, for approximately 10 minutes. Then, the silicone patterns were removed from matrixes with a dagger blade to be included in metallic muffle and submitted to the polymerization process.

Resin disks were removed and sanded on both sides with decreasing grain sandpapers until the grain 400. The disks, considered adequate (thickness 3.0 +- 0.1 mm), were immersed in distilled water for 24 hours at 37ºC in dark environment in order to eliminate residual monomers, and randomly divided into 2 groups (n=15) GC – with artificial saliva and GS – without artificial saliva. After this division, they were subdivided into 3 subgroups (n=5, from literature) according to the immersion to be evaluated: G1) distilled water; G2) Cabernet Sauvignon red wine (Reserved *Cabernet Sauvignon, Concha y Toro, Santiago, Maipo* Valley, Chile) and G3) black tea obtained by infusion of 3.0 g of powder for each 400 ml of boiling water (*Madrugada, Venâncio Aires, RS,* Brazil).

The Initial color of the disks was measured by a Konica-Minolta colorimeter model CR-10 (Konica-Minolta, Japan) (T1).

CHARACTERIZATION OF BEVERAGE CONSUMPTION:

Daily frequency and volume of ingestion of beverages were based on data from producer associations, world organizations and literature. For all the beverages involved, the values of higher consumption *per capita* found in world population was used: wine: based on information published in 2010 by the Wine Institute[15], daily consumption was established in 150 ml, equivalent to a glass of wine per day; black tea: information from the Food and Agriculture Organization of the United Nations – FAOSTAT [16] about the current state and future perspectives for tea point to the consumption in thousands of tons (prevision 2011) for several countries. The values pointed in the report were divided by

the population of countries and the situation of higher consumption was observed by the ingestion of 16.71g/person/day, which corresponds to 2000 ml/person/day in Brazilian markets. This consumption was considered as divided into 4 daily doses of 500ml.

COLOR MEASUREMENT:

The disks were suspended in the immersion medium through a nylon thread of 0.5 mm thickness glued to their sides, in order to avoid contact among them or with the recipient bottom.

Each day the disks were immersed in beverages for an equal number of times according to the daily ingestion average for each of them. Each immersion was performed 1 minute for each 10 ml ingested. Thereunto, the immersions obeyed the following frequencies and time: G1) Control, continuous immersion in distilled water; G2) one daily, 15 minutes immersion in red wine, and G3) 4 daily, 50 minutes immersions in black tea.

After each immersion, the disks were removed from the beverage, washed in distilled water for 30 seconds, dried in paper towel and stored in distilled water. Immersion solutions were daily substituted and the immersion procedures were repeated for 15 days, when the processes of washing and color measurement were carried out again (T2). Data obtained was registered in a spread sheets and posteriorly submitted to statistical analysis.

RESULTS

Table 1 shows the medium values for ΔE, ΔL, Δa and Δb, as well as the respective standard deviation of groups tested.

The chi-square test was applied to evaluate the adherence to the normal curve, and the Cochran test for homogeneity of variances. Observation of normality and homogeneity allowed the analysis of variance for 2 variation factors (2-way ANOVA) and the post-hoc Tukey's test for the four variables studied (ΔE, ΔL, Δa e Δb).

For all the variables, the analysis of variance demonstrated there is no statistically significant difference between the groups GC and GS. In all the cases, there was statistically significant difference between the solutions. The post-hoc Tukey's test was then employed, and pointed that to the variables ΔE, ΔL and Δa, there were differences among the G1 and other groups, which were all equals among them.

The results for variables ΔL and Δa also demonstrated that, regarding to the control group, the values ΔL and Δa for groups G2 and G3 were negatives.

Regarding to Δb, statistical analysis of variation module pointed there was no difference between the groups G2 and G3, which show more intense variation than the group G1. However, when the statistical

analysis considered the direction of variation, there were significant differences among the three groups; G1 did not show variation; the variation in G2 was negative, and the variation in G3 was positive.

Table 1. Average and standard deviation of values for ΔE, ΔL, Δa and Δb of groups tested.

		ΔE	ΔL	Δa	Δb
	G1	1.8 (0.98)	-0.5 (1.2)	-1.2 (0.5)	0.2 (0.44)
	G2	5.7 (1.00)	-1.7 (0.5)	-4.8 (1.1)	-2.7 (0.85)
GC	G3	4.6 (0.88)	-1.3 (0.5)	-3.9 (0.4)	1.1 (0.33)
	G1	1.97 (0.81)	0.7 (0.45)	-1.8 (0.7)	-0.3 (0.4)
	G2	5.9 (0.84)	-2.2 (1.2)	-5.0 (1.8)	-2.5 (1.16)
GS	G3	5.6 (0.86)	-1.7 (1.3)	-4.6 (1.9)	2.3 (0.58)

DISCUSSION

Food or beverage deglutition may be divided into three or four stages: Oral (that can be subdivided in oral preparatory and oral properly), pharyngeal and esophagus-pharyngeal[17]. In the first stage there is conscious control, and it is the more important stage for this study, because the food/beverage is in contact with the prosthesis. During this stage, the patient prepare the food and qualify it according to the consistence, volume, density and humidity, and place the bolus on the tongue's dorsum, preparing it to swallow. Since this work regards only to the liquid ingestion, it can be assumed the absence of oral preparatory stage (bolus mastication and humidification) and consider that the different beverages remain in the oral cavity the same period of time, equivalent to the time necessary for the qualification, organization and ejection of bolus, noticed by the volume, consistence and density, positioned on the tongue's dorsum and ejected towards the oropharynx[17].

Studies point to the permanence of liquids on the oral cavity of health individuals for a period that goes from 0.33 to 1.2 seconds [17-24]. Time variations may be caused by the organization type ("tipper" or "dipper") [17, 18, 20]; characteristics of this organization (closed, anterior opened, upper superior opened, closed or unstable) and ejection time (adequate, lentified or in two times)[17] and use or absence of use of total prosthesis[21, 24]. It was also reported that the oral stage is the same, if the different organization, types "tipper" and "dipper" [18, 20], are not taken into account. In this study, we intended to use an immersion time related to the liquid volume daily ingested, because the same volume tends to have a constant time of permanence in the oral stage. Immersion time, then, would represent the same number of ingestions for all the beverages involved in the study. Although the permanence time may vary from person to

person in the oral stage, the immersion time would represent the same number of ingestions for all the beverages, while this number may also vary from one type of oral transit to the other. Thereunto, considering the average time being of approximately 0.45s of oral transit presented by some authors[18-20, 22-24], a minute would represent 133.33 swallows of each 10 ml of beverage, or the sum of 4.44 months of swallow. The repetition for a period of 15 days, then, represents an accumulation of 66.67 months, or approximately 5.5 years of daily ingestion of all the beverages studied consume. An individual who has an oral transit twice longer (permanence of 1s for each 10 ml of beverage ingested) would have, with a proportion of immersion of 1min/10 ml, represented half time in consume; in other words, 2.25 years of daily ingestion. However, for both cases, the time of daily ingestions represented for one beverage is the same for all the others, given that swallow profile.

To analyze the color variation, the scale CIE-L*a*b* was used, where L* means luminance and varies from 0 (black) to 100 (white), a* means green-red, and b* means blue-yellow.

Acrylic resins used for the confection of prostheses are able to absorb water, and they are also able to absorb other solution types; so pigmentation can occur after the installation of the prosthesis due to the patient's habits. This absorption occurs mainly because of the creation of porosities inside the resin due to the volatilization of monomer or composites in low molecular weight, when submitted to temperatures higher than 100.8 C.

In this study, disks 3.0 mm diameter were used because they were reported in the literature[2, 9]. This thickness, despite opposite to the specification in the 17 of American Dental Association [8], is more similar to the thickness found in thicker regions of dental prosthesis, which are considered areas that most likely will be subjected to the creation of porosities by increment of temperature [3, 5].

Despite some studiesWorks having shown higher potential to wine pigmentation in composite resins[25-27], acrylic resins and nylon base [2], and reline materials[28], in this work, a statistically significant difference was not observed in three variables analyzed (ΔE, ΔL, Δa). Regarding the variable Δb, despite the variation occurring in different directions, the variation of color quantity was equal between wine and tea, since there is no statistically significant difference between the modules Δb in these groups. Each color scale CIE-Lab tries to reproduce the human capacity for perception of color variation, it is possible to say that color variation in Δb had the same intensity, despite opposite effects.

In this aspect, both for wine and tea, the color variation lead to darker and less reddish specimens (ΔL and Δa negatives). The wine

showed potential to render the specimens bluer (Δb negative), while tea tend to render them yellower (Δb positive).

The values for ΔE found in this work for the period of 15 days were significantly higher than normally found in the literature. It may evidence the need to technical improvement for polishing, research, and discard of eventual specimens too porous. The values for ΔE found for wine and tea, in this respect, are inside the numbers considered clinically acceptable [8, 9].

As limitations of the study, the difficulties to standardize the consumption of beverages can be highlighted, since the habits change according to the cultural aspects of populations and even because of the climate conditions. As a criterion, the higher consumption scenery was chosen for each beverage in order to have the most challenging case within the study parameters. However, for different populations and different habits, they can eventually result in different pigmentation standards.

CONCLUSION

Within the limits of this study, it is possible to conclude that: (a) there is no difference in the pigmentation pattern of wine and tea for the variables ΔE, ΔL and Δa; (b) the modules Δb presented by tea and wine are in the same magnitude, although, this variation occurs in different directions; (c) addition of artificial saliva did not provoke significant changes in the resin color disks.

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