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CPNS (Cooling box Photocatalyst and Nanoparticles System): Preservatives and Harmful Heavy Metals on Fish, Vegetables, and Fruits

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***Abstract*—Vegetables, fruits, and fish are the primary food of the Indonesian people. The food that unclean and polluted by some substances would be harmful for human health. Based on this problems it is needed for innovative research in order decreased levels of heavy metals in food. The aim of this research is to analyze the decreased levels of heavy metals in the pickling system based reduction of heavy metals in foods that more energy efficient based on the photocatalytic reaction by visible light from the sun as a solution to providing safe food. SEM results showed good morphology and amounted to 13.75% containing C, N amounted to 54.76% and amounted to 31.48%. Pb metal analysis results using the Atomic Absorption Spektrofometer fish without treatment equal to 0.22895 µg / kg, cooled 0.2258 µg / kg whereas with this method 0.1196 µg / kg. for vegetables without treatment 0.0522 µg / kg, cooled 0.0485 µg / kg, this method 0.0196 µg / kg. For the fruit without treatment 0.0492 µg / kg, cooled 0.0394 µg / kg, this method 0.0165 µg / kg.**

Keywords—food preservatives tools, N-doped TiO_2, Heavy Metal Reducers, Photocatalysis

I. INTRODUCTION

Four of five perfectly healthy motto proclaimed as an invitation to make a balance of nutrition in daily consumption, which consists of staple food, side dishes, vegetables, fruits and milk (Suhardjo, 1992). Vegetables are important food in memjaga health. However, vegetables can cause illness when contaminated by heavy metals or microorganisms. In 1994 data showed that vegetables grown on the roadside contain contaminants tetra ethyl lead at 28.78 ppm originating from motor vehicle fumes (Winarno, 1994). Dissertation research in 1997 against cadmium contamination at kale, basil, and calsim in the Supreme Lenteng obtained content of 1.56 ppm; 1.04 ppm; and 1.86 ppm. In Indonesia, fruits and vegetables is a food that is very easy to obtain, even each region has a fruit and vegetable as typical for the area. Fruits and vegetables with various types and colors can be complementary nutritional needs required by our body. In addition, one of the foodstuffs that contain lots of fiber found in fruits and vegetables (Jahari et al, 2001). vegetables and fruits are a source of vitamins and minerals that the body needs to regulate processes in the body. Although the need for a relative small, but the function of vitamins and minerals can hardly be replaced so that the requirement for the consumption of these substances is essential. If the consumption of vitamins and minerals does not meet the requirements, then the body will experience a deficiency of vitamins and minerals which may result in reduced endurance. According to research conducted, the type of foods that contain vegetables and fruits in the school cafeteria not meet enough criteria to be consumed.

Fish and shellfish are enough food favored by the people of Indonesia. Excellent fish and shellfish consumed because it meets the nutritional requirements and contains important compounds such as essential amino acids, saturated fatty acids, omega 3 (Vikosa, pentanoat) and DHA (Dokosa Heksa Enoat) (Lloyd, 1992). But the utilization of fish and shellfish has the disadvantage that it is easily rot after being arrested (Nurhadi, 2011) and contains harmful heavy metals such as Pb, Hg, Cd, Cu, Cr and Zn were quite high (Sutarto, 2007). So to solve these problems required the innovation system which can simultaneously reduce preservation harmful metals so both problems in fish and shellfish can be resolved. Preservation of fish and shellfish have been carried out by several methods such as freezing the freezer or refrigerator, smoking, salting and the addition of preservatives (Nurhadi, 2011). Each of the preservation process has drawbacks such as the freezing process required high energy and cause as freon byproducts that are harmful to the environment. In the process of curing produced CO emissions of harmful gases as well as the taste and texture of the fish being changed. In the salting process changes the taste, and the use of preservatives in fish and shellfish would pose a danger to consumers (Winarno, 2004). Preservation of the weaknesses of the various systems must be overcome by an innovative energy-saving technology that makes fish and shellfish avoid decay process as well as reduce harmful heavy metals in fish and shellfish without changing the sense of taste, texture and nutrition of the food.

Nanotechnology in the world is growing so rapidly. One example is the nanomaterial TiO_2 is a photocatalyst substance economically valuable (Burgess, 2007). The working principle photocatalyst TiO_2 is a nano-sized titanium dioxide when exposed to UV rays will form a super-oxide compounds which can oxidize a variety of

organic compounds so as to carbon dioxide and water (Samal et al, 2010). Properties TiO_2 that can oxidize organic compounds such as bacteria (antibacterial) and economical price makes the nano (1 nm- 100 nm) . TiO_2 as a suitable material in the manufacture of preservatives and reducing harmful metals in fish and shellfish.

Based on its utilization as a means of curing and reducing harmful heavy metals in fish and shellfish photocatalyst TiO_2 has some weaknesses that can only be initiated by UV light (Liu et al, 2011), whereas the UV light can damage the protein content in fish and shells so necessary modifications to the material in order to work on a range of visible light. One solution to this problem is to coat TiO_2 with Nitrogen (Rani et al, 2010). Coating TiO (2) with nitrogen gas to raise the activity of organic compounds hinggga pendekomposisian wavelength of 550 nm (Ashahi et al, 2001) or can be said to be N-doped TiO_2 as a visible light photocatalyst. With these modifications, the activity. TiO_2 as a photocatalyst as an antibacterial and reducing heavy metal becomes more effective.

Bacteria and harmful heavy metals are compounds that can be reduced by n-doped photocatalyst N – TiO_2 can reduce bacteria up to 98.7% by using visible light (Wang, 2011). In addition photocatalyst with N – TiO_2 can reduce dangerous heavy metals such as Cr (VI) to 80% (Slamet, 2003). From these data it can be concluded when the N – TiO_2 superimposed on the glass, the N – TiO_2 may provide antibacterial effect resulting in fish and shellfish avoid decay process as well as reducing harmful heavy metals in fish and shellfish so fish and shellfish will be safe to eat.Based on the facts above, one of the innovations that will be the solution to the problem solving preservation system and harmful heavy metals in fish and shellfish is to create a tool preservatives and reducing heavy metals be deadly in food (vegetables, fruits, fish and shellfish with N- TiO_2. The tool serves to preserve fish and shellfish with high antibacterial activity and can reduce dangerous heavy metals in fish, vegetables and fruit.

II. Ingridients and Method

A. Tools and Materials

The tools used in this research is the means of glassware, analytical balance Metter Toledo, GCA Corp. oven, furnace, magnetic strirrer, Visible light from the Light of the Sun, SEM (Scanning Electron Microscopy), Atomic Absorption Spectrofotometry (AAS). Materials used are titanium (iv) isopropoxide Sigma Aldrich, HNO_3, ethanol, urea, and distilled water.

B. Synthesis Method N – TiO_2 and Photocatalytic Activity Test

Synthesis nanosol TiO_2 using the sol-gel method with a mole ratio of H_2O:Ti the 4: 1 which is the ratio of hydrolysis in this synthesis is 30 ml of ethanol is then added HNO_3 until pH 3. Thereafter, the solution was stirred using a magnetic stirrer for ± 10 minutes for the HNO_3 added evenly distributed into the solution. Then 5 ml of ethanol in a beaker placed on digital scales and added 1,008 grams of distilled water. Then shed ethanol in a beaker dropwise until they run out and while stirring for ± 5 hours in order to be nanosol. The second step of dissolving the 5% urea solution into the titania nanosol mixture and stirred using a magnetic stirrer for 5 hours. Afterwards, the obtained sol is coated on a glass substrate. Fotocatalalis activity test samples of fish that were placed under a glass substrate that has been coated N – TiO_2 for 2 hours.

C. Sampling Method

The sample used in this study were samples of fish and shellfish (gills, liver and entrails), vegetables and fruits are taken on fish and vegetable sellers in the area have now, Gunung Pati Semarang.

D. Sample Treatment

There are three treatment samples that without treatment, refrigerated and with the tools ini.Sampel dried in an oven at 60 ° C for 24 hours and cooled in a desiccator, and then the sample was weighed as much as 2 g were put in a sealed container, then added 5 ml HNO_3 closed and left for 24 hours. Furthermore, the solution obtained was heated over a water bath at a temperature of 60-70 C for 2-3 hours (until a clear solution). Cooled to room temperature and add 1 mL HNO_3 and stirred slowly, then added 9 mL of distilled water. Samples prepared measured by AAS using air-acetylene flame.

III. Results and Discussion

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

1. At 300x magnification SEM layered look that materiality is nice and evenly.
2. At 400x magnification SEM shows that the crystalline TiO_2 nanoparticles round, coated strongly, and very tightly.
3. At 500x magnification SEM shows that the material coated with almost the same size average of 40 nm in N-doped TiO_2 nanoparticles.

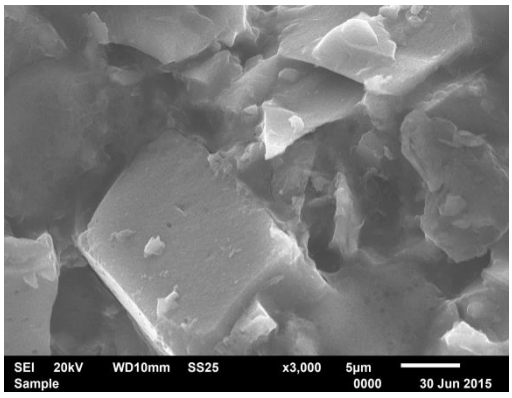

Figure 1. Morphology N – TiO_2 enlarge 300 X

The purpose of using EDX analysis is to determine the content of elements or compounds contained in the sample.

In this EDX analysis test in getting results, the content contained in these materials among others; Carbon (C), nitrogen (N), Oxygen, and Ti. EDS data can be seen that contain C by 13.75%, amounting to 54.76% N and TiO_2

for 31.48%. Analysis of Pb and Cd levels in fish and shellfish is done by using the absorption method sample, then diintrapolasikan into standard calibration curve of each element so that would be obtained regression concentration of each element.

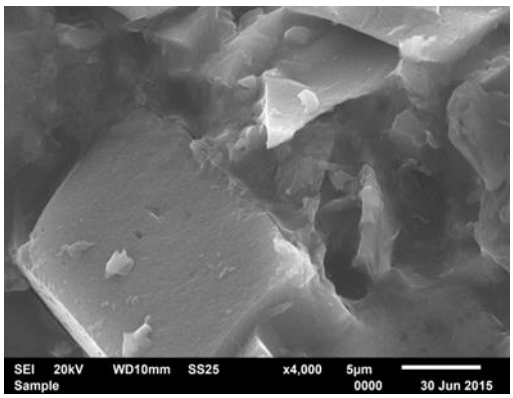

Figure 2. Morphology N – TiO_2 enlarge 400 X

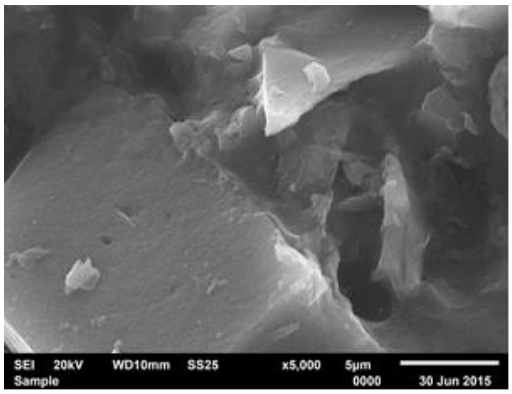

Figure 3. Morphology N – TiO_2 enlarge 500 X

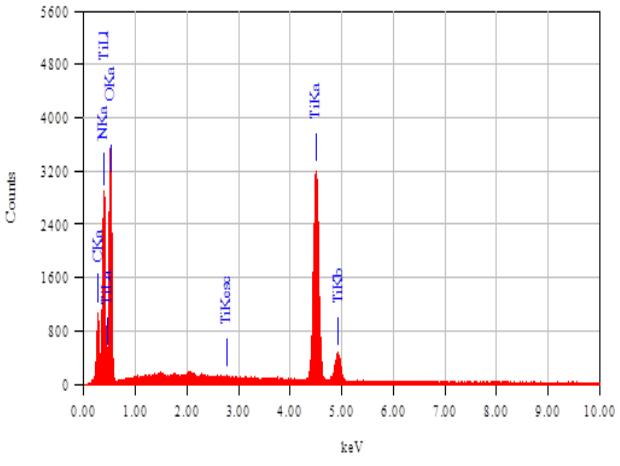

Figure 4. EDX analysis test

TABLE I. AVERAGE RESULTS OF THE ANALYSIS OF THE CONTENT OF PB IN FISH

Sample Variation	Pb metal content (µg/kg)
Without treatment	0.22895
Cooled	0.22580
Tools preservatives	0.11960

TABLE II. AVERAGE RESULTS OF THE ANALYSIS OF THE CONTENT OF PB IN VEGETABLES (CHICORY)

Sample Variation	Pb metal content (µg/kg)
Without treatment	0.0522
Cooled	0.0485
Tools preservatives	0.0196

TABLE III. AVERAGE RESULTS OF THE ANALYSIS OF THE CONTENT OF PB IN TOMATOES

Sample Variation	Pb metal content (µg/kg)
Without treatment	0.0492
Cooled	0.0394
Tools preservatives	0.0165

From the analysis by atomic absorption spectrophotometry seen that there is a decrease harmful heavy metal content in fish, vegetables, white cabbage and tomatoes with no treatment, refrigerated and by using this preservative. The best results were shown a sample by means of preservatives and reducing harmful heavy metals in fish of 0.1196 mg / kg, vegetables amounted to 0.0196 mg / kg and tomatoes at 0.0165µg / kg. Tables 1, 2 and 3 indicate that the levels of Pb in fish, vegetables, white cabbage and tomatoes have not exceeded the maximum allowable concentration is below 2.0 mg / L according Decision POM Director General of the Republic of Indonesia (Dartius, 1996).

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