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IMMERSION EFFECT OF AUTOPOLYMERIZED SOFT DENTURE LINER IN SODIUM HYPOCHLORITE AND *Ricinus communis* ON*Candida albicans* COUNTS AND SURFACE ROUGHNESS

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Abstract

Soft denture liner (SDL) is a soft material based on acrylic or silicon which is used in prosthodontic field as a soft coating material. SDL has almost the same resilience as the oral mucosa which provide a cushion effect so that it can prevent the concentration of local pressure and distribute the functional loading evenly on the mucosa and minimizing trauma on the supporting tissue under the denture area. The SDL that used in the oral cavity can cause an accumulation of plaque which is a colonization of microorganisms such as bacteria and fungi which create an anaerobic environment. This enviroment can trigger excessive growth of microorganisms, especially *Candida albicans,* therefore, SDL must be cleaned periodically with cleaning agents that have an antimicrobial effect that can eliminate the excessive *Candida albicans*. The recommended cleaning method is chemically method by soaking into the cleaning material, but soaking in the cleaning material can cause changes in the physical properties of the material such as the release of soluble components namely plasticizer from acrylic SDL or the occurrence of water absorption in the filler of silicone SDL material, this can cause the roughness changes of the surface material, therefore, the ideal cleansing agent must have a good antimicrobial effectiveness without causing significant surface roughness changes. The aims of this study to examine the effect of *Ricinus communis* and sodium hypochlorite cleaning agents on the amount of *Candida albicans* and the surface roughness of autopolymerized SDL acrylic and silicone. The research material used in this study are autopolymerized SDL acrylic and silicone. Types of cleaning agents used in this study are 0.5% sodium hypochlorite and 10% *Ricinus communis.* The sample were divided into 4 groups (n = 8), which were autopolymerized SDL acrylic and silicone groups in 0.5% sodium hypochlorite immersion, autopolymerized SDL acrylic and silicone in 10% *Ricinus communis* with *tween 80* as an emulsifier immersion. The total amount of *Candida albicans* colony is count with a colony counter in CFU / mL, meanwhile for the measurement of surface roughness the Atomic Force Microscope (AFM) was used on the same surface plane ath the baseline and after immersion in µm units. Based on statistical test results, there was no statistical significant results between autopolymerization SDL acrylic group in 0.5% sodium hypochlorite immersion and in *Ricinus communis* 10% immersion on the amount of *Candida albicans* colony (p = 0.666) and surface roughness (p = 0.341) and there was also no statistical significant results between the autopolymerized SDL silicone group in 0.5% sodium hypochlorite immersion and in the immersion of *Ricinus communis* 10% on the number of *Candida albicans* colony (p = 0.478) and surface roughness (p = 0.764). For the surface roughness group, the results of the statistical paired T-tests showed that there was a statistical significant differences of changes of 3 groups of immersion which before and after immersion of acrylic SDL in 0.5% sodium hypochlorite, (p = 0.001) before and after immersion of acrylic SDL in *Ricinus communis* 10% , (p = 0.001) before and after immersion of silicone SDL in sodium hypochlorite 0.5% (p = 0.02) and there was no difference in the groups before and

after immersion of silicon SDL in *Ricinus communis* 10% (p = 0.095). Based on the study results, it can be concluded that *Ricinus communis* 10%was effective as cleansing agent for soft denture liner because of the same antimicrobial effect with 0.5% sodium hypochlorite which was the gold standard for disinfectant agent and the surface roughness does not exceed 0,2 µm on both autopolymerized acrylic and silicon soft denture liner.

KEYWORDS: *Candida albicans* counts, Surface roughness, Soft denture liner, Sodium hypochlorite, *Ricinus communis*

Introduction

The management of prosthodontic patients is closely related to preserving and maintaining the health of the supporting tissue when the denture is functioning.[1] The denture base is a part of the denture that rests on soft tissue.[2] In general, denture bases can be made of metal or non-metal materials.[3,4] Metal materials are usually made of alloys such as Ni-Cr and Co-Cr, while non-metal materials are usually made of polymers materials.[5,6] Denture bases polymers can be differentiate into two kind based on the thermal reaction which is thermoplastic and thermosetting. Thermoplastic materials are polymers which when heated at a certain temperature and pressure will become soft and back to normal state when it is cooled, e.g. thermoplastic nylon. Thermosetting materials are materials that undergo chemical changes in the process of manufacture and formation, e.g. cross-linked poly (methyl methacrylate) or acrylic resin.[4,6]

Acrylic denture base material is the most often used material in edentulous cases either partial or fully edentulous and also for fabricating the maxillofacial prostheses. One of the basic characteristics of acrylic denture is the stiffness, which can cause injury to the alveolar mucosa in complex cases, such as sharp alveolar ridge, atrophic ridge or in a cases in which patients have a thin and non-resilient mucosa.[1,7] When it came to those cases, a soft denture liner (SDL) was used. Soft denture liners are indicated for patients with atrophic ridge, knife edges, xerostomia, and to cover post-surgical tissue area.[8,9]

Soft denture liner (SDL) is an acrylic or silicone-based material that functions to replace the intaglio surface of the denture base which is resilient, so that an even pressure distribution will be obtain, reducing a local pressure, and increasing the retention of ill-fitting denture by utilizing existing undercuts.[7,8,9] The ideal characteristics of SDL materials are easy to manipulate, minimal dimensional change, minimal water absorption, able to maintain its flexibility, easy to clean, does not change color, does not experience tarnish, tastes and smells, good aesthetics, does not dissolve in water, has a thickness of at least 2-3 mm, does not cause bacterial and fungal colonization, does not change shape, and has a strong bond strength with the denture base.[6,10]

Soft denture liner that is used in the oral cavity in a certain time can cause plaque accumulation which is a colonization of microorganisms such as bacteria and fungi. This causes the oral environment to become anaerobic. Anerobic environment can trigger the overgrowth of microorganisms, especially *Candida albicans*.[11] *Candida albicans* is the main microorganism that causes denture stomatitis. [12] This condition causes chronic inflammation of the mucosa below the SDL and in severe conditions can cause discomfort to the patient.[13] Therefore, the SDL must be clean regularly with a cleansing agent which has an antimicrobial effect which help to eliminated *candida albicans*. There is certain method of denture cleaning such as mechanical or chemical cleaning. The mechanical cleaning method will increase the

surface roughness of the SDL and denture base which result in an irregularity of it and facilitate the accumulation of plaque, colonization of *Candida albicans* also the loss of SDL elasticity.[14,15] The recommended cleaning method is chemical immersion in cleaning agents but this method can cause changes in the physical properties of the material, such as the release of the soluble component, namely plasticizer from SDL acrylic and the occurrence of water absorption in the filler material of SDL silicone.[16,17] The immersion of SDL in cleaning agents can cause an increase in the surface roughness of SDL and lead to plaque accumulation resulting in colonization of fungi and bacteria for a long time.[13,17,18]The increase in roughness that can still be tolerated by the surface of the material without causing plaque colonization is below 0.2µm. The cleaning agent selected must have good antimicrobial effectiveness without causing significant changes in material properties for example surface roughness.[19]

The cleaning materials used are generally divided into natural and artificial ingredients. The most common used cleaning material that has been approved by American Dental Association (ADA) is sodium hypochlorite (NaOCl).[19] Sodium hypochlorite is a broad-spectrum cleaning agent and a disinfecting agent with a various of concentrations. Sodium hypochlorite can clean dentures in a short time but the patient had a discomfort with the taste and smell.[17,19] Natural ingredients are usually made from a mixture of plant or animal extracts. WHO (World Health Organization) recommends the use of natural ingredients derived from animals, plants and natural minerals.[11] Most of the plants that had been studied and known shows an antimicrobial effects and are biocompatible with living things and easily to obtain with a cheap price. One of the examples is *Ricinus communis* / castor oil.[11,13,20]*Ricinus communis* contains ricinoleic acid which has been widely used in dentistry (endodontics, periodontics and prosthodontics) because it has anti-inflammatory properties and antimicrobial effects.[19,20] This solution has good characteristics as a denture cleaner because it has a detergent effect and anti-microbial activity that can break down glucose molecules from the cell walls of pathogenic microbes and fungi as well as a good taste and smell that patients can tolerate.[13] Thed entures must be immersed in a cleaning solution every day with an effective soaking time of 20 minutes.[13,21]

Arruda, et al., (2016) in his study about the effectiveness ofcleaning agent; 0.1% sodium hypochlorite, sodium hypochlorite 0.2%; and *Ricinus communis* 8% against biofilm on acrylic resin dentures and found that significantly decreased the number of *Candida albicans*, and sodium hypochlorite 0.2% and *Ricinus communis* 8% had the same effect.[22] Porta, et al., (2013) in their research found that sodium hypochlorite with a concentration of 0.5% had the best antimicrobial effect as an acrylic denture cleaning agent. Salles, et al., (2015) in their study looking at the effectiveness of cleaning agents against acrylic materials found that a solution of 0.25% sodium hypochlorite, 0.5% sodium hypochlorite, and 10% *Ricinus communis*, found that sodium hypochlorite was 0.25% and 0 , 5% had a significant antimicrobial effect against *Candida albicans*, however *Ricinus communis* 10% had no significant effect ($p = 0.001$).[23]Badaro, et al., (2016) in his study, sodium hypochlorite 0.25%, sodium hypochlorite 0.5% and *Ricinus communis* 10% found that all solutions had significant antimicrobial effects, but the *Ricinus communis* 10% cleaning agents shows the best effectiveness toward remission of*Candida albicans* colonies. The results were respectively *Candida albicans* by 50%, followed by sodium hypochlorite 0.5% with remission of *Candida albicans* colonies by 46%.[13]

The aims of this study to examine the effect of *Ricinus communis* and sodium hypochlorite cleaning agents on the amount of *Candida albicans* and the effect on the surface roughness ofacrylic and silicone auto polymerized SDL.

Material and Methods

This study is a laboratory experimental research with the design for the dependent variable number of Candida albicans colonies is a posttest only control group design. The design for the dependent variable surface roughness is a pretest and posttest control group design. The ethical clearance for undertaking this study were obtained from Health Research Ethics Committee faculty of medicine of Universitas Sumatera Utara.

In this study, we used auto polymerized acrylic-based SDL (DuraBase Soft, Reliance Dental Manufacturing LLC, Illionis, USA) and auto polymerized silicone-based SDL (Mollosil, Detax GmbH, Ettlingen, Germany). The total samples for this study are 64 samples consisting of 32 samples for *Candida albicans* colonies count and 32 samples for surface roughness testing.

The sample were prepared according to the manufacture instruction, then it was pour into the master mould with a size of 10x10x2m according to the ADA specification no 12 for the *Candida albicans* samples and for the surface roughness samples we used a master mould with a diameter of 15mm with a thickness of 10mm according to the standard ASTM: D-2240-64T. Then the mould was closed and pressed with hydraulic presser with a pressure of 1000 psi for 20minutes until the material was completely set. After setting, the samples were taken out and place into the incubator at the temperature of $37^{o}C \pm 1^{o}C$ for 24 ± 1 hours before the experiment conducted.

Preparation of 0.5% sodium hypochlorite was conducted by adding 0,5mg of sodium hypochlorite to the 100 mL of aqua bidest in the beaker glass and stirred for 20-30 times until a homogenous solution was achieved. Preparation of 10% *Ricinus communis* cleaning agent was conducted by adding 10mL of *Ricinus communis* into 10mL of tween 80 solution in the beaker glass and was stirred until corpus emulsion was achieve then 100mL of aqua bidest was added and continuous with a stirring until a homogenous solution was achieved. This procedure was done aseptically in the laminar air flow and all equipment were sterilized in autoclave before used.

The samples for *Candida albicans* colony were sterilized in UV chamber for 5 minutes then was rinse using a phosphate buffer saline (PBS) for 2 times. The suspension consists of *Candida albicans* were made by taking the pure *Candida albicans* that has been cultured and mix into 0,9% NaCl solution then a turbidity of 1x 10^{8}CFU/mL Mc Farland was achieved. The sample were inoculated into the suspension consist of *Candida albicans* for 24 hours in a room temperature. After 24 hours the samples were taken out and immerse into beaker glass of each treatment group for 20 minutes as an assumption of daily cleansing. Then the sample was taken out and rinse using a phosphate buffer saline (PBS) for 2 times. The sample then put into a test tube filled with a 10mL of 0,9% NaCl solution and vortex using vortex machine for 30 second as a purpose to remove *Candida albicans* that stick on the sample then a volume of 0,1mL NaCl 0,9% solution was taken from the test tube and breed in the petri dishes with a potato

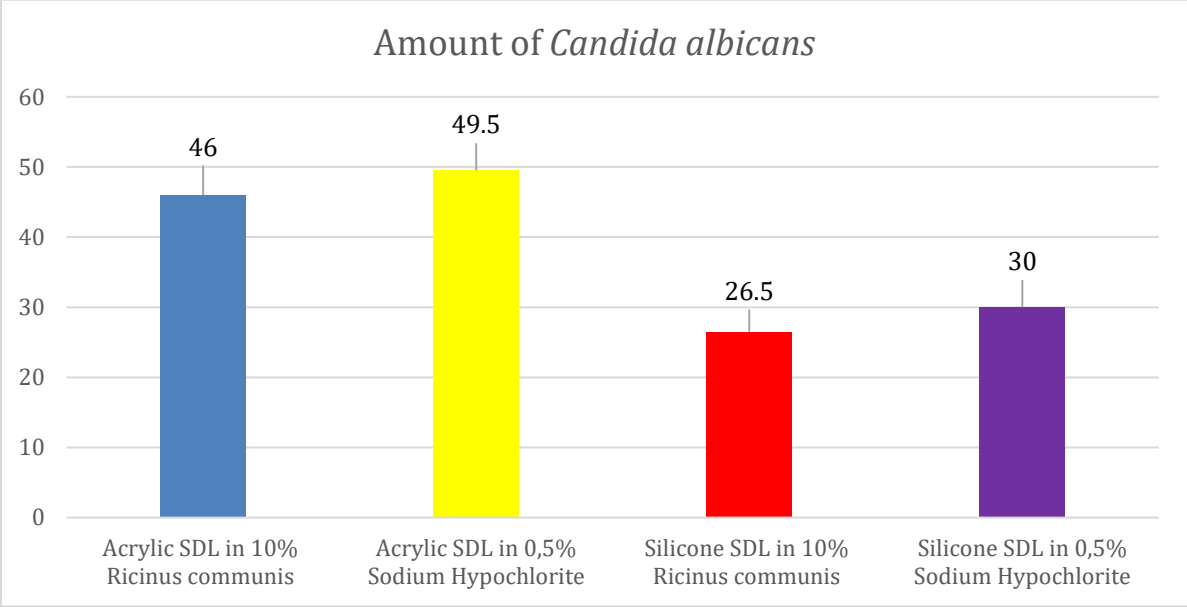
dextrose agar (PDA) as a media dan was incubate for 24 hours in a room temperature. The amount of *Candida albicans* were count using a colony counter in CFU/mL units.

The surface roughness was test using an atomic force microscope (AFM) machine at the baseline and samples were immersed for 7.302 minutes as an assumption of using denture for 1 year. The sample were taken out after the immerse period and left to be dry for 1 hour and the surface roughness was re-examine using the AFM machine.

Univariate test was used to calculated the mean and standard deviation. Unpaired T-test was used to see the difference of *Candida albicans* amount and surface roughness score of both group after the immersion in 0,5% sodium hypochlorite and 10% *Ricinus communis* cleaning agent. The paired T-test was used to see the changes of surface roughness before and after the immersion in 0,5% sodium hypochlorite and 10% *Ricinus communis* cleaning agent.

Results

The differences amount of *Candida albicans* between group that immerse in 0.5% sodium hypochlorite and 10% *Ricinus communis* cleaning agent of auto polymerized acrylic-based SDLand auto polymerized silicone-based SDL sample are presented in graph 1. T-test between both groups shows no significant differences between group that immerse in 0.5% sodium hypochlorite and 10% *Ricinus communis* cleaning agent(p=0.666 (p>0.05)). The T-test between group of auto polymerized silicone-based SDL that immerse in sodium hypochlorite and 10% *Ricinus communis* solution also shows no significant differences (p=0.478).



Graph 1. The amount of *Candida albicans* in each group of treatment and samples

The result of the surface roughness of each group at the baseline and 5 days after the immersion in 0.5% sodium hypochlorite and 10% *Ricinus communis* cleaning agent will be show in the table below (table 1-4).

The results in table 1 shows that there was a significant change in surface roughness after the immersion of auto polymerized acrylic-based SDL in 0,5% sodium hypochlorite cleaning agentp=0.001 (p<0.05). the highest value of surface roughness at the baseline is 0,17 µm and the lowest is 0,09 µm. While the highest value of surface roughness after 5 days of immersion is 0,22 µm and the lowest is 0,12 µm.It shows that there was an effect of immersion against the surface roughness

Table 1. The effect of immersing acrylic SDL in 0.5% sodium hypochlorite against surface roughness

Samples	Surface Roughness Value (µm)			*Paired t-test* (p)
	Acrylic SDL in 0.5% sodium hypochlorite			
	Baseline	After immersion	Mean differences	
1	0.11	0.15	0.04	
2	0.17**	0.22**	0.05	
3	0.13	0.17	0.04	
4	0.12	0.18	0.06	**0.001**⁺
5	0.10	0.12	0.02*	
6	0.09*	0.12**	0.03	
7	0.11	0.19	0.08**	
8	0.11	0.15	0.04	
X̄±SD	**0.1175±0.024**	**0.1625±0.034**	**0.045±0.018**	

** the highest surface roughness value in each group; * the lowest surface roughness value in each group; ⁺significant

The results in table 2 shows that there was a significant change in surface roughness after the immersion of auto polymerized acrylic-based SDL in 10% *Ricinus communis* cleaning agent p=0.001 (p<0.05). the highest value of surface roughness at the baseline is 0,15 µm and the lowest is 0,09 µm. While the highest value of surface roughness after 5 days of immersion is 0,20 µm and the lowest is 0,10 µm.It shows that there was an effect of immersion against the surface roughness

Table 2. The effect of immersing acrylic SDL in 10% *Ricinus communis* against surface roughness

Samples	Surface Roughness Value (µm)	*Paired t-test*

	Acrylic SDL in 10% *Ricinus communis*			(p)
	Baseline	**After immersion**	**Mean differences**	
1	0.09	0.11	0.02	
2	0.15**	0.19	0.04	
3	0.13	0.20**	0.07**	
4	0.14	0.17	0.03	**0.001**+
5	0.12	0.14	0.02	
6	0.14	0.19	0.05	
7	0.09*	0.10*	0.01*	
8	0.11	0.15	0.04	
X̄±SD	**0.1213±0.022**	**0.1563±0.377**	**0.035±0.019**	

** the highest surface roughness value in each group; * the lowest surface roughness value in each group; + significant

The results in table 3 shows that there was a significant change in surface roughness after the immersion auto polymerized silicone-based SDL in 0,5% sodium hypochlorite cleaning agent p=0.02 (p<0.05). the highest value of surface roughness at the baseline is 0,16 µm and the lowest is 0,06 µm. While the highest value of surface roughness after 5 days of immersion is 0,17 µm and the lowest is 0,07 µm. It shows that there was an effect of immersion against the surface roughness

Table 3. The effect of immersing silicone SDL in 0.5% sodium hypochlorite against surface roughness

Samples	**Surface Roughness Value (µm)**			***Paired t-test***
	Silicone SDL in 0.5% sodium hypochlorite			**(p)**
	Baseline	**After immersion**	**Mean differences**	
1	0.10	0.10	0.00*	
2	0.09	0.10	0.01	**0.02**+
3	0.15	0.16	0.01	
4	0.16**	0.16	0.00*	

5	0.06*	0.07*	0.01	
6	0.09	0.09	0.00*	
7	0.15	0.16	0.01	
8	0.15	0.17**	0.02**	
X̄±SD	**0.1188±0,037**	**0.1263±0.039**	**0.0075±0.007**	

** the highest surface roughness value in each group; * the lowest surface roughness value in each group; ⁺ significant table 4 shows that there was no significant change in surface roughness after the immersion auto polymerized

The results in silicone-based SDL in 10% *Ricinus communis* cleaning agent p=0.095 (p>0.05). the highest value of surface roughness at the baseline is 0,13 µm and the lowest is 0,06 µm. While the highest value of surface roughness after 5 days of immersion is 0,15 µm and the lowest is 0,06 µm the it shows that there was an effect of immersion against the surface roughness

Table 4. The effect of immersing silicone SDL in 10% *Ricinus communis* against surface roughness

Samples	**Surface Roughness Value (µm)**			***Paired t-test***
	Silicone SDL in 10% *Ricinus communis*			**(p)**
	Baseline	**After immersion**	**Mean differences**	
1	0.12	0.12	0.00*	
2	0.06*	0.06*	0.00*	
3	0.09	0.09	0.00*	
4	0.12	0.13	0.01	**0.0095**
5	0.11	0.11	0.00*	
6	0.11	0.13	0.02**	
7	0.13**	0.15**	0.02**	
8	0.13**	0.13	0,00	
X̄±SD	**0.1088±0.023**	**0.0062±0.009**	**0.006±0.009**	

** the highest surface roughness value in each group; * the lowest surface roughness value in each group

Discussion

In this study, an auto polymerized acrylic and silicone soft denture liner (SDL) was immersed into 0.5% sodium hypochlorite and 10% *Ricinus communis* cleaning agent to see the difference in the effectiveness of these cleaning agents on the amount of *Candida albicans* and their effect on surface roughness so that cliniciansand the community that used denture and SDL can choose the right type of cleaning agent to be used as disinfection agents for the denture and SDL.

This study shows that there is no statistically difference of amount of *Candida albicans* either in the group of acrylic SDL that are immerse in 0.5% sodium hypochlorite or 10% *Ricinus communis.* This result is due to the auto polymerized acrylic SDL material, when immersed, the plasticizer and soluble agent will be extruded from the material and caused an increasing in micro porosity.[17,24] When there is micro porosity on the surface of the material, the *Candida albicans* will start to inoculated, the microbes will penetrate into the micro porosity area.*Candida albicans* will start to form colonies called biofilms. The Biofilms adhere to the surface of the material and release hydrolytic enzymes and form a protective spore matrix wall composed of a layer of fat and protein.[25] In this study, both cleaning agents have a solvent component (aquabidest). The antimicrobial substance that has been mixed with the solvent will act to reduce the number of *Candida albicans*. The 0.5% sodium hypochlorite solution will penetrate into the microorganism's cells through the cell wall and plasma membrane by inhibiting the activity of enzymes that are important for the growth of microorganisms, as well as damaging the plasma membrane and microorganism DNA. This solution will oxidize and hydrolyze cells and by osmosis drain water out of the cells because it is hypertonic.[23,26] In contrast to the antimicrobial mechanism of 10% *Ricinus communis* in 10% *Ricinus communis*, the ricinoleic acid contained therein will break down cell wall glucose molecules and cause oxidation reactions, the oxidation reactions will cause lipophilic properties, so that the Ricinus communis emulsion will penetrate through the cell wall. Candida albicans and causes loss of cytoplasm and cell wall lysis.[27,28]

The results of this study indicated that the antimicrobial action of the 0.5% sodium hypochlorite solution and 10% *Ricinus communis* cleaning agents were equally effective. Sodium hypochlorite is the gold standard which is often used as an ingredient for denture disinfection, so based on the results of this study, the 10% *Ricinus communis* antimicrobial mechanism of action is as effective as 0.5% sodium hypochlorite. Although equally effective in reducing the number of Candida albicans, the 10% *Ricinus communis* cleaning agents has a slightly better effectiveness in reducing the amount of Candida albicans in acrylic SDL when compared to sodium hypochlorite. The same results show in the in the group of silicone SDL that are immerse in 0.5% sodium hypochlorite or 10% *Ricinus communis.*The study conducted by Andarde (2014) reported that hat sodium hypochlorite, alkaline peroxide and *Ricinus communis* are effective in reducing the number of *Candida albicans*.[20] Another Study reported by Badaro et al (2017) stated that 10% *Ricinus communis* has the best antimicrobial effect against *Candida albicans* fungi compared to 0.25% sodium hypochlorite and 0.5% sodium hypochlorite.SDL silicon has a hydrophobic appearance that makes it difficult for *Candida albicans* to adhere toward the SDL materials.[19,26] The results of this study also indicated that a good antimicrobial mechanism occurred in the SDL silicon group in the two types of cleaning solutions, but there were differences in the variation in the mean value between the immersion group in 0.5% sodium hypochlorite and 10% *Ricinus*

communis.Based on these differences in values, it appears that 10% *Ricinus communis* is slightly more effective in killing microbes on silicon SDL.

In this study, it indicated that there is an effect of immersion of 0.5% sodium hypochlorite and 10% *Ricinus communis* against surface roughness in the acrylic SDL. The change in surface roughness value is due to the release of plasticizer due to immersion, that cause water molecules enter the cross linking component contained in the acrylic SDL polymer chain and encourage the plasticizer to come out into the liquid, this will cause loss of elasticity and changes in the viscoelastic properties of the material as well ascauses the soft liner to become rigid and brittle and causes micro porosity and the formation of craters, the formation of craters on the SDL surface causes an increase in surface roughness.[1,29] The results of this study are in accordance with several other studies which stated a change in roughness after immersion in cleaning solutions.[1,19,29] The same things occur in 10% *Ricinus communis* group in which the mixing of *Ricinus communis* and *Tween80* cause a corpus emulsion which results it contain solvent component that can cause the dissolve of the plasticizer which result in the same mechanism as the sodium hypochlorite group. Although there is a significant change in surface roughness, the surface roughness value is not more than 0.2 µm, so it will not have a negative impact on the oral mucosa.[19]

This study shows a different result of effect of immersion of 0.5% sodium hypochlorite and 10% *Ricinus communis* against surface roughness in the silicone SDL. The auto polymerized silicon SDL used in this study has a liner chemical composition consisting of polydimethylsiloxane, filler, pigment, and platinum catalyst, and an ethyl-acetate primary composition of 60-100%.[29,30]The filler contained in this type of SDL silicone is nanoscale amorphous firmed silica which can absorb water molecules. Water absorption in SDL silicon will occur after the polymerization of cross linking has occurred in silicon, after polymerization is complete, water molecules can be absorbed by the silicon filler which can cause changes in roughness.[31] In addition, the oxidation process that occurs during immersion in sodium hypochlorite can also trigger changes in surface roughness.[32] Different result show in the group with 10% *Ricinus communis* in which there is no significant change this condition happened because the corpus emulsion cause the oil component to be hydrophilic and can penetrate the SDL surface as a cleaning agent, but this oil component is difficult to absorb by the silica filler.[33] Different results in other study may be found when using different types of auto polymerized silicone SDL, because the filler content and primary composition are different for each type of SDL. Although there is a significant change in surface roughness, the surface roughness value is not more than 0.2 µm, so it will not have a negative impact on the oral mucosa.

Conclusion

From this study, it can be concluded that the 10% *Ricinus communis* solution is effective as a cleaning agent for soft denture liners because it has the same anti-microbial properties as sodium hypochlorite which is the gold standard and changes in surface roughness that occur do not exceed 0.2 µm on the acrylic and silicone auto polymerized soft denture liners.

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