KnE Energy
ISSN 2413-5453 Volume 2 (2015) 16-21
New, Renewable Energy and Energy Conservation Conference and Exhibition
(The 3rd Indonesia EBTKE-ConEx, 2014)

Potfrigator Technology : Preservatives Equipment Low Energy For Fish and Reducing Hazardous Heavy Metals Based Photocatalytic Co Doped ZnO and Cooling Dynamic System

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Abstract

Pollution is caused by dangerous heavy metal such as Pb, Cu and Zn are toxic in the body tissues of organisms such as fish in high concentrations, it will be harmful to human health The purpose is to create an eco-friendly fish preservative tool with cooling system of thermodynamics and photocatalytic Co doped ZnO nanoparticles. this device can reach temperature 15 ^{o}C. Then to reduce dangerous heavy metals and kill bacteria used principle of photocatalytic Co doped ZnO nanoparticles. Co doped ZnO synthesized by sol-gel method. Then proceeded to spray coating and drying with furnace. The result is a purple clear homogeneous solution. From the analysis of the obtained bandgap Co doped ZnO about 2.28 eV and from SEM generated that average particle size Co doped ZnO is 60 nm. From the result of Co doped ZnO can be initiated by visible light and may have antibacterial activity so that this material can be made as a tool to prevent the growth of microorganisms only using regular light

Key words : Eco-friendly fish preservative tools; less energy based on cooling dynamic; Nano Co Doped ZnO.

1. Introduction

Fish is a food that is quite favored by the people of Indonesia. Fish is best eaten as nutritional needs and contains important compounds such as essential amino acids , saturated fatty acids , omega 3 (Vikosa , pentanoat) and DHA (Dokosa hex Enoat) [3] . But the utilization of fish has the disadvantage that it is easily foul after arrest[6] and contains dangerous heavy metals such as Pb , Hg , Cd , Cu , Cr and Zn were quite high.

Preservation of fish have been carried out by several methods such as freezing the freezer or refrigerator , curing , marinating and the addition of preservatives [6] . Each of the pickling process has drawbacks such as the freezing process required high energy and lead to adverse outcomes such as freon that are harmful to the environment . In the process of curing emissions of harmful gases produced CO (carbon monoxide) as well as the taste and texture of the fish being changed . At the pickling process changes the taste , and the use of preservatives in fish would pose a danger to consumers[10]. Weaknesses of various systems such preservation must be addressed with an innovative energy- efficient technology and environmentally friendly that keep fish stay fresh , avoid the process of decay (preserving fish) as well as the reduction of harmful heavy metals in fish without changing the sense of taste , texture and nutrition of the food.

Nanotechnology in the world is growing so rapidly . One example is nano ZnO material . Zinc oxide is a photocatalyst economically valuable substances [1]. Photocatalytic process when zinc oxide is ZnO nano-sized then exposed to UV light to form super oxide compounds that can degrade heavy metals , eliminating harmful microbes and bacteria [8]. Effect of photocatalyst can reduce dangerous heavy metals such as Cr (VI) to 80 % [7] . Jones

Selection and peer-review under responsibility of the Scientific Committee of The 3rd Indonesia EBTKE ConEx 2014.
DOI http://dx.doi.org/10.18502/ken.v2i2.352

(2008) and Seery (2008) reported that ZnO nanoparticles have a high antibacterial activity and is able to reduce heavy metals , so if ZnO is superimposed onto another substance such as glass then ZnO nanoparticles can reduce heavy metals and kill microbes and bacteria in the surrounding environment when initiated with UV light . Because zinc oxide itself is a zinc oxide catalyst then it will never run out and will continue to experience these reactions[8].

Zinc oxide (ZnO) has a weakness that can only be initiated by UV light[7]. The weakness can be overcome by making modifications to the material in order to work on a range of visible light . One solution of this problem is to coat ZnO with Cobalt (Co) [7] . ZnO coating with Cobalt (Co) will lower the bandgap of ZnO nano-sized so that the material of ZnO can work on visible light up to 550 nm wavelength , as a result of microbial activity pendekomposisian / reduction of bacteria and heavy metals more quickly and be able to use the light from the lamp we use daily [7]or can be said Co doped ZnO as an effective preservative fish and preserved fish safe to eat

From the facts above, one of the innovations that will be the solution to the system of preservation and handling of hazardous heavy metal contamination in fish is to create a tool preservatives and reducing harmful heavy metals in fish with a dynamic cooling system and photocatalytic Co doped ZnO . The tool is named potfrigator , serves to preserve and maintain the freshness of the fish by preventing cellular respiration with dynamic cooling cooling system , high antibacterial activity and can reduce the weight of heavy metals harmful to fish . This Potfrigator energy efficient due to the preservative system only requires the energy of ordinary bulbs , another advantage of this tool also does not ruin the taste , texture and nutrition because fish will only illuminated by visible light . Besides reducing tool preservatives and harmful heavy metals is easy to apply and environmentally friendly because it does not produce adverse results.

2. Materials and methods

Research "POTFRIGATOR technology : performed at the Laboratory of Analytical Chemistry and Physics Laboratory, University of Diponegoro. Research procedures performed in multiple stages

2.1 Material and tools

2.1.1.Material

The materials used in this study were zinc acetate, isopropanol, cobalt nitrate, glass, acetone, deionized water, monoethanolamine, sand.

2.1.2.Equipment

The equipment used is a set of glassware, thermometer, magnetic stirrer (magnetic stirrer), spreyer and compressors, UV-Vis Spectroscopy, SEM (Scanning Electron microscop), XRD, pots of clay.

2.2 Methods

2.2 2. Syntesis nano Co doped ZnO

Synthesis of Co doped ZnO nanoparticles made by the sol-gel method with the precursor Zn (CH3COO2) 2.2H2O as the source of Zn and isopropanol (IPA: (CH3) 2CHOH), monoethanolamine (MEA: HOCH2CH2NH2) and cobalt nitrate (CoNO3.6H2O). Preparation of ZnO nanoparticles by dissolving zinc acetate into a solution of propanol and monoethanolamine at room temperature at concentrations of 0.3 M zinc acetate molar ratio of 1:1 and then distirer for 1 hour. The results were clear white solution formed. After that add cobalt nitrate with a 10:1 ratio

with Zn (Zn: 10, Co: 1) and dilstirer for 7 hours. The result is a translucent purple homogeneous solution. The next process is the coating on a glass substrate and furnace

2.2.3 Potfrigator technology

Preparation of Potfrigator by putting a large pot filled with smaller pots. The space in between the two clay pots filled with sand. The sand creates an insulating layer that surrounds the inner pot then Installation of glass that has disprey Co doped ZnO nanoparticles and put the cover on potfrigator

3. Results and discussion

3.1 Analysis Nanoparticle Co doped ZnO.

3.1.1 Analysis of the energy gap of ZnO material

The purpose of this analysis is to know energy gap of the compounds synthesized formed. Of the energy gap can be analyzed whether these compounds may work in the visible lights or not. The fig 3 shows that the material works in all light range including visible and UV region. Peak number 1 (220 nm) and number 2 (380 nm) indicated that these wavelengths are the optimum range area when this material is exposed to UV light irradiation. These peaks arise from the properties of ZnO material. Peak number 3 (552.50 nm) indicated that this material also works at visible region. This peak arises from cobalt that has doped successfully in synthesis process. When this wavelength is converted to the max Planck equation, it is obtained 2.28 eV as the bandgap of ZnO nanoparticles doped Co.

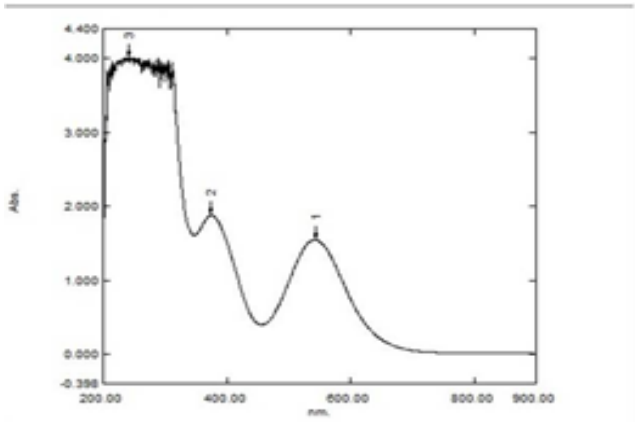

Fig.1. Testing results of DR UV- VIS spectrophotometry

3.1.2 Analysis of crystal morphology

The purpose of analysis using SEM (Scanning Electron Microscopy) is to analyze the surface morphology, texture and size of ZnO: Co coatedon the lamp.

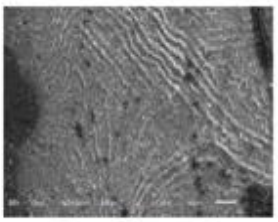
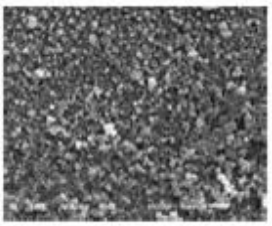
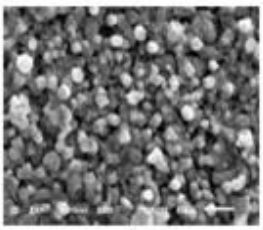

Fig.2. Fig.2. Fig.2.

Fig 2. Result of Nanoparticle Co doped ZnO

Based on the results of SEM (Scanning Electron Microscopy) can be concluded that:

- . In the SEM magnification 1.000x seen that materiality is nice and evenly coated.
- At magnification SEM 10.000x seen that doping ZnO nanoparticles Co. round-shaped crystals, coated in a strong, tightly / evenly.
- In 30.000x magnification SEM showed that the coated material of similar size to an average of 40nm

3.1.3. Analysis of material composition is coated.

EDS analysis purposes (Energy Dispersed Spectroscopy) to determine the composition of the compound coated on a glass

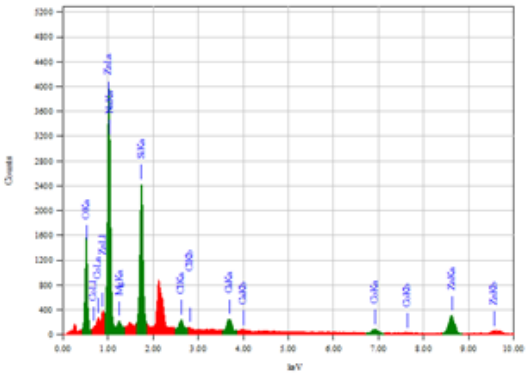

Figure 3. Testing results of EDS (Energy Dispersed Spectroscopy)

From the test results can be known that Zinc, oxygen, and cobalt are deposited on the glass. The data shows that ZnO and cobalt which were deposited on the glass up to 52.12 % and 4.15 % respectively

3.2. Results of testing equipment fish preservatives

Fig 4. Testing Fish Quality

After 18 hours the fish are preserved by this tool has a smell that is not overpowering. Besides fish also has a chewy texture. While the parameters of mucus from the fish is preserved using these tools have little mucus so it can be inferred from the physical parameters of the fish are still in decent condition to be eaten.
Test of heavy metals in fish using the tool that Cr6 + is done using a UV-Vis spectrometer. Results showed photocatalytic reduction of heavy metal that was Cr6 + with a concentration of 60 ppm is irradiated with visible light Cr6 + to 11.502 ppm. Therefore we can conclude by using this tool can reduce the levels of heavy metals in fish

3.3. The mechanism of preservatives

Potfrigator is a fish preservative tool with dynamic cooling system that is capable of maintaining the temperature reaches 150C system so as to maintain the freshness of the fish . Potfrigator is composed of a large pot filled with smaller pots . The space in between the two clay pots filled with sand , creating an insulating layer that surrounds the inner pot . Wet sand and then made permanent by means menambahkanair periodically , this tool is based on simple physical principles of water contained in the sand evaporates towards the outer surface of the larger pot where the dry air then circulates in the cap at the top using a thin glass that has been coated Co - doped ZnO uv lamp and positioned on top of it . The decrease in temperature on fish will occur continuously make cold and fresh fish , plus the use of Co -doped ZnO photocatalysts reduce heavy metals and eliminate bacteria .

Photocatalytic Process ZnO

$$ZnO + hv \longrightarrow h_{VB}^{+} + e_{CB}^{-}$$

$$h_{VB}^{+} + H_2O \longrightarrow OH$$

$$e_{CB}^{-} + O_2 \longrightarrow O_2$$

Of the photocatalytic reaction to form compounds that release superoxide O2 and OH radicals which can oxidize a wide range of heavy metals and bacteria so that the tool preserves the fish with the photocatalytic pronsip able to preserve fish by killing bacteria and microorganisms that cause decay and reduce heavy metal contamination in fish so that the product fresh fish , nice texture , and free from heavy metals .

This tool is very useful for the people of Indonesia, especially the fish merchants , eating places serving seafood and fresh fish delivery across regions and across the country . With Potfrigator fish stay fresh , not stale , chewy texture and safe from the dangers of heavy metal pollution , thus providing a solution potfrigator diIndonesia fresh

fish . Potfrigrator can be further developed to preserve than fish that fruit , meat , and other organic materials are easily rot.

4. Conclusion

Potfrigator technology is a fish preservative tool with dynamic cooling system that is capable of maintaining the temperature reaches 150C and photocatalytic systems Co doped ZnO nanoparticles were able to preserve fish by killing bacteria and microorganisms that cause decay and reduce heavy metal contamination in fish so fresh fish products, good texture , and are free from heavy metals. Co-doped ZnO nano-sized, can work in the visible, perfectly coated on the glass. Results showed photocatalytic reduction of heavy metal that was Cr6 + with a concentration of 100 ppm is irradiated with visible light Cr6 + to 11.502 ppm. With Potfrigator fish stay fresh, not stale, chewy texture and safe from the dangers of heavy metal pollution, thus providing a solution potfrigator diIndonesia fresh fish. Potfrigrator can be further developed to preserve than fish that fruit, meat, and other organic materials are easily rot.

Acknowledgent

We would thank to Chemistry Department, and Physics Department of Science and Mathematics Faculty, Diponegoro University for funding our research.

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