Macrothink Institute™

Journal of Food Studies
ISSN 2166-1073
2016, Vol. 5, No. 1

Application of Edible Coating from Chitosan Skin Shrimp (*Paneus Monodon)* to Apple (*Malus Sylvestris*) Minimum Processed

Andi Abriana

Department of Agriculture Technology, Agricultural Faculty

Bosowa University of Makassar

E-mail: andi_abriana@yahoo.com

Suriana Laga

Department of Agriculture Technology, Agricultural Faculty

Bosowa University of Makassar

Received: Feb. 24, 2016 Accepted: May 6, 2016 Published: December 1, 2016

doi:10.5296/jfs.v5i1.9087 URL: http://dx.doi.org/10.5296/jfs.v5i1.9087

Abstract

The minimum processed fruit is a series of the fresh fruit treatment with a view to removing the parts could not be consumed and reduced the size of the product to speed up their performance in the market. The aim of study to determine effect of chitosan edible coating from shrimp waste against shrinkage and chemical changes during storage of apple with minimum processed. Chitosan as the edible coating isolated from of waste skin shrimp. Chitosan used as a coating material in minimum processed apples during storage. The treatment used of edible coating and no coating as the control with storage time 3 days. Edible coating from shrimp (*Paneus monodon*) skin can be used as a coating material processed apple during storage. Using of edible coating waste shrimp contain chitosan as a coating can reduce the occurrence of several shrinkage and retain moisture and vitamin C during storage. Edible coatings for minimum processed apple coating can provide the result of the use of edible coating treatment is the best for weight reduction in shrinkage, moisture content and vitamin C during storage. The use chitosan as the edible coatings on apples in minimum processed is the one solution

avoid weight reduction, water content and vitamin C during storage.

Keywords: Skin shrimp waste, Edible coating, Chitosan, Minimum processed.

1. Introduction

The horticultural products have unique properties because it is easy to damage after harvest. Commonly horticultural product has a smooth surface and must be handled carefully and faster. One method to prevent degradation of various nutrien from containing inside is to manage the age range of horticultural product. The higher rate of respiration can stimulate product, but not suitable for people consumption.

The inhibition of respiration on horticultural product rate can be done by the application of coatings. Coating material must select several criteria as edible coating, including: able to hold oxygen and water vapor, colorless, tasteless, not cause changes in the nature of food and safe for consumption. The application of coating can protect the horticultural product from damaging and maintaining their performance.

The edible coating comes from many natural substances that can be used. For example, the chitosan is one of edible coating. Chitosan can be found on shrimp waste. The advantages of using shrimp waste as a source of chitin are easy to be found and the price of it is cheap. The final result of chitin was performed by the chitosan. These compounds can be used as the base for the manufacture of edible coating which is easily obtained and available in large quantities (Margonof, 2010).

Edible coating is thin and is the continuous layer made of a material can be eaten and to be a barrier to water vapor and gas exchange of O_2 and CO_2. Edible coating also prevents mechanical damage from handling, helps maintain the structural integrity, prevent loss of volatile compounds (Nisperos et al., 1990). Edible coating has been widely used for food products such as fruits, vegetables, meat products, poultry and seafood.

Chitosan is the result from chitin commonly, which can be used as a heavy metal absorbent materials generated by industrial waste. Chitin is the second largest polysaccharide in nature after cellulose. The wild ecosystem will produce about 108 tons of chitin each year. Chitin has a molecular formula $C_{18}H_{26}N_2O_{10}$ as an amorphous solid, crystalline, in-soluble in water, an organic acid dilute, dilute and concentrated alkali, alcohol, and other organic solvents but soluble inconcentrated mineral acids.

Chitosan is the deacetylation chitin in the concentrated solution of sodium hydroxide. Their viscosity varies and a function of time of deacetylation. Deacetylation of time needs approximately 30 minutes, which was enough to obtain soluble chitosan in acetic acid solution. But the process of the deacetylation of viscosity showed a striking change. The problems that occured in the production of chitosan are having a high molecular weight (Suhardi, 1993). Chitosan, as a dietary fiber found in shrimp and crab shells, mainly composed of chitin more useful to the human body. Chitosan causes lower cholesterol, prevents arterosclerosis, strengthens liver function, prevents heart disease, strengthens the disposal and remove of heavy metals in the body (Anonymous, 2010). The specification of chitin or chitosan (Table 1). Chitosan has large potential to use in metal industry and health care. The quality of chitosan depend on its function such as chitosan was used for a purification processes. Waste product not requiring a high quality, but need a pure material if

used in health care (Bastaman, 1989).The chitosan quality standard as shown as Table 2.

Table 1. Specification of Chitin/Chitosan

Specification	Description
Water	2-10% under normal condition in the laboratory.
Nitrogen	6-7% in chitin, 0-8,4% in chitosan.
Deacetylation degree	10% for chitin, 60% for chitosan and 90-100% for full deacetylation of chitosan.
Ash	Average< 1,0%.
Molecule Weight	1.10^6 for natural chitin 1-5, $10^5$for commercial chitin and chitosan.
Soluble in LICI-DMAC	>5% for chitin

Source: Austin (1988)

Table 2. Chitosan Quality Standard

Characteristic of Chitosan	The Desired Value
Particle measurement	Powder until piece
Water of content (% dryweight)	< 10,0%
Ash of content (% dryweight)	< 2,0%
Colour of solution	Clear
Deacetylation of degree (%)	>70,0%
Viscocity	
• Low	< 200
• Medium	200 – 799
• High	800 – 2000
• Exstra High	>2000

Source: Bastaman (1989)

Chitosan is the deacetylation chitin in the concentrated solution of sodium hydroxide. Their viscosity varies and a function of time of deacetylation. Deacetylation of time need not be long approximately 30 minutes was enough to obtain soluble chitosan in acetic acid solution. But during the deacetylation of viscosity showed a striking change and the problems that occur in the production of chitosan having a high molecular weight (Suhardi, 1993). Chitosan as a dietary fiber found in shrimp and crab shells, mainly composed of chitin more useful to the human body. Chitosan causes lower cholesterol, prevent arterosclerosis, strengthen liver function, prevent heart disease, strengthen the disposal and remove of heavy metals in the body (Anonymous, 2010).

Apple (*Malus sylvestris* Mill) is the most famous fruit in the worldwide and one of climateric fruit in the world. Fruit has a living structure and always metabolized in storage. This substance is very necessary for the body to prevent various diseases (Wills, 1981).The

browning reaction of apple need more handling and a method to extend the freshness apples with minimum processed. The one method to extend the freshness of minimum processed products by using of edible coatings. The fruit with minimum processed have an active metabolism that can lead to rapid deterioration if not controlled (Guilbert, 1996). Minimum processed is the processing methods does not destroy the integrity of the cell wall with the result the plant tissue is still alive. Minimum processed fresh fruit provide a guarantee of quality compared with the intact condition of the skin is closed because consumers can see directly the condition of the fruit flesh.

The aim of this study is to determine the effect of application of edible coating from shrimp waste that product chitosan against severe shrinkage and chemical changes in minimum processed during storage. This research is expected to provide information for managing apple after harvest and suitable to consumption in the good quality.

2. Materials and Methods

2.1. Materials and Devices

The raw materials used waste skin shrimp of black tiger (*Paneus monodon*). The chemicals used are glycerol, $CaCl_2$, iodine, NaOH, 1.25 N HCl, alcohol, PP indicator, starch, acetic acid and distilled water.

The instrument used consists of analytic scales, Martin Wess oven (temperature 70^{o}C - 300^{o}C), blenders, oil bath, thermometer, hot plate, magnetic stirer, strainer, universal testing machine Zwick Z 0.5 Lyod instrument, waterbath and glassware.

2.2. Methods

This research divided into 4 steps are: (1) making shrimp skin powder; (2) making chitosan; (3) making edible coating; (4) application of edible coating. First step using methods preparation of shrimp skin powder developed by Laga *et al* (2009) are skin shrimp, washing, dryer with sunlight (water content 8%), grinding (40 mesh), sieving and then powder skin shrimp results. The second step is making chitosan from shrimp skin powder by using a method developed by Knoor (1984) that are skin shrimp powder, de-proteination (80^{o}C – 85^{o}C) with NaOH, washing, grinding, de-mineralization (70^{o}C – 75^{o}C) with HCl 1.25 N, washing, dryer (50^{o}C) during 12 hours, chitin powder with concentrated NaOH, deacetylase (100^{o}C) during 1 hours, washing, dryer (50^{o}C) during 24 hours and then chitosan results. Third step is making edible coating from chitosan using methods that developed by Laga *et al*.(2009) are chitosan (1.5%) and acetat acid (2%), stirring, heating to 60^{o}C, added the gliserol (1.5%) and $CaCl_2$ (2%), heating (80^{o}C) during 30 minutes, refrigeration and then edible coating results. The fourth step is application edible coating to apple by using methods developed by McHugh and Senesi (2000) are apple fruit, washing (skin), feeling, apple fruit flesh, cutting (3x1.5x1.5 cm), soaking with Na-metabisulphyte (during 30 minutes), leaking, and then there are two lines (1) dipping twice (coating) during 5 minutes, leaking and (2) no layer (control); at the last step is storage (0 day, 1 day, 2 days and 3 days) and the end step there are characterization weigth of shrinkage, vitamin C and water content.

The weight measurement of shrinkage apple fruit on 3 days storage using the following equation that developed by Purnomo (2009):

$$Weight\ of\ shrinkage = \frac{(fruit\ weight\ on\ 0\ day) - (fruit\ weight\ on\ -n\ day)}{Fruit\ weight\ on\ 0\ day} x\ 100\%$$

Determination of water content based on the weight before and after drying. Ingredients are weighed as much as 2 grams on a weighting bottle of known weight. Weighed 2 grams of chitosan then dried in an oven on temperature approximately 105^{o}C for 3 hour sand cooled in exicator, weighted, and repeat until it gained weight (AOAC, 1996) using the following equation:

$$water\ content = \frac{a - b}{c} x\ 100\%$$

where

a = is weighting bottle and ingredient before drying,

b = is weighting bottle and ingredient after drying and

c = is ingredients weight.

The content of vitamin C was determined by titration. A total of 10 grams of material introduced into 100 ml volumetric flask and diluted. Filtrate of 10 ml and poured into the erlenmeyer, the filtrat epoured with 5 drops of indicator and then titrated with 0.01 Niodine solution until the blue colorarises (Sudarmadji, 1984). The calculated of ascorbic acid is using the following equation:

$$\%\ A = \frac{\text{ml iod 0.01 N x 0.88 x p x 100}}{Sample\ (gram)} x\ 100\ \%$$

Where A is mg ascorbic acid per 100 gram ingredients and p is dilute factor

3. Results and Discussion

3.1. Weight of Shrinkage

Minimum processed apple with edible coating usage experienced severel ower shrinkage when compared with no edible coating (Figure 1). The average value of weight shrinkage of apple in the treatment of minimum processed without edible coating, respectively on a day-to-0 was 0%, day to-1 was 7.43%, day to-2 was 16.25% and day to-3 was 20,46%. Shrinkage reduction in weight in a day was 7.02%. Use of edible coating treatment on day-0 was 0%, day to-1 was 5.61%, day-to-2 was10.42% and day-to-3 was 16.28%. Shrinkage

reduction in weight in a day is only 5.40%. The data was showed the used of treatment edible coating by chitosan can minimize the occurrence of severe shrinkage of minimum processed apples during storage. The coating on the surface of a hydrophilic material that avoid water vapor transmission in order to survive and not come out of treated apples. The longer of the storage time of growing edible coating decreased the severity of shrinkage, but shrinkage decreased weight lower than no edible coating. Edible coatings can served to reduce the amount of water lost from the treated apples. Edible coating are suitable for use as packaging and regulate the transfer of moisture and oxygen. (Nisperos et al., 1990)

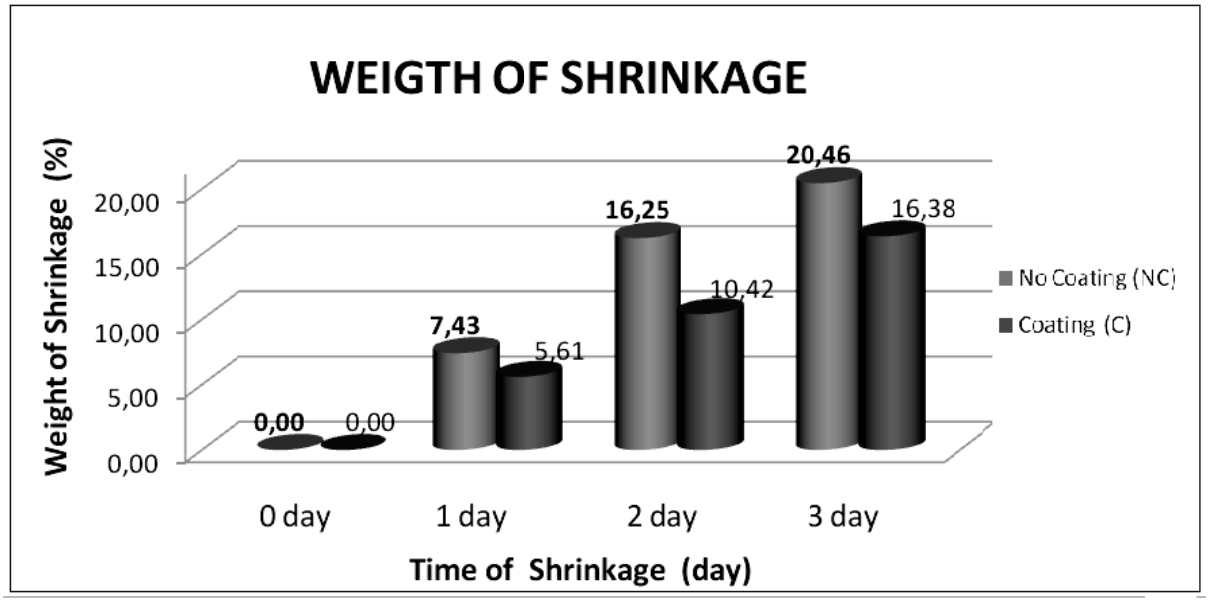

Figure 1. Interaction Between Weight of Shrinkage (%) and Time of Storage (day) on Apple Fruit Minimum Processed With Edible Coating and No Coating

3.2. Water Content

Water content in the treated apples ranged from a minimum of 79.69% - 90.91%. The average value of apples weight shrinkage in the treatment of minimum processed without the use of edible coating on a day to-0 is 89.62%, day to-1 is 85.25%, day to-2 was 80.01% and day to-3 is 81.05%. Use of edible coating treatment on day 0 was 90.55%, dayto-1 is 87.83%, dayto-2 was 81% and dayto-3 was 81.31% (Figure 2). Existence of the treatment use of chitosan as the edible coating can reduce the decline in water content of apples during storage of minimum processed. The coating layer on the surface as the hydrophilic material and avoid the water vapor transmission from treated apple.

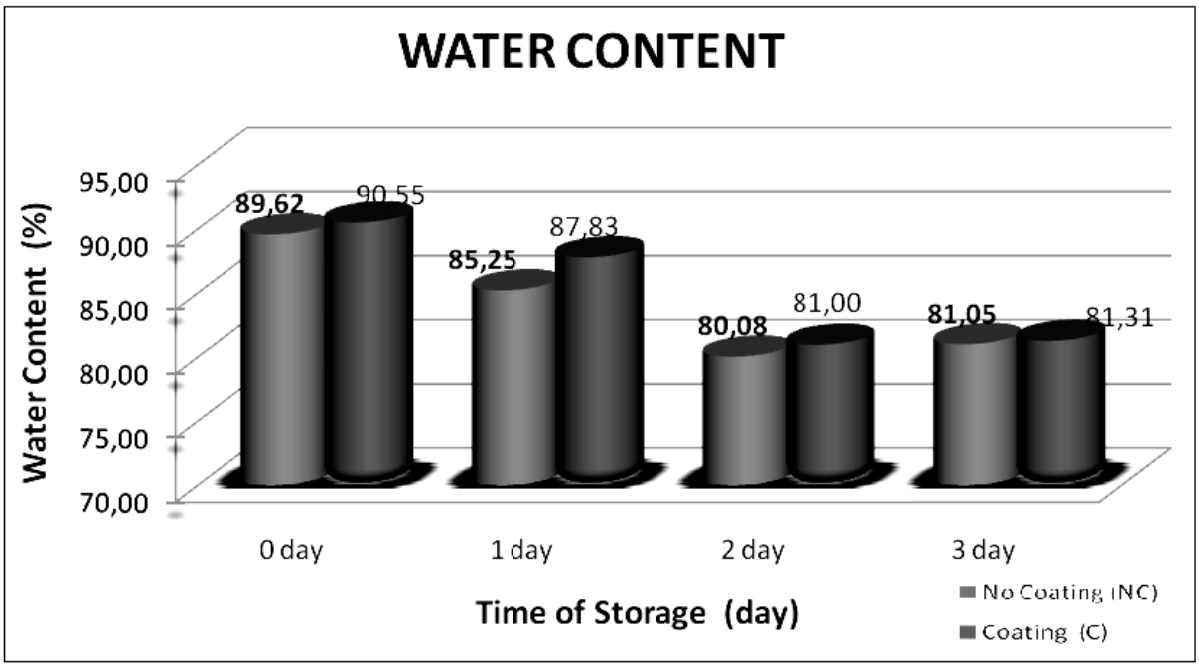

Figure 2. Interaction between water content (%) and time of storage (day) on apple fruit minimum processed with edible coating and no coating

3.3. Vitamin C

Raw fruits contain more vitamin C and will decrease with the age of fruit. Vitamin C in apple with minimum processed ranged from 1.00% to 2.91%. The highest value of vitamin C obtained at storage time day-to-3 which is 1.93% and the lowest in the old days of storage-1 is 1.17% (Figure 3). The average value of vitamin C in apples with edible coating and no coating has a large variation. In the storage time did not give a different effect of vitamin C. This means that vitamin C in apple streated in the storage time 0 day, 1 day, 2 days and 3 days are the same result.

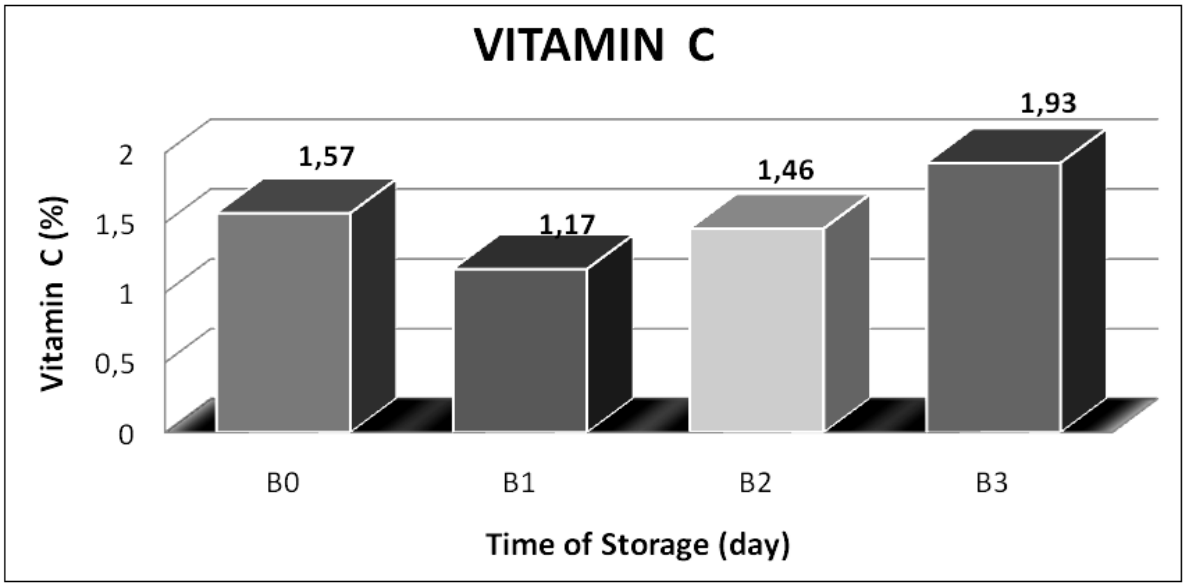

Figure 3. Interaction Between Vitamin C (%) and Time of Storage (day) an Apple Fruit Minimum Processed

The average value of vitamin C without the use of edible coating treatment and the use of edible coating treatment is different. The average value of vitamin C without edible coating treatment is 1.28% and by edible coating treatment by 1.80% (Figure 4). Existence of the treatment use of edible chitosan coating can reduce the decline in vitamin C content of minimum processed apples during storage. This is because the coating on the surface of the hydrophilic material that can serve as a barrier that can prevent the loss of vitamin C.

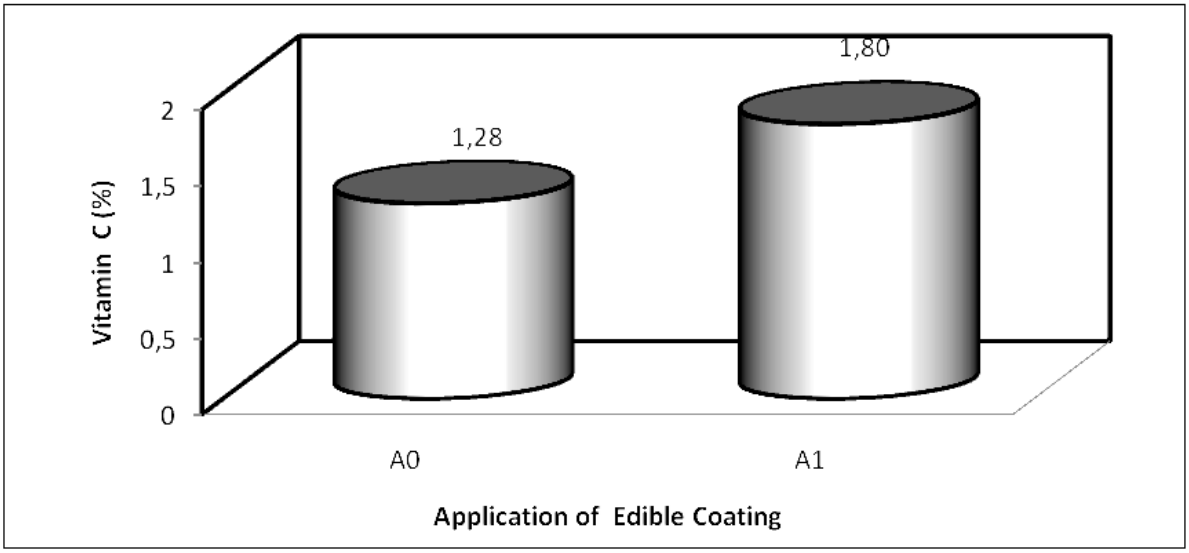

Figure 4. Interaction Between Application of Edible Coating and Content of Vitamin C (%) on Apple Fruit Minimum Processed

4. Conclusion

Edible coating from shrimp (*Paneus monodon*) skin can be used as a coating material processed apple during storage. Using of edible coating waste shrimp contain chitosan as a coating can reduce the occurrence of several shrinkage and retain moisture and vitamin C during storage. Edible coatings for minimum processed apple coating can provide the result of the use of edible coating treatment is the best for weight reduction in shrinkage, moisture content and vitamin C during storage. The use chitosan as the edible coatings on apples in minimum processed is the one solution avoid weight reduction, water content and vitamin C during storage. Application of edible coating further research should be done with the organo leptic test and synthetic polymer composites with a polymer plastic.

References

Anonymous. (2010). Shrimp Waste Absorbent Material For Heavy Metal. http://www.smallcrab.com(accessed on 11 November 2010).

AOAC. (1996). Official Methods of Analysis of the Association of Official Analytical CHEMIST of. Washington.

Austin, P.A. (1984). Chitin Solvents and Solubility Parameter. Dept. Of Commerce. The University of Delaware in Arlius, 1991. Study The Extraction of Skin Shrimp Chitosan and Utilization As Coagulation Protein Waste Material Processing Pindang Tuna Fish (Euthynnusaffinis). Faculty of Graduate Studies, IPB Bogor.

Bastaman, S. (1989). Studies on Degradation and Extraction of Chitin and Chitosan Shells From Fraum. The Department of Mechanical, Manufacturing. Aeronautical and Chemical Engineering. The Queen's University Belfast.

Guilbert, S., & Biguet. (1996). Edible Films and Coatings in G and Malton Bereau *JL Food Packaging Technology, 1*. VCH Publishers, Inc.. NewYork. Thing. 315-353.

Knorr, D. (1984). Use of Polymers in Food Kitinous. *Food Technology, 38*(1), 85-97.

Laga, S., Andi Abriana., Aryanti, S., Djagal, W. M., & Pranoto, Y. (2009). Development of Edible Film / Coating of Chitosan Skin Shrimp South Sulawesi waters to preserve the Tropical Fruits. Report of First Year Grant Character.

Margonof. (2010). Basic Biology of Shrimp Waste. http://shantybio.transdigit.com. (accessedon 23 September 2010).

McHugh, T. H., & Senesi, E. (2000). Apple Wrops. Anovel Method to Improve the Quality and Extend the Shelf Life of Fresh, Cat Apples. J. *Food Sci., 56*(3) 480-485. http://dx.doi.org/10.1111/j.1365-2621.2000.tb16032.x

Nisperos-carriedo. (1990). *Edible Coatings and Films to Improve Food Quality.* Technomic PUBL. Co. Inc., Lancaster, Pennsylvania.

Purnomo, D. (2008). Application of Genetic Papaya latex Two Females In Biofungicide for Disease Control Big Red Anthracnose on Chilli. Plant Protection Department Faculty of Agriculture. IPB, Bogor.

Sudarmadji. (1984). *Analysis of Food and Agriculture.* Publisher of Liberty, New York.

Suhardi. (1993). Chitin and Chitosan. Gadjah Mada University, Yogyakarta.

Wills, R.B.H. Postharvest an Introduction to The Physiology and Handling of Fruit and Vegetables. AVI Publishing, New York.