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RESEARCH ARTICLE

Comparative Evaluation of the Plaque and Gingivitis Reducing Efficacy of Chlorhexidine Diundecylinate (Salibact) and Triclosan Based Dentifrice: A Double Blind Randomized Controlled Trial

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ABSTRACT

Background: Microbial complexity of biofilm indicate that streptocouss mutans and candida species lives in symbiotic relationship. The combination of antiplaque agent with antifungal agent can significantly influence the dental plaque. There is a search for effective antimicrobial agent in dentifrice formulation. chlorhexidine diundecylinate((CHUA) is novel antimicrobial agent introduced by salicylates and chemicals pvt ltd, has shown extended antimicrobial properties and are comparable to triclosan

Objectives: To evaluate and compare the plaque and gingivitis reducing efficacy of chlorhexidine Diundecylinate (salibact) and triclosan based dentifrice

Material and methods: A double blind randomized controlled trial was conducted among 86 subjects who are randomly divided into two groups. Experimental group received dentifrice containing chlorhexidine Diundecylinate with antidiscoloration system (salibact 0.1%+ ADS) and control group received 0.3% triclosan containing dentifrice.Plaque and gingival index scores were compared between baseline and six weeks.

Results: There is a significant difference between mean plaque index scores between salibact and triclosan containing dentifrice p(0.032)(0.015)<0.05 respectively. Mean plaque and gingivitis reduction was found to be better for salibact compared to triclosan

Conclusion: The study results provide some evidence that CHUA (Salibact) has definite role in plaque reduction and has better efficacy compared to triclosan. The new ingredient chlorhexidine diundecylenate seems to be a better choice as an efficient antimicrobial agent for the oral care dentifrice formulations.

Keywords: Chlorhexidine, salibact, triclosan, plaque, gingivitis

Introduction

Developments in the field of dental research are majorly focusing on preventing and controlling of dental diseases. Dental plaque mediates the progression of two important dental diseases, dental caries and periodontal disease. Among the numerous approaches for controlling these dental diseases, plaque control through conventional method using dentifrice is still the most effective approach.[1-3] Dentifrice formulations have been manipulated to achieve the high level of plaque control to prevent caries, gingivitis, hypersensitivity etc[4]. The addition of antimicrobial agent to a dentifrice is the potential method for controlling the growth of cariogenic and periodontic pathogens.

Triclosan is a synthetic antimicrobial agent and due to its biocidal and antibacterial properties, has been used as an important ingredient in personal care, veterinary, industrial and household products.[5] Because of its antimicrobial activity against oral microrganisms and compatibility with tooth paste components such as fluoride and surfactant, it has been widely used in the dentifrices and found to have very good plaque control efficacy. Several studies have substantiated the use of triclosan containing tooth paste in controlling plaque and gingivitis.[6-10]

There are quite a number of health impacts of triclosan brought to light by the scientific and environmental community across the globe[11-13]. It is known to cause skin irritation, hormone disruption and it interferes with the muscle function.[14-15] It is resistant to certain bacteria, it has a detrimental effect on the central nervous system, it is also known to alter the thyroid hormone metabolism and it may also cause tumor development. The regulatory authorities such as FDA, has imposed prohibition on the use of triclosan. However, the use of triclosan in tooth pastes is under review and there is skepticism in scientific community regarding the further use or recommendation of the same. Hence there is need for effective antiplaque agent to be used in dentifrice.

The use of salts of the Chlorhexidine base over the years in various forms has shown promising results in the similar areas. Due its dicationic nature it possesses broad antimicrobial spectrum effective against range of gram-positive, gram-negative bacteria, yeasts and viruses etc.[16] A wealth of research substantiated the plaque and gingivitis reducing efficacy of chlorhexidine. Limited data, with the use of Chlorhexidine in the form of dentifrices has also shown that, it could be potentially used for plaque control.[21-24] Because of staining as an inevitable side effect and its incompatibility with ionic detergents, were found to be major limitations as reported in several studies.[25,26]

Microbial interaction within the biofilm indicate the symbiotic relationship and possible synergism between S. mutans and candida species[27,28] Thus the addition of antifungal agent such as undecylinic acid can possibly have extend antimicrobial property and thus can effectively control plaque and gingivitis Salicylates and Chemicals Pvt. Ltd has come up with novel patented antimicrobial which brings together the antibacterial properties of chlorhexidine and the antifungal properties of undecylenic acid into one agent. Chlorhexidine di-undecylenate (trade name: Salibact) has shown promising results in dermatological studies. The CAS name for this product given by the authorities is "10-Undecenoic acid, compd. with N1,N14-bis(4-chlorophenyl)- 3,12- diimino -2,4,11,13-tetraazatetradecanediimidamide(2:1)". It shows the properties of both the ingredients from which it has been derived.

The material Salibact is an oil substance with antimicrobial efficacy against gram-positive and gram-negative bacteria, fungi. It is classified as not readily biodegradable based on the biodegradability studies carried out in the laboratory conditions which is attributed to the fact that it even kills the microbes responsible for its biodegradation. Hence, under the appropriate environment it is envisaged that it could be biodegradable. Considering the broad antimicrobial spectrum in the current study the novel agent CHUA containing dentifrice is evaluated and compared with triclosan containing dentifrice in reducing plaque and gingivitis.

Materials and Methods

The study is registered with clinical trial registry of India with trial registry number CTRI/2020/01/023024. **The study has followed the CONSORT Guidelines.** The study is a Single center, Double-blinded, parallel group, randomized controlled field trial. Permission to conduct the study was obtained from Institutional Ethics committee, Mallareddy institute of medical sciences, Hyderabad. **(IEC, IHEC/MRIMS/37/2017)** The informed consent was obtained by all the study participants. With 80% power and 5% permissible error and effect size of 0.61 the sample size was estimated to be 86.The study was conducted between January To

March 2020.Participant enrollment was carried in the month of Januuary 2020 and intervention and follow up were done February 2020

Participant enrollment and allocations were done by two different investigators. A simple random sampling using lottery method was used for selection of study participants. Eighty-six subjects who are fulfilling eligibility criteria were further divided two groups, each group consist of around 43 subjects. Subject's allocation ratio was 1:1. Group1 consists of chlorhexidine undecylenic acid (salibact) containing dentifrice and group 2 consists of triclosan containing dentifrice which was used as a control. The principal investigator was calibrated with a trained periodontist for standardisng plaque and gingivitis score estimation and the kappa value of inter examiner reliability for assessing plaque and gingivitis scoring was 0.92 and 0.90 respectively

Inclusion criteria:

Subjects aged between 18 to 50 year, in generally good health and presence of at least 20 uncrowned permanent natural teeth (excluding third molars). A major inclusion criteria being mean Plaque Index score of at least 1.5 determined by the Turesky modification of the Quigley-Hein Plaque Index and mean gingival index score of 1 as determined by modified Loe and Sillness

Exclusion Criteria

If subjects had advanced periodontal disease, Five or more decayed carious lesions requiring immediate restorative treatment, presence of partial removable dentures or presence of orthodontic bands. Subjects on any prescribed medications that could interfere with the study outcome or used antibiotics within 1 month prior to the start of the study and subjects with a history of allergies to the test products, or allergies to oral care products or their ingredients

Efficacy evaluation

Assessment of outcome

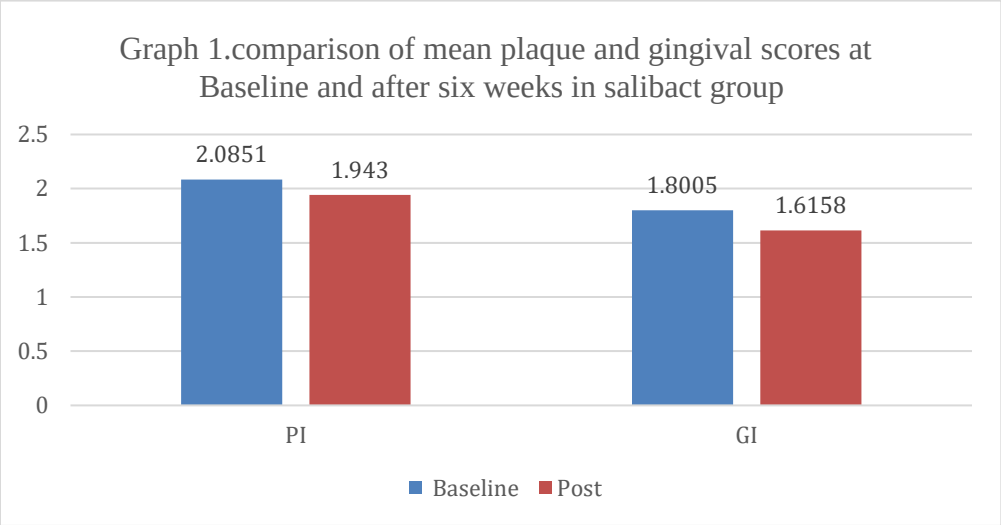
Dental plaque assessment - The dentition was disclosed with disclosing solution and plaque scored at the disto-, mid-, mesio-buccal and disto-, mid-, mesio-lingual surfaces of each tooth according to the criteria of the modified Quigley and Hein Index

Qualifying subjects received a baseline plaque and gingivitis evaluation, they were randomly assigned to study and control groups. The study group consists of 0.1% Chlorhexidine di-undycelanate and control group consists of 0.3% triclosan, 2.0% copolymer and 1,450 ppm F as sodium fluoride in a silica base. Following random allocation, subjects were provided with a new medium bristle toothbrush and a tube of toothpaste for home use. Subjects were instructed to brush their teeth for 5 minute twice daily (morning and evening) with the toothpaste provided. No control was exercised over dietary and oral hygiene practices. All toothpastes were provided in plane unlabelled tube to mask the subjects. The principal investigator was blinded with respect to group allocation. The follow up plaque and gingival score assessment was done after six weeks of product use. Additionally, at each examination, subjects were receiving an evaluation of their oral soft tissue for any allergic reaction or pigmentation of hard tissue by the examining dentist.

SPSS version 20 was used for analyzing the data.Normality test was performed. The results are analyzed using Mann whitney u test for mean comparison followed by wilcoxon signed rank test for pre and post comparison in both the groups.

Results

The mean plaque index scores at baseline 2.08$\pm$0.10 and after six weeks 1.94 $\pm$0.13 for salibact and mean gingival index score at baseline 2.12$\pm$0.23 and after six weeks 1.99$\pm$0.14 for triclosan containing dentifrice(Graph 1).There is no significant difference for the mean plaque index scores for salibact and triclosan groups with P >0.05(0.810) at the baseline.(Table 1) There is no significant difference between study and control groups for mean gingival index score p>0.05(0.266) at baseline using Mann Whitney U test. After six weeks, there is a significant difference between mean plaque index scores between salibact and triclosan containing dentifrice P<0.05(0.032) and significant difference is also observed for mean gingival scores for both the groups after six weeks. In the salibact group p 0.015(<0.05) (Table 1) There is significant difference in the mean gingival index scores at baseline and after six weeks. Within the group comparison shows that there is significant difference mean plaque and gingival score at baseline and after six weeks for both the groups at p 0.001(<0.05) Table 2



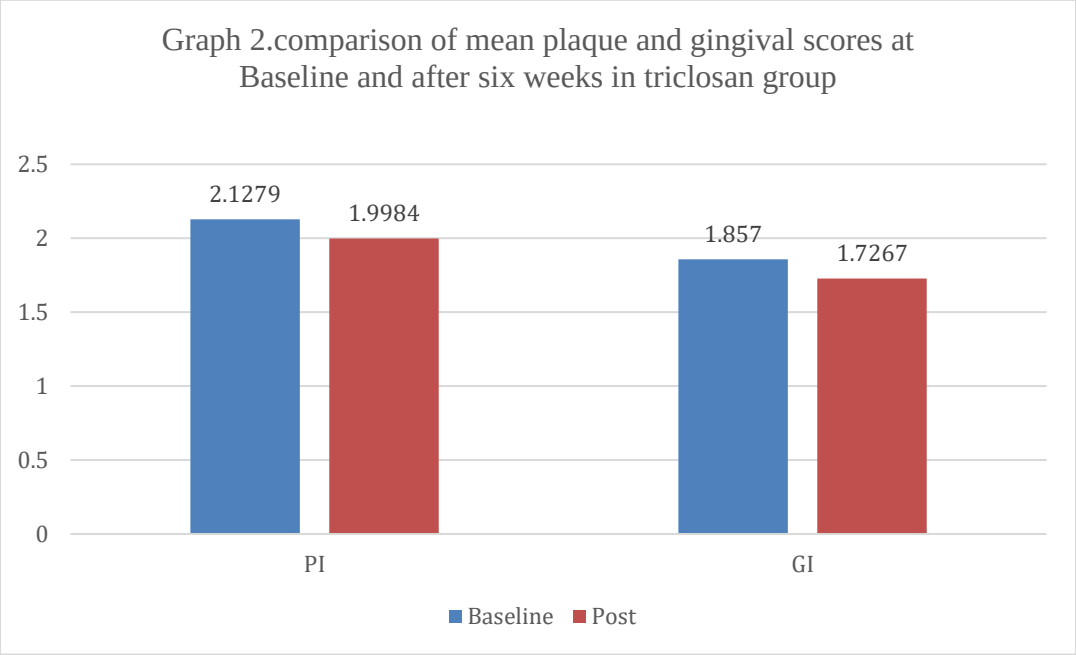


Table 1. Comparison of mean plaque scores between the two Groups at base line and after six weeks by Mann whitney u test

	group	N	Mean Rank	Sum of Ranks	Z value	P value
Plbaseline	Salibact	43	42.86	1843.00	-0.240	0.810
	triclosan	43	44.14	1898.00		
Glbaseline	Salibact	43	40.57	1744.50	-1.111	0.266
	Triclosan	43	46.43	1996.50		
Plpost	Salibact	43	37.78	1624.50	-2.145	0.032*
	Triclosan	43	49.22	2116.50		
Glpost	Salibact	43	37.05	1593.00	-2.425	0.015*
	Triclosan	43	49.95	2148.00		

Mann whitney U test ($P<0.05$)

Table 2. Comparison of mean plaque scores within the groups at base line and after six weeks for salibact and triclosan for both plaque and gingivitis

A		N	Mean Rank	Sum of Ranks	Z value	P value
Salibact – plaque scores Baseline- six weeks	Negative Ranks	42[a]	21.50	903.00	-5.199	<0.0001 **
	Positive Ranks	1[b]	43.00	43.00		
	Ties	0[c]				
	Total	43				
Salibact – gingival scores Baseline- six weeks	Negative Ranks	40[d]	20.50	820.00	-5.549	<0.0001 **
	Positive Ranks	0[e]	.00	.00		
	Ties	3[f]				
	Total	43				
triclosan – plaque scores Baseline- six weeks	Negative Ranks	37[g]	21.04	778.50	-4.958	<0.0001 **
	Positive Ranks	3[h]	13.83	41.50		
	Ties	3[i]				
	Total	43				
triclosan – Gingival scores Baseline- six weeks	Negative Ranks	26[j]	17.71	460.50	-4.195	<0.0001 **
	Positive Ranks	5[k]	7.10	35.50		
	Ties	12[l]				
	Total	43				

Wilcoxon signed rank test $p<0.05$

Discussion

The addition of antimicrobial agent or antiplaque agent to a dentifrice formulation is very much essentials for effective control of plaque and gingivitis. Efficacy against oral microrganisms, compatibility with other agents of dentifrices, effect on soft and hard tissue such as staining and allergic reactions and alteration of normal microbial flora on long term use are some of the important factors to be considered while adding any agent to dentifrice formulation. Several agents have been tried with varying efficacy but with one or other limitations. Triclosan has been used for a longtime as a suitable antiplaque agent in dentifrice,[6-10] however recent concerns with use of triclosan demands a suitable alternative.

Chlorhexidine has been tried as antibacterial agent in dentifrices with a concentration of 0.04 to 1% with varying efficacy the staining as a predominant side effect, largely restricts further research.[21-24] Staining is most common with use of the chlorhexidine in any form. Efforts have been made to use antidiscoloration system (sodium metabisulphate and ascorbic acid) in different chlorhexidine formulation however, the data on use of ADS in the form of dentifrice is very limited.There are concerns with use of ADS. Studies have reported that plaque reducing efficacy is compromised with addition of ADS. Current study aimed to reduce the intensity of discolouration without compromising plaque reducing efficacy. A tooth paste containing chlorhexidine undecylenate, ADS and non ionic surfactant was used to maximize the benefits of chlorhexidine and minimize the staining as a side effect.

The study is first of its kind in evaluating the efficacy of new agent salibact.The direct comparison is not possible because of limited research evidence. However, the the paque reducing efficacy is majorly attributed to main ingradient chlorhexidine. The addition of undecylinic acid as an antifungal agent can be added effect as the symbiotic relation of streptococus mutans and candida albicans within the biofilm. In the present study the salibact was found to be effective in controlling plaque and gingivitis after six weeks of use. The triclosan was also found to be effective in controlling plaque and gingivitis. Systemic review on plaque removal efficacy of triclosan revealed that after six to seven months of use plaque was reduced by 22%. In the current study 13% reduction was observed, which could be attributed to shorter follow up.

The efficacy was slightly better for salibact compared to triclosan in controlling both plaque and gingivitis. The fluoride is also found to have some antiplaque properties, studies have shown that there is reduction in plaque and gingivitis. However fluoride compounds have not been used in the dentifrice formulation of salibact. Thus the antiplaque efficacy is majorly attributed to the active ingradient salibact. Like all chlorhexidine salts, Salibact was also not compatible with the anionic surfactants, however a non-ionic surfactant has been in the current

formulations, thus avoiding problems associated with the stability of the product. .

The study is carried under field setting without exercising any control over dietary and oral hygiene factors thus the possible confounding effect cannot be underestimated. The staining being the predominant side effect in most of the reported studies, was carefully monitored in the current study. There are no visible color changes which can be attributed to chlorhexidine in any of the subjects. While most of the studies reporting staining as a side effect, no discoloration in the present can be attributed to lower concentration (0.1%) of chlorhexidine in salibact. The subjective evaluation also revealed that none of the patients complained of staining or taste disturbance. However, the objective assessment using staining index can precisely rule out the staining and is recommended in further studies.

Further studies on longterm evaluation of salibact for a period of six months would give precise efficacy in reducing plaque and gingivitis and would also help to know the staining intensity. Further studies can also focus on comparing CHUA to CHX gluconate, with or without ADS, to precisely estimate and compare the effect of new agent.

Conclusion

After six weeks of trial, the mean reduction in plaque score was found to be better with SALIBACT as compared to triclosan. The study results provide some evidence that CHUA(Salibact) containing dentifrice has definite role in plaque reduction and has better efficacy compared to triclosan. The new ingredient chlorhexidine di undecylenate seems to be a better choice as an efficient antimicrobial agent for the oral care preventive or dentifrice formulations.

Source of funding- The study is self funded. The test material chlorhexidine undecylinic acid (CHUA)(salibact) containing dentifrice is sponsored by salicyliates and chemicals pvt ltd.Hyderabad, Telangana, India

Conflict of interest- None

Abbreviations

CHUA- chlorhexidine undecylinic acid. trade name - Salibact

ADS- Anti Discoloration System

References

1. Lippert F. An introduction to toothpaste – its purpose, history and ingredients. *Monogr Oral Sci*. 2013;23:1–14
2. Yavnai N. [Toothpastes: ingredients, brands, categories and their utilization]. Refuat Hapeh Vehashinayim (1993). 2010 Apr;27(2):19-27, 61. Hebrew. PMID: 21250403.
3. Valkenburg C, Van der Weijden FA, Slot DE. Plaque control and reduction of gingivitis: The evidence for dentifrices. Periodontol 2000.
4. Sanz M, Serrano J, Iniesta M, Santa Cruz I, Herrera D. Antiplaque and antigingivitis toothpastes. *Monogr Oral Sci*. 2013;23:27–44.
5. Jones RD, Jampani HB, Newman JL, Lee AS. Triclosan: a review of effectiveness and safety in health care settings. Am J Infect Control. 2000
6. Trombelli L, Farina R. Efficacy of triclosan-based toothpastes in the prevention and treatment of plaque-induced periodontal and peri-implant diseases. Minerva Stomatol. 2013 Mar;62(3):71-88.
7. Feng HS, Pinheiro IC, Grande SR, Pannuti CM, Barros FJ, Lotufo RF. Effectiveness of a triclosan/copolymer dentifrice on dental plaque and gingivitis in Brazilian individuals with cerebral palsy. Spec Care Dentist. 2007 Jul-Aug;27(4):144-8.
8. Monteiro MF, Tonelli H, Reis AA, Casati MZ, Silvério KG, Nociti Junior FH, Sallum EA, Casarin RCV. Triclosan toothpaste as an adjunct therapy to plaque control in children from periodontitis families: a crossover clinical trial. Clin Oral Investig. 2020 Apr;24(4):1421-1430.
9. Niederman R. Triclosan-containing toothpastes reduce plaque and gingivitis. Evid Based Dent. 2005;6(2):33.
10. Weatherly LM, Gosse JA. Triclosan exposure, transformation, and human health effects. J Toxicol Environ Health B Crit Rev. 2017; 20(8):447-469.
11. Dhillon GS, Kaur S, Pulicharla R, Brar SK, Cledón M, Verma M, Surampalli RY. Triclosan: current status, occurrence, environmental risks and bioaccumulation potential. Int J Environ Res Public Health. 2015 May 22;12(5):5657-84.
12. Michael Goodman, Daniel Q. Naiman & Judy S. LaKind (2018) Systematic review of the literature on triclosan and health outcomes in humans, Critical Reviews in Toxicology, 48:1, 1-51
13. Witorsch RJ, Thomas JA. 2010. Personal care products and endocrine disruption: a critical review of the literature. Crit Rev Toxicol. 40:1–30.
14. Witorsch RJ. 2014. Critical analysis of endocrine disruptive activity of triclosan and its relevance to human exposure through the use of personal care products. Crit Rev Toxicol. 44:535–555.
15. Lim KS. Chlorhexidine pharmacology and clinical applications anaesthetic intensive care. 2008; 36: 50-12
16. Johnson BT. Uses of chlorhexidine in dentistry. General Dentistry. 1995; 43: 126- 132 10. Hull P S. Chemical inhibition of plaque. Journal of Clinical Periodontology. 1980; 7: 431-442 11.
17. Johansen JR, Gjermo P, Eriksen HM. Effect of 2-years' use of chlorhexidine-containing dentifrices on plaque, gingivitis, and caries. *Scand J Dent Res*. 1975;83:288–292.
18. Hioe KP, Van der Weijden GA. The effectiveness of self-performed mechanical plaque control with triclosan containing dentifrices. *Int J Dent Hyg*. 2005;3:192–204.
19. Davies, R.M. The effect of topical application of chlorhexidine on the bacterial colonization of the teeth and gingiva. Periodontal Research.1970; 5: 96-101. 12.
20. Flotra, L, Gjenno, P., Rolla, G. et al. A 4-month study on the effect of chlorhexidine mouth washes on 50 soldiers. Scandinavian Journal of Dental Research. 1972; 80: 10-7.
21. Gjermo P and Rolla G. Plaque inhibition by antibacterial dentifrices. Scandinavian Journal of Dental Research. 1970; 78: 464-470.
22. Sanz M, Vallcorba N, Fabregues S, Muller I, Herkstr € €oter F. The effect of a dentifrice containing chlorhexidine and zinc on plaque,gingivitis, calculus and tooth staining. J Clin Periodontol 1994; 21:431–437.
23. Putt MS, Van der Weijden GA, Kleber CJ, Saxton CA. Validation of a 21-day, partial-mouth gingivitis model for evaluating chemotherapeutic dentifrices. *J Periodontal Res*. 1993;28:301–307.
24. Slot DE, Berchier CE, Addy M, Van der Velden U, Van der Weijden GA. The efficacy of chlorhexidine dentifrice or gel on plaque, clinical parameters of gingival inflammation and tooth discoloration: a systematic review. Int J Dent Hyg. 2014 Feb;12(1):25-35.

25. Addy M, Jenkins S, Newcombe R. Studies on the effect of toothpaste rinses on plaque regrowth. (I). Influence of surfactants on chlorhexidine efficacy. *J Clin Periodontol*. 1989;16:380–438.
26. de Carvalho FG, Silva DS, Hebling J, Spolidorio LC, Spolidorio DM. 2006. Presence of mutans streptococci and Candida spp. in dental plaque/dentine of carious teeth and early childhood caries. Arch. Oral Biol. **51**:1024–1028.
27. Yang XQ, Zhang Q, Lu LY, Yang R, Liu Y, Zou J. 2012. Genotypic distribution of Candida albicans in dental biofilm of Chinese children associated with severe early childhood caries. Arch. Oral Biol. **57**:1048–1053.