



## **Effect of Various Disinfectant Solutions on Colour Stability of Acrylic Resin Denture Base Materials” an Vitro Study**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author PK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors RM, KKP, AG and VG managed the analyses of the study. Authors AA and AKT did the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Purpose:** To evaluate the change in colour of two commercially available denture base resins after subjecting them into three commonly used disinfectant solutions at different time interval.

**Materials and Methods:** A precise stainless steel die measuring 50mm in diameter and 1 mm in thickness (ADA No. 12)<sup>29</sup> was customized and Duplication of the diameter and the thickness of die were achieved by using polyvinyl siloxane impression material after putting it into the die space to prepare testing samples. These polyvinyl siloxane putty samples were then invested to make mold for fabrication of the resin samples. 60 specimens were made using heat cure resins

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(DPI&TREVALON). 10 additional specimens from each resin specimens were also made as control group. After finishing and polishing, all sample of resin was subjected to colour measurement using computer controlled CM-3310 d Spectrophotometer (MINOLTA), before immersion and after immersion into the three disinfecting solutions at different time intervals.

**Results:** Both the denture base resins materials DPI and TREVALON have shown significant colour change with all the three disinfectants 0.5% Chlorhexidine (A), 2% Gluteraldehyde (B) and 0.5% Sodium Hypochloride (C) at difference in different time intervals.

DPI & TREVALON has shown significant amount of colour change with 2% Gluteraldehyde (B) disinfectant as compare to 0.5% Sodium Hypochloride (C) and 0.5% Chlorhexidine (A), DPI has shown least amount of colour change with 0.5% Sodium Hypochloride (C) which is not significant and TREVALON has shown least amount of colour change with 0.5% Chlorhexidine (A).

**Conclusion:** When DPI & TREVALON denture base resins were compared, TREVALON exhibited more colour change than DPI denture base resins regardless of any disinfectant used. Among all the three disinfectants, 2% Gluteraldehyde (B) has shown more colour changes than any other disinfectants, regardless of any denture base material used.

*Keywords: Denture bases; acrylic resins; colour changes.*

## 1. INTRODUCTION

The need for cross-infection control in dental practice has received increasing attention in recent years because of greater awareness of communicable diseases such as Hepatitis B and acquired immunodeficiency syndrome (AIDS). The spread of infection in dental practice by contaminated instruments, impressions, and prostheses have been emphasized by a number of investigators [1] and it was suggested that every patient treated should be regarded as a potential risk and appropriate measures should be taken to control the spread of infection [2].

Microorganisms can spread by direct contact with blood or saliva from an infected patient in the clinical area or by indirect contact through impressions, gypsum casts, and dental prostheses both in the clinical and laboratory areas [3,4].

Since many materials and instruments used in dentistry cannot be subjected to high temperature, chemical agents must be used to sterilize or disinfect them. The council of dental therapeutics accepted Chlorine compounds, Aldehydes, Iodophors as potential disinfectants [5].

A new and old denture may be exposed several times to a disinfecting solution and sometimes it may be recommended to keep the denture in disinfectant solution to reduce the possibility of microbial colonization of the surface of a denture [6].

Studies on different physical and mechanical properties of denture base resins subjected to

immersion disinfection have shown that some disinfecting solutions can change the physical and mechanical properties of denture base material in which colour is an important factor for maintaining the esthetics and characterization of denture base resins [7].

Hence, an in-vitro study is planned to evaluate the change in colour stability of two commercially available denture base resins after subjecting them into three commonly used disinfectant solutions at different time interval.

**Aim of the Study:** To evaluate the change in colour stability of two commercially available denture base resins after subjecting them into three commonly used disinfectant solutions at different time interval

## 2. METHODOLOGY

This prospective, in-vitro study was conducted in the department of Prosthodontics, Bapuji Dental College and Hospital, Davangere, Department of civil engineering, UBDT engineering college, Davangere & Bapuji institute of engineering and technology, Davangere.

### 2.1 Materials Used in this Study

1. Addition silicone impression material (putty), [3M ESPE, batch no: 7GR 26]
2. Dental stone (Gold stone), [Asian chemicals, Rajkot, India, batch no:1146]
3. Separating medium (cold mold seal)
4. Two heat cure denture base resins
  - A. DPI heat cure denture base resin. Dental products of India, [a division of the

- Bombay Burmah trading corporation Ltd, Mumbai, batch no:385, lot no:382.]
- B. TREVALON heat cure denture base resin, [a product of Dentsply India Pvt Ltd, Gurgaon, Haryana, Batch no: T060912.]
5. Three commercially available disinfectant solutions.
- A. 0.5% Chlorhexidine gluconate (A) [manufactured by Kayyee Aeropharm (p) Ltd and marketed by Casil health products Ltd, Kadi, Gujarat, batch no: 112126.]
- B. 2% Gluteraldehyde (B) [manufactured by 3M health care, Batch no: 2214.]
- C. 0.5% Sodium Hypochloride (C) [manufactured by Qualigens fine chemicals, a division of Glaxo Smithkline Pharmaceuticals Ltd, Mumbai, Batch no: 4495, lot no: 6507 - 2.]
6. Distilled water

## 2.2 Materials and Method Followed in This Study has been Discussed under the Following Headings

- Preparation of Mold
- Preparation of the samples with marking of numbers (1-10)
- Measurement of colour value of the samples prior to disinfection ( $T_1$ )
- Disinfection procedure
- Measurement of colour value of the samples after immersion into the disinfectants at different time intervals of  $T_2$ ,  $T_3$  &  $T_4$ .

## 2.3 Preparation of the Mold

A precise stainless steel die measuring 50mm in diameter and 1mm in thickness (ADA No. 12)<sup>29</sup> was customized at Bapuji institute of engineering and technology Davangere. Duplication of the diameter and the thickness of die were achieved by using polyvinyl siloxane impression material after putting it into the die space to prepare testing samples. These polyvinyl siloxane putty samples were then invested to make mold for fabrication of the resin samples.

## 2.4 Preparation of the Samples and Numbering

After investing of all the putty samples in KAVO metal dental flasks in type III dental stone and

they were removed from the dental stone after the stone is set. Separating media was applied over the stone mold. According to manufacturer's instructions, for both resins, powder and liquid were mixed for 15- 30 seconds in a porcelain jar and left to polymerize. When the dough stage was reached, the resins were packed into the molds; flasks were closed under pressure using bench press (3.5 psi) and allowed for bench curing for 30 minutes. Forty samples of each resin were placed in regular water for 60 minutes, maintained at 68°C for 30 minutes and boiled for 20 minutes (short curing cycle). After processing, the flasks were allowed to bench cool for 30 minutes, followed by immersion in running water for 15 minutes. After deflasking, flash and excess resin was removed by using acrylic trimming burs and then polishing on both sides was done using 600, 800, 1000 and 1200 grit silicon carbide paper. By using carbide straight fissure bur resin samples were marked from 1 to 10. Total 60 specimens were made from which 10 specimen from each denture base resin (I and II) for three disinfectant solutions (A, B & C). 10 additional specimens from each resin specimens were also made as control group (Fig. 1).



**Fig. 1. Duplication of master die with additional silicon putty impression material and preparation of resin sample**

## 2.5 Measurement of Colour Value of the Samples Prior to Disinfection

After finishing and polishing, all the specimens from each denture base resin were dried and

then each sample of resin was subjected to colour measurement using computer controlled CM-3310d Spectrophotometer (MINOLTA), before immersion into the three disinfecting solutions.

## 2.6 Disinfection Procedure

After evaluation of the colour value of each sample before disinfection ( $T_1$ ), each specimen was then immersed for 10 minutes ( $T_2$ ), 10 hours ( $T_3$ ) and 7 days ( $T_4$ ) in all of the following disinfecting solutions:

- Deionized distilled water (control)
- 0.5% Chlorhexidine gluconate (A)
- 2% Gluteraldehyde (B)
- 0.5% Sodium Hypochloride (C)

## 2.7 Measurement of Colour Value after Disinfection

After immersion of each specimen into three disinfectant solutions, the values of colour change were then measured and calculated at respective time intervals using computer controlled CM-3310d spectrophotometer (MINOLTA).

Colour and colour difference was determined by using computer controlled CM-3310d Spectrophotometer (MINOLTA), averages of three readings were taken and the mean of each material were calculated with the use of CIE lab uniform colour scale.

Statistical analysis was carried out and significant colour changes, exhibited by denture base resins in solution were compared for equal length of time by using 'Mann-Whitney U' test.

## 2.8 Statistical Analysis of the Data

Statistical analysis of the data was conducted with the following tests:

- Mean
- Standard deviation
- Kruskal Wallis ANOVA
- Wilcoxon's signed rank test
- 'Mann-Whitney U' test.

## 3. RESULTS

Table 1 depicts the master chart. It shows the two group of the denture base material

(TREVALON and DPI) with the control groups, having ten samples of each and the colour change of each sample before immersion ( $T_1$ ) and at time interval of ten minutes ( $T_2$ ), ten hours ( $T_3$ ) & after seven days ( $T_4$ ).

The colour of each sample expressed as following variables

L\*= Lightness  
a\*= Chroma on red green axis  
b\*= Chroma on yellow blue axis  
 $\Delta E$ = The total colour difference & is evaluated from combination of three independent colour variables.

All the specimens of both the resins have shown different pattern of colour change by exhibiting different L\*, a\*, b\* &  $\Delta E$  values when subjected to immersion with deionized distilled water, used as control.

Table 2 depicts the master chart. It shows the two group of the denture base material (TREVALON and DPI) with 0.5 % Chlorhexidine (A) groups, having ten samples of each and the colour change of each sample before immersion ( $T_1$ ) and at time interval of ten minutes ( $T_2$ ), ten hours ( $T_3$ ) & after seven days ( $T_4$ ).

The colour of each sample expressed as following variables

L\*= Lightness  
a\*= Chroma on red green axis  
b\*= Chroma on yellow blue axis

All the specimens of both the resins have shown different pattern of colour change by exhibiting different L\*, a\*, b\* &  $\Delta E$  values when subjected to immersion with 0.5% Chlorhexidine (A) disinfectant.

Table 3 depicts the master chart. It shows the two group of the denture base material (TREVALON and DPI) with 2% Gluteraldehyde (B) groups, having ten samples of each and the colour change of each sample before immersion ( $T_1$ ) and at time interval of ten minutes ( $T_2$ ), ten hours ( $T_3$ ) & after seven days ( $T_4$ ).

The colour of each sample expressed as following variables

L\*= Lightness  
a\*= Chroma on red green axis  
b\*= Chroma on yellow blue axis

All the specimens of both the resins have shown different pattern of colour change by exhibiting different L\*, a\*, b\* & ΔE values when subjected to immersion with 2% Gluteraldehyde (B) disinfectant.

Table 4 depicts the master chart. It shows the two group of the denture base material (TREVALON and DPI) with 0.5% Sodium Hypochloride (C) groups, having ten samples of each and the colour change of each sample before immersion (T<sub>1</sub>) and at time interval of ten minutes (T<sub>2</sub>), ten hours (T<sub>3</sub>) & after seven days (T<sub>4</sub>).

The colour of each sample expressed as following variables

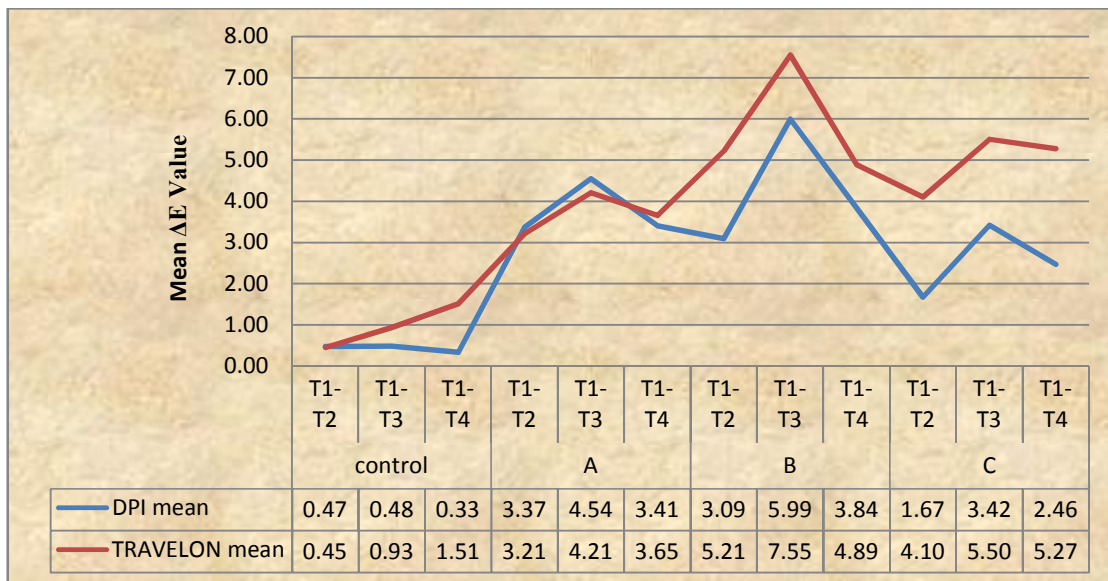
- L\*= Lightness
- a\*= Chroma on red green axis
- b\*= Chroma on yellow blue axis

All the specimens of both the resins have shown different pattern of colour change by exhibiting different L\*, a\*, b\* & ΔE values when subjected to immersion with 0.5% Sodium Hypochloride disinfectant (C)

Both DPI and TREVALON specimens have shown maximum colour changes at difference in different time interval of ten hours (T<sub>1</sub>-T<sub>3</sub>) and the DPI has shown less

colour changes as compare to TREVALON specimens.

All the specimens of DPI and TREVALON have shown colour change with all the three disinfectants; to know which disinfectants showed maximum colour change the results were subjected to Kruskal - Wallis ANOVA\* H and it was found that 0.5% Sodium Hypochloride (C) showed least colour change (ΔE 1.67) than other disinfectants at all the difference in different time intervals with DPI specimens, and 2% Gluteraldehyde (B) showed maximum colour change (ΔE 5.99) than any other at time interval of T<sub>1</sub>-T<sub>3</sub> for DPI specimens. With TREVALON specimens, least colour change was found with 0.5% Chlorhexidine (A) (ΔE 3.21) at T<sub>1</sub>-T<sub>2</sub> interval and highest colour change was found with 2% Gluteraldehyde (B) (ΔE 7.55) at T<sub>1</sub>-T<sub>3</sub> interval. When three disinfectants were compared, with DPI specimens no difference was found between A & B at any of the difference in time interval but significant difference was found between A & C; B & C at first two difference in different time interval (T<sub>1</sub>-T<sub>2</sub> & T<sub>1</sub>-T<sub>3</sub>). When disinfectants were compared with TREVALON specimens, there was no difference between A & C, B & C at any time interval, but significant difference was found between A & B at the first two differences in different time interval (T<sub>1</sub>-T<sub>2</sub> & T<sub>1</sub>-T<sub>3</sub>) and between B & C at T<sub>1</sub>-T<sub>3</sub> interval (Tables 2,3).



**Graph 1. Showing the comparison of mean ΔE values for both DPI and TREVALON specimens, at differences in different time interval T<sub>1</sub>-T<sub>2</sub>, T<sub>1</sub>-T<sub>3</sub> & T<sub>1</sub>-T<sub>4</sub> along with control group**

**Table 1. Master chart showing the L\*, a\*, b\* & ΔE values of DPI and TREVALON denture base materials at different time interval (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> & T<sub>4</sub>) with Deionized distilled water (Control)**

DPI- control																	
		T <sub>1</sub>				T <sub>2</sub>				T <sub>3</sub>				T <sub>4</sub>			
L*	a*	b*	Δ E	L*	a*	b*	Δ E	L*	a*	b*	Δ E	L*	a*	b*	Δ E		
47.43	14.79	-3.99	49.84	46.48	14.58	-4.51	48.92	46.38	14.23	-3.3	48.63	46.67	13.2	-3.73	48.64		
45.88	17.45	0.88	49.09	45.09	14.65	-4.78	47.65	44.45	16.42	-0.75	47.39	44.21	14.17	-4.48	46.64		
45.04	15.66	-1.02	47.70	44.96	14.82	-4.77	47.58	44.80	13.42	-4.51	46.98	44.94	14.43	-4.83	47.45		
44.57	14.78	-1.15	46.97	44.21	14.17	-4.48	46.64	44.09	14.17	-4.54	46.53	43.76	15.42	-1.43	46.42		
43.34	13.32	-1.52	45.37	42.76	13.54	-4.97	45.13	42.38	14.83	-2.40	44.96	42.81	15.47	-1.96	45.56		
43.25	13.96	-2.17	45.50	43.51	13.64	-4.57	45.81	43.56	15.22	-1.83	46.18	43.25	13.57	-2.18	45.38		
45.69	15.92	-0.53	48.39	44.94	14.43	-4.83	47.45	45.03	14.04	-3.91	47.33	46.38	14.23	-3.30	48.63		
46.52	13.98	-0.91	48.58	46.27	13.96	-4.35	48.53	46.79	14.38	-3.47	49.07	47.42	13.35	-4.19	49.44		
44.92	14.44	-1.92	47.20	44.25	13.58	-4.66	46.52	45.09	14.65	-4.78	47.65	45.61	15.20	-4.67	48.30		
<b>44.73</b>	<b>15.42</b>	<b>-1.11</b>	<b>47.33</b>	<b>44.62</b>	<b>14.25</b>	<b>-4.81</b>	<b>47.07</b>	<b>43.76</b>	<b>15.42</b>	<b>-1.43</b>	<b>46.42</b>	<b>43.56</b>	<b>15.22</b>	<b>-1.83</b>	<b>46.18</b>		
TREVALON- control																	
		T <sub>1</sub>				T <sub>2</sub>				T <sub>3</sub>				T <sub>4</sub>			
L*	a*	b*	Δ E	L*	a*	b*	Δ E	L*	a*	b*	Δ E	L*	a*	b*	Δ E		
46.38	14.23	-3.30	48.63	46.27	13.96	-4.35	48.53	46.48	14.58	-4.51	48.92	46.04	13.83	-4.33	48.27		
47.42	13.35	-4.19	49.44	47.58	14.09	-4.06	49.79	47.56	13.71	-4.34	49.69	47.00	13.05	-4.12	48.95		
47.07	15.33	-4.15	49.68	46.64	17.18	-4.51	49.91	46.79	14.38	-3.47	49.07	46.11	14.08	-3.35	48.33		
49.08	13.69	-3.97	51.11	48.43	14.61	-3.91	50.74	47.42	13.35	-4.19	49.44	46.76	12.99	-4.26	48.72		
47.59	11.54	-3.85	49.12	47.59	11.54	-3.85	49.12	47.02	14.14	-4.19	49.28	46.54	14.33	-4.13	48.87		
48.03	15.94	-4.31	50.79	47.42	13.35	-4.19	49.44	47.11	13.77	-4.35	49.27	46.78	11.44	-3.87	48.31		
46.07	13.51	-4.03	48.18	46.79	14.38	-3.47	49.07	46.27	13.96	-4.35	48.53	46.05	13.67	-4.24	48.22		
47.07	14.73	-4.20	49.50	46.46	13.99	-4.48	48.73	45.14	12.21	-4.62	46.99	45.02	12.13	-4.34	46.83		
48.02	14.12	-3.91	50.21	47.58	12.40	-3.65	49.30	46.66	12.80	-3.76	48.53	46.43	12.23	-3.21	48.12		
47.88	15.41	-4.33	50.48	46.44	11.60	-3.55	48.00	46.33	12.44	-4.23	48.16	45.67	11.89	-4.11	47.37		

**Table 2. Master chart showing the L\*, a\*, b\* & ΔE values of DPI and TREVALON denture base materials at different time interval (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> & T<sub>4</sub>) with 0.5% Chlorhexidine disinfectant (A)**

DPI															
A - T <sub>1</sub>				A - T <sub>2</sub>				A - T <sub>3</sub>				A - T <sub>4</sub>			
L*	a*	b*	ΔE	L*	a*	b*	ΔE	L*	a*	b*	ΔE	L*	a*	b*	ΔE
47.43	14.79	-3.99	49.84	43.48	12.78	-4.43	45.54	43.51	13.6	-4.50	45.81	44.86	14.71	-4.41	47.42
47.86	14.61	-4.25	50.22	44.60	14.25	-4.81	47.07	44.32	14.41	-4.84	46.85	45.11	13.62	-4.83	47.37
48.88	14.10	-3.57	51.00	46.27	13.96	-4.35	48.53	45.62	14.20	-4.38	47.98	46.47	13.85	-4.33	48.68
48.44	14.12	-4.21	50.63	44.94	14.43	-4.83	47.45	42.49	12.82	-5.08	44.67	44.93	13.83	-4.61	47.24
50.52	14.02	-3.97	52.58	44.90	14.00	-4.74	47.27	44.39	14.90	-4.53	47.04	45.59	14.35	-4.68	48.02
48.02	14.12	-3.91	50.21	44.25	13.58	-4.66	46.52	43.88	12.98	-4.85	46.02	42.67	12.27	-4.89	44.67
47.88	15.41	-4.33	50.48	44.96	14.82	-4.77	47.58	42.76	13.54	-4.97	45.13	45.45	15.42	-4.68	48.22
48.83	14.70	-4.17	51.16	46.48	14.58	-4.51	48.92	45.09	14.65	-4.78	47.65	45.26	14.38	-4.62	47.71
47.90	14.34	-4.02	50.16	44.21	14.17	-4.48	46.64	41.29	11.56	-5.22	43.19	43.26	13.45	-4.70	45.55
47.88	15.84	-4.25	50.61	44.80	15.75	-4.62	47.71	44.29	15.42	-4.76	47.14	45.16	15.48	-4.67	47.97
TREVALON															
A - T <sub>1</sub>				A - T <sub>2</sub>				A - T <sub>3</sub>				A - T <sub>4</sub>			
L*	a*	b*	ΔE	L*	a*	b*	ΔE	L*	a*	b*	ΔE	L*	a*	b*	ΔE
44.90	14.44	-1.90	47.20	41.94	13.54	-3.00	44.17	41.12	13.11	-3.67	43.32	42.86	15.21	-2.23	45.53
45.88	17.45	0.80	49.09	41.52	14.21	-2.09	43.93	38.62	11.52	-4.26	40.53	39.89	12.68	-3.86	42.03
44.73	15.42	-1.11	47.33	41.34	15.23	-2.20	44.11	39.31	12.49	-4.16	41.46	41.58	14.58	-2.34	44.12
43.34	13.32	-1.52	45.37	40.85	13.18	-2.59	43.00	38.81	11.97	-3.65	40.78	40.64	12.3	-2.88	42.56
43.30	12.79	-1.68	45.18	39.72	12.12	-3.12	41.65	39.97	12.27	-3.02	41.92	41.14	12.48	-2.70	43.08
45.69	15.92	-0.50	48.39	41.55	13.57	-2.46	43.78	41.99	14.86	-1.98	44.59	42.85	15.60	-1.33	45.62
45.04	15.66	-1.02	47.70	42.01	15.43	-2.01	44.80	42.10	15.69	-2.01	44.97	42.36	15.27	-1.99	45.07
46.52	13.98	-0.91	48.58	43.25	13.96	-2.17	45.50	40.67	11.71	-3.71	42.48	42.20	12.10	-3.01	44.00
44.57	14.78	-1.15	46.97	43.24	15.37	-1.42	45.91	43.01	15.70	-1.39	45.81	41.43	14.65	-2.40	44.01
44.96	15.13	-1.41	47.46	42.01	13.66	-3.36	44.30	42.58	15.38	-2.28	45.33	38.75	11.28	-5.39	40.72

**Table 3. Master chart showing the L\*, a\*, b\* & ΔE values of DPI and TREVALON denture base materials at different time interval (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> & T<sub>4</sub>) with 2% Gluteraldehyde disinfectant (B)**

DPI															
B - T <sub>1</sub>				B - T <sub>2</sub>				B - T <sub>3</sub>				B - T <sub>4</sub>			
L*	a*	b*	Δ E	L*	a*	b*	Δ E	L*	a*	b*	Δ E	L*	a*	b*	Δ E
48.17	15.73	-4.14	50.84	45.82	15.94	-4.57	48.73	45.26	15.68	-4.54	48.11	46.46	14.32	-4.65	48.84
48.14	13.44	-4.33	50.17	43.95	11.46	-4.56	45.65	41.26	10.31	-5.22	42.85	41.83	10.09	-4.87	43.30
47.58	14.09	-4.06	49.79	44.52	13.61	-4.60	46.78	41.54	10.93	-5.43	43.30	45.41	13.39	-4.37	47.54
47.02	14.14	-4.19	49.28	45.03	14.02	-4.53	47.38	44.09	14.17	-4.54	46.53	45.36	13.55	-4.30	47.54
46.07	13.51	-4.03	48.18	44.51	12.48	-4.18	46.42	43.41	11.84	-4.70	45.24	45.36	13.55	-4.30	47.54
47.07	14.73	-4.20	49.50	43.18	10.91	-4.55	44.77	41.15	11.38	-5.40	43.03	40.49	7.260	-4.47	41.38
48.24	13.61	-4.08	50.29	44.98	12.02	-4.81	46.81	41.38	10.03	-5.26	42.90	40.99	9.230	-5.44	42.37
49.08	13.69	-3.97	51.11	45.14	12.21	-4.62	46.99	41.44	9.980	-5.07	42.93	46.65	13.66	-4.08	48.78
47.59	11.54	-3.85	49.12	43.92	13.84	-4.55	46.27	37.39	6.800	-4.90	38.32	43.14	10.03	-5.01	44.57
48.03	15.94	-4.31	50.79	45.57	15.48	-4.77	48.36	43.49	13.92	-4.98	45.93	46.56	13.94	-4.82	48.84
TREVALON															
B - T <sub>1</sub>				B - T <sub>2</sub>				B - T <sub>3</sub>				B - T <sub>4</sub>			
L*	a*	b*	Δ E	L*	a*	b*	Δ E	L*	a*	b*	Δ E	L*	a*	b*	Δ E
48.17	15.73	-4.14	50.84	42.54	14.55	-2.97	45.06	39.44	12.38	-4.58	41.59	42.84	14.15	-2.53	45.19
48.14	13.44	-4.33	50.17	42.16	14.93	-2.17	44.78	41.80	14.40	-2.40	44.28	41.50	14.90	-2.00	44.14
47.58	14.09	-4.06	49.79	42.85	14.48	-2.51	45.30	39.99	12.33	-4.33	42.07	43.40	15.29	-1.80	46.05
47.02	14.14	-4.19	49.28	41.66	14.51	-2.76	44.20	39.54	12.39	-4.39	41.67	42.42	14.34	-2.45	44.85
46.07	13.51	-4.03	48.18	42.32	14.11	-2.83	44.70	39.71	12.14	-4.35	41.75	42.34	14.82	-2.35	44.92
47.07	14.73	-4.20	49.50	42.05	13.09	-1.98	44.08	40.56	12.41	-2.64	42.50	41.63	13.31	-1.80	43.74
48.24	13.61	-4.08	50.29	43.15	14.53	-2.02	45.58	42.48	14.41	-2.26	44.91	43.76	14.85	-1.40	46.23
49.08	13.69	-3.97	51.11	41.30	12.04	-2.44	43.09	37.12	9.620	-4.31	38.59	41.62	11.94	-2.15	43.35
47.59	11.54	-3.85	49.12	42.24	14.54	-2.94	44.77	40.22	13.09	-4.10	42.49	43.83	15.46	-1.85	46.51
48.03	15.94	-4.31	50.79	42.71	15.23	-1.96	45.39	41.26	14.18	-3.06	43.74	42.45	15.37	-2.03	45.19



**Table 4. Master chart showing the L\*, a\*, b\* & ΔE values of DPI and TREVALON denture base materials at different time interval (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> & T<sub>4</sub>) with 0.5% sodium Hypochloride disinfectant (C)**

DPI															
C - T <sub>1</sub>				C - T <sub>2</sub>				C - T <sub>3</sub>				C - T <sub>4</sub>			
L*	a*	b*	ΔE	L*	a*	b*	ΔE	L*	a*	b*	ΔE	L*	a*	b*	ΔE
48.43	14.61	-3.91	50.74	44.8	13.42	-4.51	46.98	42.9	12.22	-4.92	44.88	43.1	10.86	-5.28	44.76
48.21	16.35	-4.20	51.08	46.64	17.18	-4.51	49.91	45.64	15.87	-4.94	48.57	46.75	17.24	-4.66	50.04
47.56	13.71	-4.34	49.69	46.46	13.99	-4.48	48.73	45.36	13.44	-4.69	47.54	44.91	13.71	-4.66	47.19
47.67	15.57	-3.81	50.29	45.96	16.69	-4.32	49.09	44.99	16.37	-4.61	48.10	45.58	15.22	-4.65	48.28
46.79	14.38	-3.47	49.07	44.32	14.08	-3.66	46.65	42.11	12.18	-4.27	44.04	43.22	12.12	-4.75	45.14
46.38	14.23	-3.30	48.63	44.35	13.46	-3.83	46.51	42.86	12.55	-4.28	44.86	43.67	13.40	-4.31	45.88
47.42	13.35	-4.19	49.44	44.90	13.39	-4.33	47.05	44.29	13.05	-4.57	46.40	44.80	13.30	-4.53	46.95
47.07	15.33	-4.15	49.68	45.61	15.20	-4.67	48.30	44.26	14.03	-4.91	46.69	45.38	15.05	-4.95	48.07
46.67	13.20	-3.73	48.64	45.03	14.04	-3.91	47.33	43.63	13.33	-4.22	45.82	44.56	13.54	-4.30	46.77
46.67	13.60	-3.62	48.75	46.46	13.99	-4.48	48.73	43.01	12.26	-4.28	44.93	45.58	15.22	-4.65	48.28

TREVALON															
C - T <sub>1</sub>				C - T <sub>2</sub>				C - T <sub>3</sub>				C - T <sub>4</sub>			
L*	a*	b*	ΔE	L*	a*	b*	ΔE	L*	a*	b*	ΔE	L*	a*	b*	ΔE
48.43	14.61	-3.91	50.74	44.45	16.42	-0.75	47.39	39.90	12.92	-3.83	42.11	42.62	16.05	-1.38	45.56
48.21	16.35	-4.20	51.08	42.90	15.06	-1.37	45.49	41.53	13.06	-2.13	43.59	40.87	12.62	-2.83	42.87
47.56	13.71	-4.34	49.69	41.93	15.18	-1.56	44.62	43.82	13.33	-2.13	45.85	43.25	13.57	-2.18	45.38
47.67	15.57	-3.81	50.29	42.89	13.66	-2.42	45.08	41.66	15.09	-2.03	44.36	40.83	14.33	-2.74	43.36
46.79	14.38	-3.47	49.07	43.90	15.09	-1.79	46.46	42.81	15.47	-1.96	45.56	43.13	15.37	-2.01	45.83
46.38	14.23	-3.30	48.63	43.76	15.42	-1.43	46.42	41.16	12.48	-3.80	43.18	40.15	12.02	-3.05	42.02
47.42	13.35	-4.19	49.44	42.89	15.32	-2.08	45.59	41.93	14.28	-2.91	44.39	42.22	13.49	-3.24	44.44
47.07	15.33	-4.15	49.68	43.56	15.22	-1.83	46.18	42.38	14.83	-2.40	44.96	43.18	14.99	-2.27	45.76
46.67	13.20	-3.73	48.64	40.03	11.89	-3.01	41.87	39.63	11.90	-3.24	41.50	40.13	12.02	-3.05	42.00
46.67	13.60	-3.62	48.75	43.02	15.91	-1.92	45.91	42.71	15.59	-2.17	45.52	43.30	15.48	-1.94	46.02

DPI denture base material has shown colour changes with all three disinfectants at difference in different time interval with least colour change with 0.5% Sodium hypochloride (C) which is not significant and but significant colour change was found with both 0.5% Chlorhexidine (A) and 2% Gluteraldehyde (B) disinfectant.

TREVALON denture base material has shown colour changes with all three disinfectants at difference in different time interval with least colour change with 0.5% Chlorhexidine (A) & 2% Gluteraldehyde (B), which is not significant, but significant colour change was found with 0.5% Sodium Hypochloride (C) disinfectant.

The result of present study can be summarized as follows:

- Both the denture base resins materials DPI and TREVALON have shown significant colour change with all the three disinfectants 0.5% Chlorhexidine (A), 2% Gluteraldehyde (B) and 0.5% Sodium Hypochloride (C) at difference in different time intervals.
- DPI has shown significant amount of colour change with 2% Gluteraldehyde (B) disinfectant as compare to 0.5% Sodium Hypochloride (C) and 0.5% Chlorhexidine (A), with least amount of colour change with 0.5% Sodium Hypochloride (C) which is not significant.
- TREVALON denture base material has shown significant amount of colour change with 2% Gluteraldehyde (B) disinfectant and least amount of colour change was seen with 0.5% Chlorhexidine (A).

When comparison was made between both TREVALON and DPI denture base materials, TREVALON has shown more amount of colour change as compared to DPI which is statistically (Graf.4)

#### 4. DISCUSSION

Cross contamination between patients and dental personnel can occur not only through contaminated dentures but also through polishing agents and instrumentation. Technicians working in a dental laboratory may be at risk from the aerosol created during polishing procedures even though they do not directly handle the prosthesis in the clinics. The use of the same wheel and pumice slurry to polish new and old dentures may contaminate the new dentures [4].

Therefore to reduce the chances of cross contamination, new dentures should be completely disinfected and sterilized before being inserted in the patient mouth.

Since many materials and instruments used in dentistry cannot be subjected to high temperature, chemical agents must be used to sterilize or disinfect them. The council on dental therapeutics accepted Chlorine compounds, Aldehydes, Iodophors as potential disinfectants [5,8]. The immersion of a denture in a suitable disinfecting solution for an adequate length of time to achieve disinfection or sterilization is a convenient and inexpensive method.

A new and old denture may be exposed several times to a disinfecting solution and sometimes it may be recommended to keep the denture in disinfectant solution to reduce the possibility of microbial colonization of the surface of a denture [6,9].

Studies on different physical and mechanical properties of denture base resins subjected to disinfectant solutions have shown that some disinfecting solutions may cause changes in these physical and mechanical properties of denture base material in which colour is an important factor for maintaining the esthetics and characterization of denture base resins [7,10].

Hence this study is planned to evaluate the effect of disinfectant solutions on the colour stability of two commercially available heat cure denture base resins after immersion in disinfectant solutions at different time intervals. The data obtained under the conditions of this study confirmed the hypothesis that the colour of denture base resins could be affected by chemical disinfection and after storage in water.

The commonly used Colour system is the CIE-LAB system. In this system the colour of the samples is expressed as three variables, namely,  $L^*$ ,  $a^*$  and  $b^*$ . The  $L^*$  colour coordinate ranges from 0 to 100 and represent Lightness,  $a^*$  colour coordinate ranges from -90 to 70 and represent the greenness on the positive axis and redness on the negative axis, the  $b^*$  colour coordinate ranges from -80 to 100 and represents Yellowness (positive  $b^*$ ) and blueness (negative  $b^*$ ). The total colour differences ( $\Delta E$ ) evaluated from combination of three independent colour variables namely,  $\Delta L$ ,  $\Delta a$ ,  $\Delta b$  where  $\Delta L$  is difference in the lightness ( $L^*$ ) of two sample,  $\Delta a$  is difference in ( $a^*$ ) Chroma of two samples on

green-red axis and  $\Delta b$  is the difference in ( $b^*$ ) chroma of two samples on yellow-blue axis.

$$\Delta E = \{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2\}^{1/2}$$

To fulfill the objectives of the study, comparison was made between the mean  $\Delta E$  values of the DPI and TREVALON resin samples before disinfection ( $T_1$ ) and the values obtained after disinfection at different time intervals ( $T_2$ ,  $T_3$ , &  $T_4$ ). Both the DPI & TREVALON heat cure resin samples except control groups have shown statistically significant colour change after disinfection, regardless of the disinfectant solutions used.

All the specimens of DPI & TREVALON showed a significant colour change after immersion in 0.5% Chlorhexidine (A). The use of this concentration was based on a previous study that evaluated the factors affecting the development of staining associated with the use of 0.5% Chlorhexidine [11,12].

A case study was reported that a small decrease in optical density, indicating colour change, was observed when perspex resin specimens were immersed in 0.5% Chlorhexidine gluconate solution on the 10<sup>th</sup> day. Increasing the concentration up to 0.1% showed increase in optical density, thereafter no fall or raise in optical density was seen. This change may be attributable to the formation of unstable cationic or anionic complexes on the surface of perspex specimen with cations predominating on the surface [11]. Same results were found in present study where both the resin have shown colour change with 0.5% chlorhexidine (A).

A significant colour change of DPI specimens in 0.5% Chlorhexidine (A) was found at differences in different time intervals, with the p values of <0.05 at  $T_1$ - $T_2$ ; < 0.01 at both  $T_1$ - $T_3$  &  $T_1$ - $T_4$  time intervals. Similarly significant colour change of TREVALON specimens was found at differences in different time intervals, with the p values of <0.01 for all the three time intervals. When the comparison of colour changes between two resins (DPI & TREVALON) with 0.5% Chlorhexidine (A) was made at differences in different time intervals using Mann-Whitney test it was found to be statistically non significant with the p value of 0.88, 0.57 and 0.97 for  $T_1$ - $T_2$ ,  $T_1$ - $T_3$  &  $T_1$ - $T_4$  respectively.

As far as Chlorhexidine induced staining is concerned, it has been proposed that molecules

of the disinfectant which are adsorbed to the surface may react with the dietary factors and in which iron may be one of these factor. The change in the colour in present study may be attributable to the same reason as mentioned above [6].

All the specimens of DPI & TREVALON that were immersed in 2% Gluteraldehyde (B) showed a significant colour change. The use of this concentration was based on a previous study that evaluated the effect of 2% Gluteraldehyde (B) based disinfectants on denture base resins. In this study two Gluteraldehyde disinfectant solutions, one is alkaline and other an alkaline with a phenolic buffer, were selected and it was concluded that phenol buffered disinfectant should not be used as a disinfecting agent whereas alkaline base solution may be used and it was also found that 2% Gluteraldehyde should not be used more than ten minutes because it may alter the physical and mechanical properties of denture base materials. Reason for change in physical properties and colour may be attributed on the fact that phenol may penetrate the resin base material and can cause partial dissolution and softening of the surface [13,14-18]

Similarly in present study significant colour change of DPI denture base material in 2% Gluteraldehyde (B) was found at difference in different time intervals, with the p values of <0.01 at  $T_1$ - $T_2$ ,  $T_1$ - $T_3$  &  $T_1$ - $T_4$  time intervals respectively. The change in the colour may be attributable to the same reason as mentioned above [6]. Similarly highly significant colour change of TRAVELON denture base material was seen with differences in different time intervals with the p values of <0.001 for all the three time intervals. When the comparison of colour changes between two resins (DPI & TREVALON) was made with 2% Gluteraldehyde (B) at differences in different time intervals using Mann-Whitney test it was found that both have shown significant colour change at  $T_1$ - $T_2$  interval with the p value of <0.01 and 0.27 and 0.24 at time interval of  $T_1$ - $T_3$  &  $T_1$ - $T_4$  respectively which is not significant.

All the specimens of DPI & TREVALON that were immersed in 0.5% solution of Sodium Hypochloride (C) showed a significant colour change. In the past soaking of denture in 0.5% Sodium Hypochloride (C) was discouraged because of its bleaching effect on the denture base materials. Bleaching of acrylic resins dentures by 0.5% Sodium Hypochloride (C) has been observed by the author. Moore et al

investigated the use of denture cleanser, one of which was a 0.5% Sodium Hypochloride (C) to sterilize the dentures. A study by Rudd et al demonstrated that soaking denture in full strength of 0.5% Sodium Hypochloride (C) for 15 hours did not cause any colour change [19]. The change in the colour in this study may be attributable to the same reason as mentioned above.

Significant colour change of DPI denture base material was seen in 0.5% Sodium Hypochloride (C) at difference in different time intervals, with the p values of <0.01 at T<sub>1</sub>-T<sub>2</sub>, T<sub>1</sub>-T<sub>3</sub> & T<sub>1</sub>-T<sub>4</sub> time intervals respectively. Similarly significant colour change of TREVALON denture base material was found with differences in different time intervals with the p values of <0.01 at T<sub>1</sub>-T<sub>2</sub>, T<sub>1</sub>-T<sub>3</sub> & T<sub>1</sub>-T<sub>4</sub> time intervals respectively which support the previous study.

When the comparison of colour changes was made between two denture base resins (DPI & TREVALON), with 0.5% Sodium Hypochloride (C) at differences in different time intervals using Mann-Whitney test it was found to be statistically significant with the p value of <0.01 at T<sub>1</sub>-T<sub>2</sub>, T<sub>1</sub>-T<sub>3</sub> & T<sub>1</sub>-T<sub>4</sub> time intervals respectively.

## 5. CONCLUSION

The present study have shown significant colour change of all the samples of DPI resin with all the three disinfectants (A, B & C) at the differences in different time intervals (T<sub>1</sub>-T<sub>2</sub>, T<sub>1</sub>-T<sub>3</sub> & T<sub>1</sub>-T<sub>4</sub>) whereas TREVALON specimens have shown highly significant colour change with 2% Glutaraldehyde (B) and significant with 0.5% Chlorhexidine (A) and 0.5% Sodium Hypochloride (C) disinfectants at the differences in different time intervals (T<sub>1</sub>-T<sub>2</sub>, T<sub>1</sub>-T<sub>3</sub> & T<sub>1</sub>-T<sub>4</sub>).

This study also reveals that all the disinfectants used for the study can affect the colour of both the resins (DPI & TREVALON) significantly when compared with the control group. The DPI has shown significant colour change at time interval of T<sub>1</sub>-T<sub>2</sub> with all the three disinfectants and the TREVALON has shown significant colour change at T<sub>1</sub>-T<sub>4</sub> time interval.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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