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**Literature Review**

# Effect of nano calcium carbonate from *Anadara granosa* shell induced odontoblast-like cells as a pulp capping material candidate

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## *ABSTRACT*

***Background:*** *Vital pulp therapy is a treatment to repair and maintain pulp vitality. Calcium hydroxide is the gold standard in pulp capping materials. Calcium hydroxide has advantage antibacterial. However, calcium hydroxide has some disadvantages such form a layer liquefaction necrosis. Blood clam shells contain 98.7% calcium carbonate. Calcium carbonate ($CaCO_3$) content becomes a good source of calcium can be used as a bone repair material.* ***Purpose:*** *To review effect nano $CaCO_3$ from Anadara granosa shell induced odontoblast-like cells as a pulp capping candidate. Nanoparticles $CaCO_3$ has advantages such as high surface area, low toxicity, biocompatibility, biodegradability, pH-sensitivity, and osteoconductivity.* ***Review:*** *Nano $CaCO_3$ from Anadara granosa are promising to promote odontoblast-like cells formation.* ***Conclusion:*** *Nano $CaCO_3$ its potential to influence odontoblast-like cells, which play a crucial role in dentin regeneration and repair.*

***Keywords:*** *Nano $CaCO_3$; Anadara granosa; Odontoblast-like cells; Pulp Capping*

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## INTRODUCTION

Reversible pulpitis is a mild to severe inflammation of the pulp due to stimulation. Vital pulp therapy is a treatment to repair and maintain pulp vitality.[1] Calcium hydroxide is the gold standard in pulp capping materials. Calcium hydroxide has advantage antibacterial due to the alkaline pH which can reduce contamination pulp from mycobacteria. However, calcium hydroxide has some disadvantages such as high solubility, pulp calcification, and form a layer liquefaction necrosis.[2-4] Therefore, it is necessary to explore natural materials that have better physical and mechanical properties in terms of good stability, and does not easily dissolve in water.

Calcium carbonate ($CaCO_3$) is an alternative mineral that is currently widely used. Blood clam shells contain 98.7% calcium carbonate, 0.05% magnesium, 0.9% sodium, 0.02% phosphate, and 0.2% others. Calcium carbonate is a good source of calcium, biocompatible, insoluble in water, does not toxic, and can be used as a bone repair material.[5]

In recent years, nanotechnology has begun to develop rapidly and applied in the health sector. $CaCO_3$ in the form of nanoparticles able to be a candidate material for treating osteomyelitis because osteoconductivity and bioresorbability properties.[6] Nanoparticles $CaCO_3$ has advantages such as high surface area, low toxicity, biocompatibility, biodegradability, pH-sensitivity, and osteoconductivity. $CaCO_3$ nanoparticles can be used for drug delivery and immobilization processes protein, disease detection and bone regeneration.[7] Therefore, this article aims to review effect nano $CaCO_3$ from *Anadara granosa* shell induced odontoblast-like cells as a pulp capping candidate.

## METHODS

The authors searched English-language articles on the effect of nano calcium carbonate from *Anadara granosa* shell induce odontoblast like cells as pulp capping material candidate by using the databases Google Scholar. Research and literature studies conducted between 2015 and 2024 were included. It was determined that nano calcium carbonate, *Anadara granosa,* odontoblast-like cells, and pulp capping were the search parameters.


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## REVIEWS

### Blood Clams Shells (*Anadara granosa*)

Blood clam shells (*Anadara granosa*) are an economic resource and found in abundance in Indonesia. Blood clam shells contain 98.7% calcium carbonate, 0.05% Mg, 0.9% Na, 0.02% P and 0.2% others. Calcium carbonate ($CaCO_3$) in blood clam shells is a good source of calcium because biocompatible for use as bone repair materials. Blood clam shells are expected to be an alternative pulp capping material by starting dentin tissue deposition so that the healing process can occur through formation of reactionary dentin.[8]

The calcium element in shellfish can be further synthesized and converted into Ca- based compounds such as hydroxyapatite (HA), tri-calcium phosphate (TCP), calcite ($CaCO_3$), and calcium hydroxide Ca $(OH)_2$ for biomedical.[9]

### Nano $CaCO_3$ (Calcium carbonate)

Nanoparticles are generally defined as materials with particle sizes less than 100 nm while the size of microparticles ranges from 0.1 to 100 nm. Nano-calcium carbonate is one of the most widely used nanoparticles. Compared with micro-calcium carbonate, Nano-calcium carbonate has a small particle size and specific area larger than microparticle, so that it has a more significant influence on the hydration process, workability, mechanical properties and durability.[10]

### Odontoblast-like Cells

Odontoblast-like cells have a similar shape with odontoblasts. These odontoblasts are found at the periphery of the pulp tissue and originate from ectomesenchymal cells derived from neural crest cell migration during early craniofacial development. Odontoblasts sustain the tooth by producing new layers of dentin as long as the pulp remains viable. Odontoblast- like cells are cells that show characteristics similar to odontoblasts, which are the main type of cells in the dental pulp tissue that are responsible for in dentin formation.[11]

## DISCUSSION

Blood clam shells (*Anadara granosa*) are easily found in Indonesia and contains 98.7% $CaCO_3$, 0.05% Mg, 0.9% Na, 0.02% P, and 0.2% other components. The high calcium content makes Anadara granosa a viable alternative material for pulp capping. Previous studies have shown that the $CaCO_3$ in *Anadara granosa* stimulates TGF-β1 and VEGF-A, modulates cell growth, acts as an angiogenic agent, and promotes tertiary dentin formation.[12] Growth factors have an important role in responding to injury and repair. network. The presence of caries triggers odontoblast activity, resulting in an increase TGF-β1expression. TGF-β1 is an important regulator of proliferation and pulp cell differentiation during the process of dentin formation and repair.[13] Research conducted that $CaCO_3$ comes from the shells of blood clam shells (*Anadara granosa*) can increase the expression of TGF-β1 in odontoblast cells. The expression of TGF-β1 as the initial stage of the process of forming odontoblast-like cells this growth factor will cross the dentinal tubules to the pulp and trigger various cellular responses, including activation of odontoblast cells.[5]

Nano $CaCO_3$ its potential to influence odontoblast-like cells, which play a crucial role in dentin regeneration and repair. Nanoparticles have a smaller particle size than microparticles. This will affect the biological effect, namely the smaller the particle size, the surface area is larger, so that the interaction of the material with the surrounding tissue more increasing. More and more calcium ions will be trapped in the tissue thus stimulating odontoblast cells to form dentinal bridges.[14,15] Nano calcium carbonate is able to accelerate the dissolution of calcium ions and increase concentration of calcium ions which plays a role in maintaining bones and teeth.

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