CURRENT ISSUES OF FOOD IN INDONESIA

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NANOTECHNOLOGY IN FOOD SAFETY AND SECURITY

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Nanotechnology is defined as the design, production and application of structures, devices and systems through control of the size and shape at the nanometer scale (10^{-9} meters), in which a unique phenomenon enables the presence of new applications. Nowadays nanotechnology is developed in various aspects including food application. Nanotechnology is used from the food production process, post-harvest processing, to the final product packaging process. Nanotechnology plays a role in improving the quality and efficiency of products. The nanotechnology in the food production is used in the process of fertilizer encapsulation that breaks when plants give signals for finding nutrients, hence the use of fertilizer becomes more efficient. In addition, nanoclay capsules containing a combination of active ingredients fertilizers and pesticides have been developed in a collaboration program between Pakistan and US Science and Technology. The capsules deliver active ingredients with a slow release so that fertilizer and pesticide can be applied once during the planting period (Hoerudin and Irawan, 2015).

The definition of food security also means that the available food meets nutritional needs. Some nutrients and bioactive compounds have a low water solubility and are easily damaged

due to oxygen exposure, light, heat or pH so that it becomes obstacles in the processing, storage, transportation and digestion. To overcome these problems, nanostructured for delivery systems, such as nanoemulsions and liposomes, can be used to improve solubility, stability and absorption of nutrients and bioactive compound (Sudibyo and Djumarman, 2008). The development of vitamin A nanoemulsions and nanoencapsulates for food fortification materials are other potential applications of nanotechnology.

The role of nanotechnology in the food processing industry and nutritional supplements is divided into four groups, i.e (1) improving the safety of the manufacture, processing, and delivery of food products by becoming sensors for the detection of pathogens and contaminants; (2) Devices for maintaining the historical record of products and tracking their shipments; (3) Providing an integrated system between sensing, localizing, reporting, and remote control of food products (smart systems) and which can improve the efficacy and safety of food processing and transportation; (4) Delivering, protecting and carriering functional foodstuffs to their specific place of action using an encapsulation system (Weiss *et al.*, 2006)

The application of nanotechnology for food processing has been applied to improve the taste, color, flavor, texture and consistency of food. The design of food ingredients aims to improve the functional ability of these ingredients in the food system so that it reduces its use. Nano-sized fats produce improved flavor and a stabilized emulsion in lesser amount of normal fat. Among the products applied this technology are ice cream products, mayonnaise or spread (spread food) with low fat content, but have a creamy texture like products with a high fat content so as to provide a healthy alternative food for consumers.

A very small size of nanoparticles increases the absorption and bioavailability of nutrients, vitamins and minerals so that it can be used in the form of developing nutraceuticals and food supplements. An example of a food supplement applying nanotechnology is the use of calcium nanoparticles in dairy

products intended for consumers potentially suffering from osteoporosis.

Packaging of food products using nanotechnology has been widely applied to improve the mechanical and functional properties of the package such as increasing its strength, improving the inhibitory properties of gasses diffusion or water vapor, stabilizing the temperature and developing the antimicrobial ability of the packaging. Mixing nano-clay particles into ethylene-vinyl alcohol copolymer and poly-lactic acid biopolymer produces a matrix that increases the inhibition of oxygen. Material modification for food packaging and silicate polymer nano composite materials is reported to improve gas retarding ability, mechanical attractiveness and heat stability. There are also nano composite polymers which are combined with metal or metal oxide particles that are developed as active packaging with antimicrobial ability, resistant to abrasion, and able to absorb ultraviolet (UV) rays.

The application of nanotechnology in the post-harvest agricultural process is primarily intended to maintain the physical quality (including freshness) and chemical quality of the product. At present, there has been a lot of research on nanocoating that has been applied to the surface of fresh whole fruit to maintain its quality and extend its shelf life. Preparation of bio-nanocomposite pectin and nano zinc oxide which was applied to mangoes and star fruit showed that the treated fruit had a longer freshness and extended its shelf life. Based on its antimicrobial ability, silver and zinc oxide nanoparticles have been developed as packaging materials that can contact with food and are claimed to extend the shelf life of food by inhibiting the growth of microorganisms.

Beside as an active package, nanotechnology can also be applied as a smart packaging that provides information on the condition of food in the packaging. The development of equipment consisting of ultra-small silicon with cantilever-nano protein layers can detect the presence of contaminants such as viruses, bacteria and other pathogenic microbes (Sudibyo and Djumarman, 2008). Biosensor technology can be used to detect the presence of gases

or volatile compounds in the packaging of food products, which are indicators of the occurrence of food damage by pathogenic bacteria that can be done using nanotechnology (Chaudhry *et al.*, 2008). The biosensor technology is incorporated in food packaging so that it gives a signal to consumers, producers and distributors in order to provide a function as an assurance of food safety.

As a conclusion, the application of nanotechnology in maintaining food security and security today needs to be considered more seriously. Therefore, it needs support from all stakeholder to develop nanotechnology including the government in providing facilities and regulations, especially in food sector.

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