

The Effect of Moringa Leaf Extract (*Moringa oleifera Lam.*) As a Topical Application on Hardness of Rats's Tooth (Laboratory Study)

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Abstract:-

Background: The chemicals used in teeth whitening cause demineralization. One way that can be done to overcome this is by applying remineralizing materials. Utilization of natural materials containing calcium for tooth remineralization can be used as an alternative choice. Calcium is a major component in tooth structure and enamel demineralization caused by retention of calcium ions from tooth enamel. The calcium content of Moringa leaves is very high, making it possible to use it as a basic material for tooth remineralization applications.

Objective: To prove the effect of applying Moringa leaf extract gel on the remineralization process in rat teeth.

Methods: This research is a true experiment using a posttest only control group design. Samples were selected at simple random, the total sample size was 25 which were divided into two groups. For 14 days, after applying H₂O₂ 30% of the control group was given CPP-ACP and the intervention group was given Moringa leaf extract gel with a concentration of 5%, 10% and 15%.

Results: The results showed that there was a significant difference between the five groups in tooth hardness with $p < 0.05$. Where the different groups were the positive control, the concentration groups were 15% and 10% with $p < 0.05$. While the level of dental calcium $p > 0.05$. This shows that there is no significant difference between the five groups.

Conclusion: Administration of moringa leaf extract gel (*Moringa oleifera Lam.*) for 14 days to the teeth of rats that had been demineralized with 30% H₂O₂ had an effect on increasing the hardness of rat teeth but had no effect on the amount of dental calcium of rats.

Keywords: Demineralization, Remineralization, Moringa Leaves, Tooth Hardness, Dental Calcium

I. INTRODUCTION

Enamel is a very hard structure, but it is susceptible to acid attack, either directly from food or the result of the metabolism of bacteria that ferment carbohydrates into acid or when applying tooth whitening agents. this causes the dissolving of tooth minerals, which affects calcium levels, roughness and hardness of tooth enamel. [1],[2],[3]

Bleaching is a procedure for whitening discolored teeth using chemicals. Tooth discoloration can be caused by several factors including fluorosis, restorative materials, trauma, drugs, and genetic factors. In the bleaching procedure, there are two choices of materials used, namely carbamide peroxide and hydrogen peroxide. [11]

Hydrogen peroxide and carbamide peroxide which are used as home bleaching materials have side effects, which include decreasing levels of elemental calcium from the mineral content of enamel and demineralizing teeth, thus affecting the hardness and roughness of enamel. Decreased enamel hardness and enamel roughness can increase the occurrence of dental caries. [3]

To prevent side effects from the bleaching process, you can apply a remineralizing agent. The remineralization process is a procedure using remineralizing materials that function to restore dissolved tooth minerals.¹⁴ One of the materials used is CPP-ACPF (casein phosphopeptide amorphous calcium phosphate + fluoride 900 ppm). [5]

CPP-ACP is a milk protein derivative which is a source of calcium ions and phosphate ions. These calcium ions and phosphate ions can replace the damaged calcium hydroxyapatite structure, resulting in a tooth remineralization process. [4],[6] CPP-ACP has unfavorable properties, including the solubility of CPP-ACP in acidic pH, affinity and low penetration power on the eroded enamel surface. These properties cause the ability of calcium and phosphate to adhere to the surface of the demineralized tooth to decrease, so that the remineralization process is disrupted. [7]

Calcium is the main component in tooth structure and demineralization of enamel occurs due to the release of calcium ions from tooth enamel. Continuous demineralization can cause the dissolution of calcium minerals. [2] To restore lost minerals, a supply of calcium and phosphate ions is needed so that remineralization can occur. [9] The calcium content of Moringa leaves can reach 17 times more with a bioavailability of 8.79 times better when compared to milk. [10] The calcium content of Moringa fruit is very high, so it is very possible for the basic material for tooth remineralization applications.

II. METHODS

The type of research used is a true experiment using a posttest only control group design. Subjects in this study were divided into two groups, namely the treatment group and the control group. In the treatment group Moringa leaf extract gel was applied while in the control group, namely the positive control group was smeared with CPP-ACP and the negative control group was smeared with gel without Moringa leaf extract.

The samples in this study were the teeth of Wistar rats (*Rattus norvegicus*) which met the inclusion and exclusion criteria. The number of samples used was 25 rat teeth. The treatment group and the control group were taken by simple random sampling. All rats were numbered and then grouped into five groups by drawing lots.

Tabel 2. Comparison of dental hardness effectiveness tests in the intervention group and control group

Groups	Mean±SD	sig.**
Group I > < Group II	280,84±46,77 > < 312,42±40,79	,302
Group I > < Group III	280,84±46,77 > < 320,90±37,97	,229
Group I > < Group V	280,84±46,77 > < 355,58±18,26	,028
Group II > < Group III	312,42±40,79 > < 320,90±37,97	,864
Group II > < Group V	312,42±40,79 > < 355,58±18,26	,246
Group III > < Group V	320,90±37,97 > < 355,58±18,26	,323
Group IV > < Group I	240,93±11,72 > < 280,84±46,77	,156
Group IV > < Group II	240,93±11,72 > < 312,42±40,79	,014
Group IV > < Group III	240,93±11,72 > < 320,90±37,97	,009
Group IV > < Group V	240,93±11,72 > < 355,58±18,26	,000

Description: Group I (5% concentration), Group II (10% concentration), Group III (15% concentration), Group IV (Negative Control), Group V (Positive Control)

Table 2. Post Hoc tests show that the 10% concentration group and the 15% concentration group with a p-value of <0.05 mean that there is no difference with CPP-ACP as a positive control.

IV. DISCUSSION

One of the side effects of the teeth whitening process is demineralization. [3] Demineralization is the process of dissolving minerals in the teeth. [8] The dissolution of tooth minerals can be characterized by increased erosion of the enamel and a decrease in the micro hardness of the enamel surface. [13] Teeth that have been demineralized can be remineralized again. In the remineralization process there will be a process of placing new minerals into demineralized teeth. Remineralization will occur when there are sufficient calcium and phosphorus ions. [8]

Moringa leaves contain high calcium. [12] Calcium is one of the elements needed in the tooth remineralization process. The mineral content of calcium in Moringa leaves is one of the minerals needed for remineralization. This Moringa leaf extract gel is a preparation that works by remineralizing teeth. The occurrence of the remineralization process in the teeth can be seen in several ways, including by increasing tooth hardness, dental calcium levels, tooth roughness and tooth microporosity.

III. RESULT

Table 1. effectiveness test of tooth hardness in the intervention group and control group

	df	sig.*
Tooth hardness	4	,005

* *Kruskal Wallis*

Table 1 shows tooth hardness in the intervention group and control group with p-values < 0.05. This shows that there are significant differences between the five groups. Therefore, a follow-up analysis test was carried out to find out which groups were different and the same, using the Post Hoc test.

In this study, the Kruskal Wallis test was carried out to see differences between groups in the tooth hardness test with a p-value of 0.005 <0.05. This shows that there is a significant difference between the five groups in increasing tooth hardness, so to find out which group is different, a post hoc test is continued. After the post hoc test was carried out to find out which group had a significant effect, the results were positive control group, 15% concentration group, and 10% concentration group with a p-value <0.05 meaning different or significant. Whereas in the 5% concentration group and the negative control group the p-value > 0.05, which means there is no difference.

So, it can be concluded that the gel formulation of Moringa leaf extract has an effect on increasing tooth hardness, where a concentration of 15% has the best effect on increasing tooth hardness among the three formulations. An increase in tooth hardness can occur because there is a high supply of calcium minerals from Moringa leaf extract.

This is in line with research conducted by Dwiandhono et al (2019), this study showed that whey extract and Calcium phosphopeptideamorphous calcium phosphate (CPP-ACP) can increase the hardness of the tooth enamel surface after extracoronal bleaching procedures. Whey extract can carry out a remineralization mechanism because it contains reactive calcium and phosphate ions. Calcium and phosphate ions will react directly to the enamel interprismatic gap to

replace minerals lost due to extracoronal bleaching procedures. This reaction enhances the enamel gap closing process and reduces the porosity of the enamel resulting in an increase in the surface hardness of the enamel. [7]

In addition, this study was also supported by research conducted by Liwang et al (2014), namely tooth whitening agents significantly reduced the surface microhardness of young permanent tooth enamel. The application of remineralizing paste can increase the microhardness of the enamel surface of young permanent teeth. The remineralization process in teeth is highly dependent on calcium and phosphate ions and is assisted by fluoride to form a new layer in the lesions that occur due to demineralization. The content of calcium and phosphate in remineralizing materials is useful as a reserve provider of calcium and phosphate ions which will work to replace calcium and phosphate ions in demineralized tooth enamel. [14]

V. CONCLUSION

Moringa leaf extract gel in this study can be used as a topical material for remineralization applications because the administration of Moringa leaf extract gel (*Moringa oleifera* Lam.) concentrations of 5%, 10% and 15% for 14 days on the teeth of rats that had been demineralized with 30% H₂O₂ had effect on the increase in rat tooth hardness. Where, the concentration of 15% has the best effect on increasing tooth hardness.

REFERENCES

- [1]. Syahrial, A. A., Rahmadi, P. & Putri, D. K. T. Perbedaan Kekerasan Permukaan Gigi Akibat Lama Perendaman dengan Jus Jeruk (*Citrus sinensis* . Osb) secara In Vitro. *J. Kedokt. Gigi I*, 1–5 (2016).
- [2]. Panigoro, S., Pangemanan, D. H. C. & . J. Kadar Kalsium Gigi yang Terlarut pada Perendaman Minuman Isotonik. *e-GIGI 3*, 356–360 (2015).
- [3]. Anwar, A. I. & Tjokro, J. Efek Aplikasi Karbamid Peroksida 10 % dan hidrogen Peroksida 6 % pada Prosedur Home Bleaching terhadap Kekerasan dan Kekasaran email. *Makassar Dent J 7*, 68–74 (2018).
- [4]. Yesilyurt, C., Sezer, U., Ayar, M. K., Alp, C. K. & Tasdemir, T. The Effect of a New Calcium-Based Agent, Pro-Argin, on the Microhardness of Bleached Enamel Surface. *Aust. Dent. J.* 207–212 (2013) doi:10.1111/adj.12063.
- [5]. Wiryani, M., Sujatmiko, B. & Bikarindrasari, R. Pengaruh lama aplikasi bahan remineralisasi casein phosphopeptide amorphous calcium phosphate fluoride (CPP-ACPF) terhadap kekerasan email. *Maj. Kedokt. Gigi Indones.* 2, 141 (2016).
- [6]. Heshmat, H., Ganjkar, M. H., Jaber, S. & Fard, M. J. K. The Effect of Remin Pro and MI Paste Plus on Bleached Enamel Surface Roughness. *J. Dent.* 11, 1–6 (2014).
- [7]. Dwiandhono, I., Imam, D. N. A. & Mukaromah, A. Applications of Whey Extract and Cpp-Acp in Email Surface Towards Enamel Surface Hardness After Extracoronal Bleaching. *J. Kesehat. Gigi 6*, 93–98 (2019).
- [8]. Dzulfia, L., Damiyanti, M. & Herda, E. Pengaruh Susu Sapi dan Protein Whey terhadap Kekerasan Email Gigi setelah Demineralisasi. *J. Mater. Kedokt. Gigi 2*, 28–35 (2016).
- [9]. Setyawati, A. & Waladiyah, F. Porositas Email Gigi Sebelum Dan Sesudah Aplikasi Pasta Cangkang Telur Ayam Negeri. *J. Kedokt. Gigi Univ. Padjadjaran 31*, 221–227 (2019).
- [10]. Nur.W.A, R., Sayekti, S. & Prasetya, D. Gambaran Kadar Kalsium pada Daun Kelor (*Moringa oleifera* Lam.) dan Susu Sapi Segar Menggunakan Metode AAS (Atomic Absorption Spektrofotometry). 2018.
- [11]. Dewi, D. F., Mozartha, M. & Bikarindrasari, R. Pengaruh Aplikasi Gel Ekstrak Apel (*Malus Domestica*) terhadap Kelarutan Kalsium Gigi. *J. Kedokt. Gigi 13*, 16–23 (2019).
- [12]. Fatmawati, Marcelia, F. & Badriyah, Y. Pengaruh Ekstrak Daun Kelor (*Moringa oleifera* L.) terhadap Kualitas Yoghurt. *J. Indobiosains 2*, 21–28 (2020).
- [13]. Dzulfia, L., Damiyanti, M. & Herda, E. Pengaruh Susu Sapi dan Protein Whey Terhadap Kekerasan Email Gigi Setelah Demineralisasi. *J. Mater. Kedokt. Gigi 5*, 28 (2016).
- [14]. Devlin, H., Bassiouny, M. A. & Boston, D. Hardness of Enamel Exposed to Coca-cola and Artificial Saliva. *J. Oral Rehabil.* 33, 26–30 (2006).