



# The Journal of **MacroTrends** in Health and Medicine

## **Mouthwash based of Nanocalcium- and Nanochitosan for dental health care in a way that is practical and efficient.**

**Ayu Astriandari, Annisa Ulfa Safitri**

*Bogor Agricultural University, Jalan Lingkar Akademik, Bogor and 16680, Indonesia*

### Abstract

*Dental health is one of the aspects of human health that are often missed. Dental health problems in general are cavities, cracked teeth, the onset of plaque and bad breath. Mouthwash is one way of dental health care. Dental problems can arise because of the lack of an mineral needed teeth because of dental porous structure is very small. With regard to the small pore size, then nanotechnology is the solution. N-CMouthwash is a mouthwash made by using nanokalsium and nanokitosan with shrimp shell waste material. The methods used to produce nanokalsium is top down and bottom up and gelasi ionic to produce nanokitosan. The use of nanokalsium in the mouthwash is intended to allow the calcium it needs teeth can be absorbed at 100% so that it can prevent cavities and closes the teeth layer cracked. Based on the data obtained 100% absorption of nanokalsium into gear very quickly about 9 minutes. In addition there are also nanokalsium the use of nanokitosan. Used Nanokitosan function as antibacterial so it can prevent plaque and bad breath. The data shows in 40 seconds, bacterial can be reduce until  $< 25 * cfu/ml$ . this research serves to add value of shrimp waste so it can be beneficial to health, particularly the health of human teeth and can be a first step in the application of the principle of zero waste to support Indonesia's economic blue.*

Keywords: *nanochitosan; nanocalcium; mouthwash*

### **1. INTRODUCTION**

Household Health Survey (Survey) mentions, oral disease ranks first with a total of 60 percent of the 10 most diseases suffered by the public. The high number of these problems can not be underestimated. Therefore there needs to be an activity in order to maintain hygiene and oral health. One way that many do in maintaining oral health is mechanically. However, this method

was less effective, way of maintaining oral hygiene in a way that is effective rinsing using *mouthwash*. Use of mouthwash is very effective because of its ability to reach places that are difficult to clean with a toothbrush and can damage the formation of plaque. The use of chemicals to prevent the formation of dental plaque due antimicrobialnya effects, such as by containing antibacterial ingredients. However, the content of antiseptic in mouthwash is thought to be adult carcinogenic effect and minimal other natural ingredient beneficial to dental health. Seeing these problems need to look for alternative anti-bacterial substances and substances of natural dental health care and safe in use (Widodo 1980).

One of the antibacterial substance is chitosan. Ability of chitosan is applied in many fields of modern industries, such as pharmaceuticals, biochemistry, cosmetics, food industry, textile industry and to continue to encourage the development of a variety of studies using chitosan, including modifying chitosan chemically or physically. Chemical modifications result in improved stability of chitosan through functionalization of existing functional groups, pore size improvement chitosan using porogen compound, and can increase the adsorption capacity of chitosan when chitosan combined with other polymers. Physical modifications include changes in chitosan particle or grain size becomes smaller chitosan for wider utilization. Therefore, the development of physical modification leads to a form of nanoparticles so that the effectiveness and application of chitosan is able to run optimally (Zahid 2012).

Other ingredients in mouthwash is usually only serves as a refresher and preventing bad breath but minimal other ingredients that serve to dental health care. One of the minerals needed for healthy teeth is calcium, as 90% compiler tooth substance is in the form of calcium hydroxyapatite. Calcium are commonly consumed in the form of micro calcium. Particle size is related to the amount of calcium absorption of calcium by the body, especially for teeth that have very small pore size. Micro size can be absorbed only 50% so often lead to deficiency. Formation of calcium technology smaller size need to be developed to increase the absorption of calcium in teeth. Formation technology needs to be developed that measure calcium is nano technology. Nano calcium has a very small size ie  $10^{-9}$  m which causes rapid receptor into the body perfectly, hence nano calcium can be absorbed by the body almost 100% (Suptijah *et al.* 2010). The purpose of the filing of innovation-based mouthwash and nanokalsium nanokitosan is to produce dental health care products are natural, and effective for dental health as well as supporting the declaration of zero waste by utilizing shrimp waste as a useful material and lead to the blue economy.

## 2. METHOD

Materials used in the manufacture of nano partikel chitosan are chitosan from shrimp shells, aquades, H<sub>2</sub>SO<sub>4</sub> solution, Tween 80, and STTP while the tool used are a magnetic stirrer and 1L glass backer. Materials used in the manufacture of nanokalsium are HCl, NaOH, KCl, and water. This study is divided into two parts, manufacture of nano partikel chitosan and manufacture of nanokalsium. Chitosan nanopartikel is made using chitosan derived from shrimp shell waste. Chitosan weighing 1.5 grams is mixed with acetic acid to taste, stirring to form a chitosan gel.

Chitosan gel formed is dissolved using sterile aquades as much as 500 mL, stirring using a spatula. Chitosan solution is changed to nano size using magnetic stirrer for two hours. Then add 25 mL of emulsifier (Tween 80) 0.1% gel which can separate between the gel with another gel. Surfactant (Tween 80) is given by dropwise way to the chitosan which has been cut and allowed to stand for 30 minutes then add STTP 100 mL by slowly shedding it. The next step is manufacture of nanocalcium, separation of minerals from the skin by 0.5-1.5 N HCl extraction with a 1:7 ratio. Heating is carried out at a temperature of 100 ° C with a treatment time of 30, 60, 90 minutes. Once the separation is complete extraction residue. Filtrate separated by decantation (BCCF 2007), the residue was re-extracted three times. Filtrate dilakukan precipitation combined with ionic gelation method with NaOH + KCl. Precipitation separated and neutralized with distilled water to pH 7, then performed the PSA test. Preparation followed by incineration with combustion furnace burning at a temperature of 800 0 C treatment on the burning blend nano furnish incorporated in nanoscale devices for 30 minutes to blend the resulting Ca nano-particles (nano Ca). Nanocalcium which has been obtained is then tested with a particle size using a PSA (Particle Size Analyze) and total mineral chemical analysis using AAS (Atomic Absorption Spectrofotometri).

### 3. RESULT AND DISCUSSION

Fine Particle Chitosan or nano chitosan is chitosan which has shaped dense particles with a size of about 10-1000 nm. Chitosan in nanoparticle form is also neutral, non-toxic, and has a stable stability. Nanoparticles are used in a variety of routes (parenteral applications, eg oral mucosal, nasal, and ocular mucosa) which is not invasive. In drug delivery systems, nanoparticle acts as a carrier (carrier) by dissolving, trapping, encapsulate, or paste in the drug matrix. Recently, nanoparticles derived from polymeric materials used as potential drug delivery systems because of the ability distribution in organs over time, and its ability to deliver proteins or peptides (Mohanraj and Chen 2006).

Mouthwash is a liquid solution or used to rinse the oral cavity with a number of objectives, among others, to get rid of pathogenic bacteria, remove odors, has therapeutic effects and eliminate the infection or prevent dental caries. In General a mouthwash containing 5-25% alcohol. Alcohol included in mouthwash for some uses, among others, as an antiseptic, stabilize the herb-herb active in mouthwash, extend the save of mouthwash, preventing contamination from microorganisms, and dissolve materials giver flavor. However, according to Herawati (2005), the content of alcohol in mouthwash this causes certain individuals cannot use a mouthwash containing alcohol, such as children, pregnant/nursing women, alcoholics, patients who use metronidazole, patients with xerostomia, and certain religious believers.

Wynder (1983), stated that the alcohol content in a mouthwash can also increase the risk of cancer of the oral cavity and esophagus, especially when used in regular usage. Therefore the new formula were underway that could prevent the onset of halitosis (bad breath) which is made from natural chitosan partical fined made from shrimp shells as mouthwash as a substitute for alcohol. The lobster shell was intended to use the waste waters of the results can

be dimanfaatkan to the maximum and effectively used as a raw material for the manufacture of a product that provides economic value. Therefore a single mouth wash containing chitosan nanoparticle as a substitute for alcohol and nano calcium and to strengthen the tooth.

Calcium is an essential mineral that is needed by the body to metabolize them, producing energy, participation in the formation of protein structure, bone structure, DNA, and plays a role in enzyme activity. Mineral calcium is generally available in the form of micro, in the absorption of calcium is predicted only 50% absorbed by the body so that the body has deficiencies that cause a disruption of calcium in the bones and teeth of them: rikets, osteoporosis, brittle teeth and others (Guyton 1987). The best alternative for improving the availability of calcium for the body is the nano calcium intake. Calcium particles are so small that is  $10^{-9}$  m, so quickly absorbed into the receptor and 100% perfectly. Thus the extra calcium in the form of nano calcium would be a solution for diseases caused by calcium deficiency. The positive impact of calcium in children will stand out, such as increased growth and height and form bones and teeth strong and healthy (Henry 1997). While the positive effects in adults are strong bones and teeth, nerve sensitivity excellence, improve skin health, avoid stress, and avoid osteoporosis. Extracting solution used was HCl with various concentrations. The extraction is done to produce a substance called a recovery. Histogram comparison results between the concentration of HCl recovery with recovery of the resulting nano calcium can be seen in Figure 1.

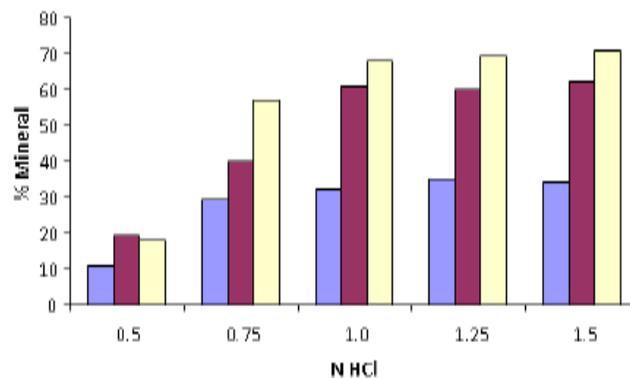


Figure 1 Histogram% mineral acquisition / Ca at various concentration and extractors (HCl)

Figure 1 shows that the number of nano calcium mineral produced is directly proportional to the concentration of HCl used. The lower the concentration of HCl that are used, the number of nano-calcium mineral produced is also less and less. It can be seen from the concentration of 0.5 N HCl produces the smallest amount of nano calcium concentration by the comparison between the old extraction. While the concentration of 1.5 N HCl to generate the most amount of nano calcium concentration comparison with many of the old extraction. When calculated by weight of 1 kg of raw material per kilo then dried shrimp shells weighing 1 kg, 0.5 kg wet weight will produce 100 g of dry matter and produce nano calcium 24.4 g. These results can be used for alternative products domestically sourced from the blue waters as well as supporting the

economy in the future. Phase extraction with 0.5-1.5 N HCl treatment with extraction time 30, 60, 90 minutes, showing the higher concentration of HCl is the stronger can extract minerals contained in the shells of previous studies showed that the most efficient HCl in extracting minerals than acid other (acetate and citrate). Extraction time of treatment showed that the longest time extract more produce mineral extraction, it is in line with the principles of extraction that time, concentration and extraction temperature will affect the extraction results.

Absorption (bioavailability) of calcium mostly occurs in the duodenum and proximal jejunum because the situation is more acidic than the other parts of the intestine 8. Calcium absorption in the small intestine takes place through duamekanisme, by active transport and passive transport. Active transport mechanism regulated by 1,25 - Dehidroxycholecalciferol [1,25 - (OH) 2D], the most active form of vitamin D produced in the kidney. Calcium absorption in the gastrointestinal tract usually ranges between 30-80% of total calcium intake. The human body absorbs about 20% to 40% of calcium from the diet, but is generally tailored to the needs of the body. Calcium absorption is increased when there is a decrease of blood calcium levels. Instead decreased calcium absorption when high blood calcium levels (Murray *et al.* 2003). Bioavailability testing is done by injecting nano calcium into the body of mice and was observed with a span of 10-15 minutes. Curve of absorption (bioavailability) nano calcium can be seen in Figure 2.

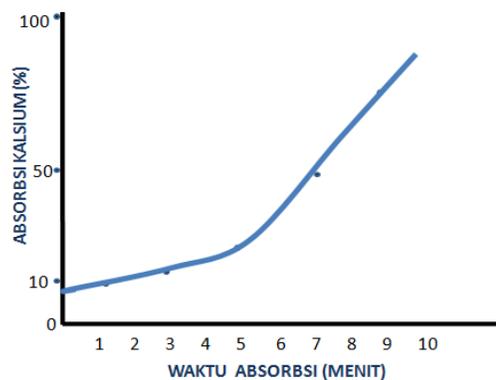


Figure 2 Curve nano calcium bioavailability

Figure 2 shows that the absorption of nano calcium has been started since the minute seriring 1 and continued to increase over time. Absorption of calcium in the minute 1 adalah 8%, 2nd minute by 9%, the 3rd minute by 15%, the 4th minute by 20%, the 5th minute by 25%, the 6th minute by 30%, 7th minute by 50%, the 8th minute by 65%, 9 minutes by 80% and 10 minute by 90%. Significant increase in absorption occurred in the period between the 6th minute until the 9th minute.

Nanokalsium is calcium 100-400 nm sized particles. Calcium particles so fine that it is quickly absorbed into the blood system, the particles running fast with quick movements to be stored in the bone structure. Analysis results proved that the absorption rate nanokalsium very good,

compared to conventional calcium intake. Calcium is needed by the body in sufficient quantities, because if too much and not absorbed by the body may be other health problems. Size is reduced to *nano* calcium ( $10^{-9}$  nm) with a *nano-blend* technology will make direct absorption by the cells become more perfect. Size of nano-sized particles of calcium which aims to macronutrient calcium can be absorbed fully in gear and does not leave residue on the teeth (Kamelia 2009).

#### 4. CONCLUSION

Chitosan can be applied in various ways, the physical modification of chitosan as antibacterial agents used as nanoparticles in the mouth and is used as the raw material manufacture of mouthwash. Utilization of nanochitosan more effective than chitosan since it has a low molecular weight and cause particles scattered well around the bacterial cell. therefore nano chitosan used instead of alcohol and nano calcium to strengthen the tooth

#### ACKNOWLEDGEMENT

The authors are very grateful for facilities provided by Bogor Agricultural University and Aquatic Product Technology's lecture, Dr. Dra. Pipih Suptijah, MBA as supervisor in this paper.

#### References

1. Guyton AC1987. Medical Physiology. EGC, Book Medical Publishers, 587 p.
2. J Henry V. , 1997. New Guide to Medicines & Drugs. The British Association Medical London. Dorling Kindersly. 479 PGS.
3. Camellia. , 2009. Lead Poisoning. *Annual Review of Medicine* 55: 209-220.
4. Widodo S, Lambri SE. 1980. *Peranan Kumur-kumur dalam Perawatan Periodontal*. Kumpulan Naskah Ceramah Ilmiah dan Kongres Nasional ke XIV PDGI, hal. 140-144.
5. Murray RH, Keck CM. , 2003. Challenges and solutions for the delivery of biotech drugs - a review of drug NanoCrystal technology and lipid nanoparticles. *Journal of Biotechnology* 113: 151-170.
6. Supitjah P, Hardjito L, Haluan J, dan Suhartono M. 2010. Recovery dan manfaat nano kalsium hewan perairan (dari caangkang udang). *LOGIKA*.7(2): 61-64
7. Zahid A. 2012. Uji efektivitas kitosan mikrokristalin sebagai alternatif zat-antibakteri alami dalam *mouthwash*. [skripsi]. Bogor: Fakultas Perikanan dan Ilmu Kelautan, Institut Pertanian Bogor.