Histological Description as a Pulp of Mangosteen Rind Paste (Gracinia mangostana L.) and Formocresol in Wistar Rats (Rattus Norvegicus)

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Abstract

This study aims to compare the histology of mangosteen rind paste and Formocresol as pulp devitalization material.

Samples were Wistar maxillary left and right first molars that met the criteria. The rats were first anesthetized using ketamine HCL, then the devitalization material was placed in the dental cavity, temporarily filled with cavit-G (Espe, France) and on the 7th day euthanized and the teeth were extracted for histological examination.

Based on one-way ANOVA and post hoc LSD statistical tests, it was stated that there was a significant difference in necrotic pulp cells on day 7 between the two devitalization materials (P<.05). The results of this study stated that mangosteen rind paste (Gracinia mangostana L.) has potential as a pulp devitalizing agent in white wistar rats (Rattus norvegicus).

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Introduction

Caries is a disease of dental hard tissue that begins with demineralization by acids which is produced by bacteria. The prevalence of dental caries based on the World Health Organization (WHO) states that dental caries in children is still large, 60-90%.[1,2,3] Caries in children is a problem that needs attention because it can cause complaints of pain and even decrease productivity.[3] Untreated dental caries cause more bacterial invasion, damage the deeper tooth structure, and even cause the pulp to be exposed.[4] The bacterial invasion that reaches the pulp and causes inflammation is called pulpitis. Pulp treatment that can be done is devitalized pulpotomy.[2]

Pulp Devitalization

Pulp devitalization is the removal of pulp tissue in the pulp chamber that has previously been devitalized.[5,6] Devitalizing ingredients will numb the nerves so that pain can be permanently eliminated.[7] Buckley formula formocresol contains 19% formaldehyde, 35% cresol and 15% glycerin.[4,5,6] Formocresol has been widely used as a devitalizing agent, but its uses can cause bone damage, necrosis and toxic properties for the body.[5] Therefore, alternative materials are needed in reducing the toxic effects that obtained from formocresol chemicals.[4]

Manggost Rind Paste

Manggost rind paste is high in tannins which can denature cells, and saponins can interfere with cell activity and have a devitalizing effect on pulp cells.[5,6] Tanumihadja et al., in their research, showed the effect of pulp cell death from castor gum combined with sidaguri root at doses of 5%, 25%, and 50%.[3] The high distance sap contains tannins and saponins, which have a necrotic effect on pulp cells.[3,5] Pulp cell death is characterized by lysis of blood vessels and the appearance of blood spots (hemorrhage) on histological observation.[4]

Materials and methods

This study began with preparing a tooth sample by preparing the molars using a round diamond bur in the occlusal area to perforation (there was a speck of bleeding). The preparation procedure was conducted 2-3 times to prevent stress in rats. After the preparation procedure was conducted, the cavity was cleaned with tweezer and cotton pellets that had been moistened with saline solution to avoid debris.

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Isolation of the teeth in the buccal and lingual sections afterward disinfected with povidone-iodine, the final result in the preparation process will be cavities in the 1st molars of Wistar rats in a clean condition (no debris)(Fig. 1). Devitalized material was placed in the cavity and filled with a temporary filling(Fig. 2), and on the seventh day, euthanasia was performed for tooth sampling.

Data Analysis

Data were analysed using a 1-way ANOVA parametric statistical test and the Least significant difference (post hoc LSD). 1-way ANOVA was used to see whether or not there was a difference in the mean across the sample groups. The least significant difference test (post hoc LSD) was used to compare the differences between the control groups given the treatment (*P<.05*).

Material	Type	Processing method	Manufacturer
Formocresol		Injection technique;	Sultan Healthcare, USA
Ketamine HCL		Injection technique; 0.5 mg/kg for 1 min	Hospira, Inc., Lake Forest, IL 60045 USA
Cavid-G		Temporary filling material	USA

Table 1. Denture base materials used in the present study.

Results

Histological observations on day 7 showed a necrotic effect by the mangosteen peel paste group 75% and formocresol on pulp cells with the average percentage of necrotic cells exceeding 50% of the total sample. Differences in Day 7 Pulp Necrosis Cells against 1st Molars of Wistar Rats using 1-way ANOVA (*P<.05*), then followed by LSD post-hoc test (*P<.05*)

Source	Sum of squares	Df	Mean square	F	*P*
Differences in Pulp Necrosis Cells					
Between groups	198136.467	2	1010.175	99068.233	<.000
Within groups	183487.000	27	7.964	6795.815	
Total	381623.467	29			

Table 2. 1-way ANOVA for Differences in Pulp Necrosis Cells.

I(Group)	J(Group)	Mean Difference (I-J)	Std Error	P
Formocresol	Manggost rind paste 75%	-198.700*	36.867	<.000

Table 3. Post-hoc LSD for Differences in Pulp Necrosis Cells Between Treatment Groups.

Discussion

Histological observations were conducted on the 7th day in four fields of view on a microscope with a magnification of 40x10. [3] (Fig. 3). This study showed that 75% mangosteen rind paste was the treatment group that had a higher pulp cell death than the formocresol group and had the potential as an alternative material for pulp devitalization. Cell death is indicated by blood spots (hemorrhage) on histological observation.[3,5]

Figure 1. Preparation 1st Molars in Occlusal.

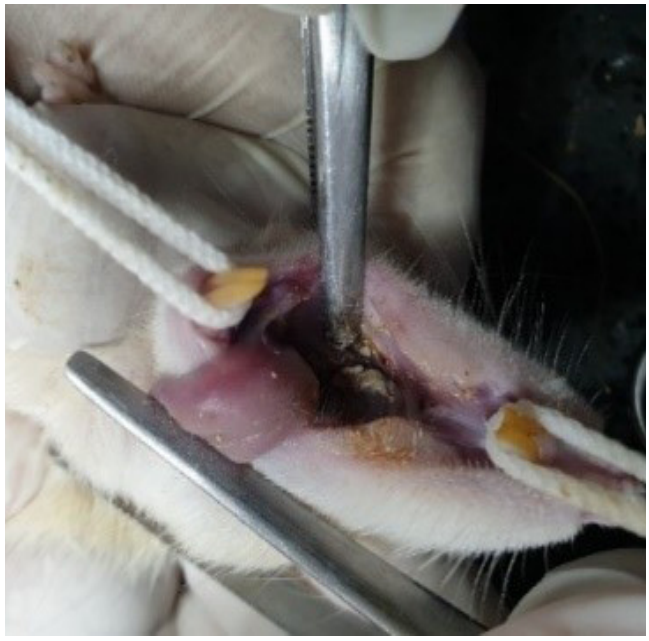

Figure 2. Temporary Filling with Cavid-G.

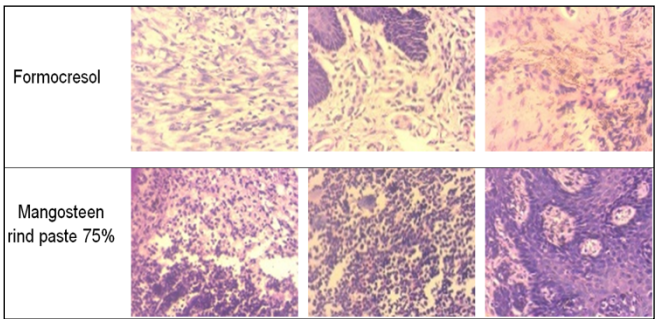

Figure 3. Formocresol Group of Necrotic Pulp Cells and 75% Manggost Rind Paste Staining HE 40x10 Magnification.

Pulp death or necrosis is a condition of disruption of physiological activities that result in premature cell death.[5,7,8] Formocresol contains active ingredients, including 19% formaldehyde, 35% tricresol, plus 15% glycerin and water.[4] Formocresol is known to be toxic and at risk of mutagenic, carcinogenic in humans when absorbed systemically and increases the prevalence of hypoplastic and/or hyper mineralizing effects, and is also known to cause tissue necrosis when in contact with the gingiva.[9,10] Mangosteen rind paste contains a tannin compound of 28%.[6,7] Tannins inhibit lipid peroxidation induced by adenine 5'-diphosphate (ADP) and ascorbic acid. Tannin-derived compounds are proanthocyanidins (condensed tannins) with a strong affinity for proteolytic enzymes such as elastase, xanthine oxidase, glucuronidase collagenase, and hyaluronidase, which are involved in the breakdown of matrix components.[11] Proanthocyanidins can interact with cell wall membranes through weak energy bonds of hydrogen type bonds and hydrophobic interactions.[12] Proanthocyanidins can neutralize enzymes that stop the degradation of the extracellular matrix by neutralizing excess Matrix Metallo Protease (MMPs).[10] The presence of MMP -2, -3, -9 can damage the cell matrix to inhibit cell development. Decreased cell proliferation indicates cell death, and this is due to the activity of astringent tannins so that they can cause mucous membranes to bind more strongly and become less permeable.[13]

Other compounds in the mangosteen rind paste, namely saponins, can affect cell activity and cause capillary blood vessels to burst.[12] Saponin compounds also function as antiseptics and trigger the growth of collagen to speed up the healing process. The saponin and flavonoid compounds in the mangosteen rind paste (Garcinia manggostana L.) also work by inhibiting the lipoxygenase and cyclooxygenase enzymes in the inflammatory cascade.[11]

This study is in line with previous studies, where high levels of tannins and saponins can cause cell death and potentially be pulp devitalization materials. Research conducted by Tanumihadja et al. found that the combination of sidaguri root (Sidarhombifolia L.) and castor gum (Jatropha curcas L.) was effective as a pulp devitalization agent characterized by cell death at a dose of 5% with the appearance of blood spots (haemorrhage) that are seen histopathologically.[3,5] The tannin content in castor gum can inactivate cell adhesion, inactivate enzymes and interfere with cell protein transport.[12] Tannins also affect cell wall polypeptides so that the formation of cell walls is less than perfect, and this causes cells to lyse due to osmotic or physical pressure so that cells will die.[10,12]

Research using mangosteen rind paste as an alternative to pulp devitalization has never been conducted before. The use of mangosteen rind paste as an alternative ingredient for devitalization is very beneficial, because mangosteen rind paste is relatively easy to find, patients do not need to spend extra costs.

Conclusions

After a 1-way ANOVA test and followed by post-hoc LSD had been done, the conclusion can be drawn that mangosteen rind paste (Gracinia mangostana L.) had a potential as a pulp devitalizing agent in indicated the presence of necrotizing pulp cell hemorrhage in Wistar Rats (Rattus norvegicus) ($P<.05$).

Declaration of Interest

The authors report no conflict of interest.

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