

Vinegar As An Effective And Safe Disinfectant For Extracted Human Teeth

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Abstract:

Background: Extracted human teeth are routinely used in dentistry to learn technical, preclinical skills and in histopathological laboratory. Effective and economical disinfectants are needed to kill microorganisms from extracted human teeth. The acetic acid component of vinegar efficiently kills microorganisms after a week without any harm to operator. Many of proposed disinfection methods starting from use of formalin, sodium hypochlorite and to autoclaving have their own drawbacks and may not be practical.

Aim: To assess the effectiveness of vinegar for disinfection of extracted human teeth

Materials and method: A total of 30 extracted non carious human teeth were kept in six disinfectant media- 10% formalin, 3% hydrogen peroxide, 5.25% sodium hypochlorite, 70% alcohol, vinegar and normal saline. 5 samples were placed in each disinfectant individually for a period of 7 days, at room temperature. Later teeth from each group were placed individually in separate test tube containing 10 ml of tryptic soy broth at 37°C for 48 hrs to observe the evidence of growth of microorganisms. Semiquantitative analysis of all the sample was done in EMB agar at 37°C for 48 hrs.

Statistical Analysis Used: The number of teeth disinfected in each group was compared using Chi square test.

Results: 10% formalin and vinegar were effective disinfectant. The result was statistically significant with a Chi square value of 18.597; $P \leq 0.05$ ($P=0.002$).

Conclusion: Vinegar can be used as an effective and safe disinfectant for extracted human teeth.

Keywords: Disinfection, extracted teeth, formalin, vinegar

I. INTRODUCTION

Extracted human teeth are routinely used in dental institutions to train dental students in preclinical lab and in histopathological labs. These teeth are used for various purposes such as preparing ground section, cavity preparation and for learning endodontic procedures. Extracted human teeth are also used for in vitro laboratory dentin bonding research, before clinical trials ultimately decide their clinical effectiveness. This exposes dental operators to risk of cross

infections from pathogens associated with the extracted human teeth.

Universal precautions, as applied in the clinical setting, require that all body fluids and tissues be treated as if known to be infectious for Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV) or other blood borne pathogens. The Occupational Safety and Health Administration (OSHA) blood borne pathogens standard considers human teeth used for research and teaching purposes as a potential source of blood borne pathogens. The Centers for Disease Control and Prevention (CDC) has adopted

guidelines for infection control of extracted teeth used for research and teaching, requiring that teeth be sterilized before use, to minimize the risk of transmission of blood borne pathogens. Infection control concerns regarding the handling of teeth for research purposes have prompted investigators to evaluate the effects of disinfection/sterilization on extracted teeth³. Various methods have been tried for disinfection / sterilization of extracted human teeth with variable results. The centre for Disease control (CDC) recommended storing extracted teeth in 1:10 household Bleach. Investigators have found formalin storage to be effective for infection control purposes. Most of the studies including the recent ones report that immersing extracted teeth in 10% formalin can disinfect the tooth sample in 7 days. Formalin may be the most effective disinfectant, but it is a hazardous material and a potential carcinogen. In a recent study, 5% Virkon and Gigasept PA that proved effective against the laboratory model of disinfection was carried forward to challenge freshly extracted human teeth. GigaseptPA was the only disinfectant that sterilized 100% of the tooth samples. Hence, Gigasept PA could be considered a safer and effective alternative to formalin for the sterilization of extracted teeth destined for teaching purposes. This product though effective is a high level hospital disinfectant that is used on medical instruments. Hence, a suitable alternative to formalin for storage and disinfection of extracted human teeth is essential. Studies done in the past as well as the recent ones have assessed the disinfection of various chemicals like formalin, sodium hypochlorite, hydrogen peroxide, thymol, glutaraldehyde and so forth apart from autoclaving and microwave radiation techniques. As in institutional set up in which extracted teeth were used in preclinical for number of procedures, it was necessary to find best, safe, affordable, easy method of sterilizing extracted teeth. The disinfectant should be easily available in market. Several chemicals, microwave radiation and autoclave sterilization methods are available to disinfect the tooth, but they have their own disadvantages.

AIM: To assess the effectiveness of vinegar for disinfection of extracted human teeth

OBJECTIVE: To compare the efficacy of different disinfectants such as 3% hydrogen peroxide, 70% ethyl alcohol, 10% formalin, 5.25% sodium hypochlorite, normal saline with 20% vinegar to disinfect extracted human teeth.

II. MATERIALS AND METHODS

30 non carious, unrestored and intact freshly extracted human teeth were used. In all, 5 teeth were stored individually in closed containers in one of the six disinfectants. All the teeth were kept immersed separately in 10 ml of disinfectant for 7 days at 25°C.

Group-1 Teeth (5) were immersed in 10ml of 3% hydrogen peroxide in bottle for 7 days.

Group-2 Teeth (5) were immersed in 10ml of 70% ethyl alcohol in bottle for 7 days.

Group-3 Teeth (5) were immersed in 10ml of 10% formalin in bottle for 7 days

Group-4 Teeth (5) were immersed in 10ml of 5.25% sodium hypochlorite bottle for 7 days

Group-5 Teeth (5) were immersed in 10ml of normal saline in bottle for 7 days

Group-6 Teeth (5) were immersed in 10ml of 20% vinegar in bottle for 7 days



Figure 1: Extracted teeth immersed in different disinfectant media

After the disinfection process, the solution was discarded and all the samples were cleaned on shaker in sterile saline for 60 s. The saline was discarded.

A nutrient medium (tryptic soy broth) was prepared and autoclaved. Then, teeth from each group were incubated individually in separate test tubes containing 10 ml of tryptic soy broth at 37°C for 48hrs. Evidence of growth was observed after 2 days. Evidence of microbial growth in the broth was visible as turbidity in the sample. No visible growth in the broth was considered effective disinfection. Semi-quantitative analysis of all the samples was further done in eosin methylene blue agar (EMB agar) at 37°C for 48 hrs. All the data collected was then entered into excel spreadsheet and then the results were analyzed using the software SPSS version 16.0. Descriptive statistics and chi square analysis were performed to show efficacy of disinfectant and comparison of turbidity produced by the samples.

III. RESULTS

The nutrient broth was observed for all the six groups at the end of a 48 hrs period. Evidence of turbidity in the broth indicates microbial growth and hence ineffective sterilization.

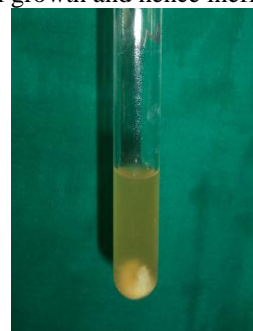


Figure 2: Turbidity in saline (control)



Figure 3: absence of turbidity in 20% vinegar

| Disinfectant | Sample | Turbidity |
|---------------------------|----------|-----------|
| Vinegar | Sample 1 | No |
| | Sample 2 | Yes |
| | Sample 3 | No |
| | Sample 4 | No |
| | Sample 5 | No |
| 70% Alcohol | Sample 1 | Yes |
| | Sample 2 | Yes |
| | Sample 3 | Yes |
| | Sample 4 | Yes |
| | Sample 5 | Yes |
| 10%Formalin | Sample 1 | No |
| | Sample 2 | No |
| | Sample 3 | No |
| | Sample 4 | No |
| | Sample 5 | No |
| 3%Hydrogen peroxide | Sample 1 | Yes |
| | Sample 2 | No |
| | Sample 3 | Yes |
| | Sample 4 | No |
| | Sample 5 | No |
| 5.25% Sodium hypochlorite | Sample 1 | Yes |
| | Sample 2 | Yes |
| | Sample 3 | No |
| | Sample 4 | Yes |
| | Sample 5 | Yes |
| Normal saline | Sample 1 | Yes |
| | Sample 2 | Yes |
| | Sample 3 | Yes |
| | Sample 4 | Yes |
| | Sample 5 | Yes |

Table 1: Comparison of presence of turbidity using different disinfectant

Aliquots from all the samples were further streaked on to the EMB agar and incubated at 37°C for 48 hrs. Microbial colonies were counted on positive samples. All the turbid samples exhibited microbial growth of more than 10⁵ colony forming unit per ml

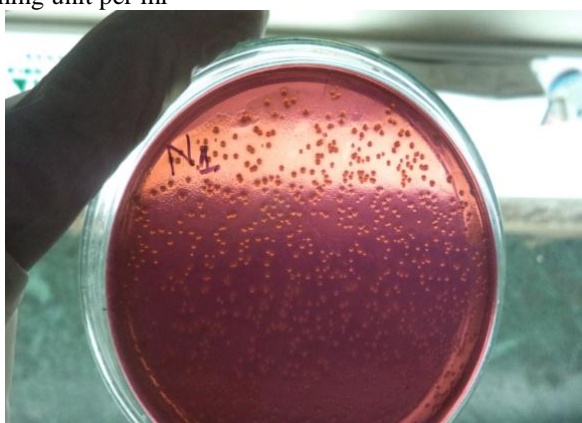


Figure 4: presence of microbial colony



Figure 5: No growth on EMB agar

| Disinfectant | Duration (days) | Number of teeth disinfected out of 5 teeth |
|----------------------------------|-----------------|--|
| vinegar | 7 | 4 |
| 3% hydrogen peroxide | 7 | 3 |
| 70% ethyl alcohol | 7 | 0 |
| 10 % formalin | 7 | 5 |
| 5.25 %sodium hypochlorite | 7 | 1 |
| Normal saline | 7 | 0 |

Table 2: Disinfection of extracted teeth In all the six groups

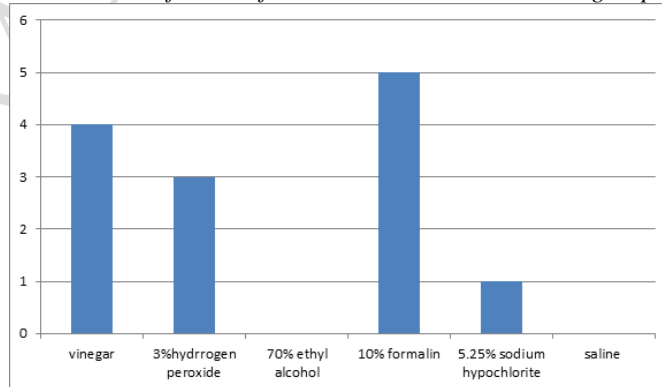


Figure 6: Disinfection of extracted teeth in all the six groups

Descriptive statistic and chi square analysis were performed to show efficacy of disinfectant and comparison of turbidity produced by the samples. The result were statistically significant with a Chi-Square Value =18.597; P ≤ 0.05 (P=0.002)

IV. DISCUSSION

Since extracted human teeth may harbor potential pathogens, disinfection of extracted human teeth in teaching laboratory is important for educators and students. The difference in the effectiveness of the methods could be due inactivation of disinfectants by organic substances present on teeth. Difficulties do exist in the use of extracted human teeth because:

- ✓ They are grossly contaminated
- ✓ Difficult to sterilize because of their structure and may be damaged or altered by the sterilization procedures.

But we have to handle teeth with care because many blood borne pathogens may be present In pulp, radicular and periradicular tissue of extracted human teeth.

In a study by Nikita V loyalayekar et al 10% formalin and 5.25% sodium hypochloride and autoclaving were able to sterilize all the teeth. ArunGhosh et al study documented 10% formalin, 3% sodium hypochlorite solution, autoclaving of extracted teeth are highly effective for sterilization and disinfection of extracted human teeth for institutional use.

In a study by M Kumar et al showed that immersion in 10% formalin for seven days and autoclaving at 1210 C, 15 lbs psi for 30 minutes were effective in disinfecting/sterilising the extracted human teeth. In a study by ManishaTijareet al found that 10% formalin, 3% hydrogen peroxide and vinegar were 100% effective in disinfecting/sterilizing all the extracted teeth when immersed for a period of 7 days.

In present study only 10%formalin was 100% effective and vinegar was 80% effective in disinfecting all the extracted teeth when immersed for a period of 7 days.

Although in our study 10%formalin were able to sterilize all the teeth,but has many disadvantages like ,formalin is hazardous , irritant and potential carcinogenic.⁶But when used its recommended the container holding the teeth should be opened only under a fume hood and the teeth should be rinsed prior to their use. Impervious gloves and goggles should be used to prevent skin and eye exposure. On other hand vinegar is less irritant and non carcinogenic.

V. CONCLUSION

20% acetic acid present in vinegar was able to disinfect an extracted tooth sample in 1 week in the present study. Vinegar, a household disinfectant and also use to make pickles that has not been much studied earlier as disinfectant for extracted human teeth, was assessed in the present study. It is simple to use, safe and cost effective, as the teeth are just required to be kept immersed in the solution in a closed container. Based on the findings in the present study, vinegar could be used as a storage and disinfectant medium for extracted human teeth. It should be kept in mind that the extracted human teeth should be handled with extreme care apart from following the CDC-recommended guidelines.

Infection control measures:

- ✓ Extracted teeth used for teaching dental health care workers should be considered infective and classified as clinical specimens as they contain blood
- ✓ All persons who collect, transport or manage extracted teeth should handle them with the similar precautions as a sample for biopsy
- ✓ Before extracted teeth are manipulated in dental educational training, the teeth first would be cleared of adherent patient material by scrubbing with detergent and water or by using an ultrasonic cleaner
- ✓ Teeth should then be stored and immersed in a fresh solution of sodium hypochlorite (household bleach 1:10

with tap water) or any liquid chemical germicide for clinical specimen fixation

- ✓ Persons handling extracted teeth should wear gloves. Gloves should be disposed off properly and hands washed after completion of work. Additional personal protective equipment, e.g. face shield or surgical mask and protective eyewear should be worn if our mucous membrane makes contact with debris or spatter is expected when the specimen is handled, cleaned or manipulated
- ✓ Work surfaces and instruments should be cleaned and decontaminated with a suitable liquid sterilizer after completion of work activities.

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