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PHYSICOCHEMICAL PROPERTIES OF SOME DRIED FISH PRODUCTS IN INDONESIA

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ABSTRACT

Some traditional fish products in Indonesia have potential opportunity for global market, such as fish crackers, dried fish, ikan kayu ('katsuobushi') and dried pempek (traditional fish product from Palembang). Study on such products based on its glass transition temperature is still rare. On the other hand, glass transition phases of dried product play an important role in determining food stability because it can give an overview of physicochemical properties of the products. Using its glass transition temperature, dried fish product can be estimated for its shelf life. The purposes of this research are to observe the relation between some physicochemical properties of glass transition temperature of some dried fish products and its water content/water activity to the self life of the products. Dried fish products used were: fish cracker, dried-salted fish, ikan kayu (katsuobushi), fufu (very dried-smoked fish) and dried pempek. The samples were taken from different area in Indonesia (Cilacap, Palembang, and Sulawesi). The sample were taken using purposive sampling method. The method used for analysis of glass transition temperature was DSC method (Differential Scanning Calorimetry), and for water content and water activity were analysed using Aw meter and Moisture analyzer. All samples were analyzed in duplo. Research method used was experimental laboratory with research design of Completely Randomised Design. The experiment was conducted from August 2008 to December 2008 at Fish Product Processing Laboratory, Fisheries Department, Faculty of Fisheries and Marine Science – Diponegoro University, Food Engineering Laboratory – SQU, Oman. The results showed that different sample with different characteristics on physicochemical properties give different in water activity and also water content. The lowest water activity was performed by dried pempek. Glass transition temperature (Tg) of the products was very depend on the water content. The Tg of samples was ranged between 38.4^{o}C – 76.4^{o}C. The water content of the products ranged between 8.28%-37.28%. The Aw of the product was ranged between 0.57 – 0.87.

Key words: dried fish products, glass transition, water activity, water content, shelf life, quality

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INTRODUCTION

Some traditional fish products in Indonesia have potential opportunity for global market, such as fish crackers, dried fish, ikan kayu ('katsuobushi') and dried pempek (traditional fish product from Palembang). Traditionally fish products in Indonesia are varied and many of them have their specific name and taste even though for the similar product.

Dried fish products are very popular in Indonesia and some of the product even have been marketed abroad specially in Southeast Asean countries such as Thailand, Singapore and Malaysia. But western countries such as Netherland and America also require some of dried fish products (fish/shrimp crackers). We need to promote other dried fish product produced from Indonesia as we have many variety of the product and some of them have potential market to become exported commodity such as dried pempek, and ikan kayu (like "katsuobushi" product produced from Maluku). For dried fish product such as dried pempek and fish crackers, depending upon the concentration of fish or shrimp meat and flour, the quality of the products will be determined. Good quality of fish crackers is composed from equal fish meat and flour (Clucas and Ward, 1996).

Dried fish products are usually processed from underutilized fish species or bad quality of fish (especially for dried-salted fish product). Only few processors have been concerned on quality of raw material used for processing of salted–dried fish. But recently, most people have awareness on the quality and safety of the product resulted. Consequently they are improving the ability to produce some food product to fulfill consumer's need. Salted-dried anchovy for example, has been exported and consequently the quality and processing of such product has followed standard requirement determined by buyer. Many traditional dried fish products in Indonesia can be considered to be a potential commodity for export, such as fish crackers, ikan kayu, dried pempek. However, some problems encountered with them should be overcome especially related to their quality, processing technique, packaging and marketing.

Quality evaluation of such products can be done by some methods includes chemical, physical and microbiological methods. It is very important to do quality assessment of such products, especially in facing the global era, in order to compete with similar products resulted from other region or countries, because quality and safety of the products will be the most concerned by the consumer. Therefore, it is necessary to conduct some experiment related to dried fish product in order to perform its quality assurance and safety.

Glass transition temperature (Tg) is an important physical parameter in food science because it has explained the physical and chemical behavior of food system (Bell and Touma, 1996). Study on such products based on its glass transition temperature is still rare. On the other hand, glass transition phases of dried product plays an important role in determining its stability because it can give an overview of physicochemical properties of the products. The glass transition is promoted by the addition of heat and/or the uptake of plastiziser and occurs in amorphous material over a range of temperature. Using its glass transition temperature, dried fish product can be estimated for its shelf life. Therefore, in this experiment, analysis of Tg was conducted together with other parameter of Aw and water content to evaluate the quality of some dried fish products that has potential prospect in the future for export commodities.

MATERIALS AND METHODS

Collection of samples

Some dried fish products taken from different places were used. (see Table 1). The samples were taken based on consideration that the products have been commercially consumed, sold and have economical value and prospect for global market.

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Table 1. Samples of dried fish products used in the experiment

No	Sample	Code	Place of origin
1	Mugil dried fish	A	Ternate
2	Fufu (very dried-smoked fish)	B	Ternate
3	Ikan kayu (Katsuobushi)	C	Ternate
4	Ikan Kayu (katsuobushi)	D	Aceh
5	Fish cracker (Kemplang polos)	E	Palembang
6	Dried squid	F	Jepara
7	Fish cracker	G	Bangka
8	Dried Pempek	H	Palembang
9	Fish cracker (Kemplang getas)	I	Bangka
10	Dried Tekwan	J	Palembang
11	Fish crackers (Kemplang)	K	Lampung
12	Shrimp cracker (Kerupuk udang)	L	Cilacap
13	Dried fish (Ikan kurisi asin)	M	Tegal
14	Catfish Dried fish (Ikan Jambal)	N	Cilacap
15	Ray dried fish (Ikan pari asin)	O	Cilacap
16	Mugil dried fish	P	Tegal
17	Dried fish (Ikan Bilis Asin)	Q	Cilacap
18	Dried anchovy (Ikan Teri Tawar)	R	Rembang
19	Dried fish (Ikan Layur Tawar)	S	Rembang
20	Dried fish (Ikan asin kurisi)	T	Sulawesi
21	Dried fish (Ikan asin layur)	U	Sulawesi
22	Fish cracker	V	Jepara
23	Shrimp cracker	W	Jepara

Analyses of Water content *(Moisture Analyzer,* Ohaus MB 45*)*

Procedure for water content analysis was conducted by Moisture Analyzer Ohaus MB 45 as follow :

The samples were grounded by a mortar or blended to produce a powder.

The equipment was set according to specified samples, and then enter into the program.

The equipment (top cover) was opened and the sample was loaded into the chamber (weight approximately 3 grams).

The top cover was closed and was started the measurement.

The measurement was waited for approximately 15 – 20 minutes (depends upon the sample characteristic) and the water content of the sample and the result was be displayed on the monitor.

Analysis of Water activity (Aw)

Water activity was analyzed using Aw meter Rotronik as follows:

Precondition of the equipment was done before starting analysis as well as for sample container in cool temperature (23-25^{0}C), for approximately 2 hours until stable.

The samples were prepared and put into container (don't exceed of the border line) and then the equipment was closed.

The measurement was carried out for 30-60 minutes before the results could be displayed. All analyses were conducted in cool room.

After precondition, the sample container was put and loaded into sample holder in Aw

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meter. The top cover was opened and the sensor was put on it. Glove was used when holding all the sample container.
The Aw of the sample was measured using Aw Quick Mode.
'ON/OFF' button on the equipment was pressed. Then continue 'menu' button was pressed, 'MODE' appeared on display monitor, and 'enter'button was pressed.
Button ↑ or ↓ was pressed to choose program 'Aw Quick', then 'enter' button was pressed.
'Q DWELL' (MIN) was shown.
Button ↑ or ↓ was pressed to determine value (for 'Quick mode' maximal value is 5), and 'enter'button was pressed.
Display shows 'Q TS' (^{0} C/min).
Button ↑ or ↓ was pressed to determine value (0.01-0.1), then 'enter'button was pressed.
Measurement end when display monitor shows triangle mark showing the Aw value and temperature.

Analysis of Glass Transition temperature (Tg)

Glass transition temperature of some dried fish products were analyzed using Differential Scanning Calorimetry (DSC) method. The procedure of analyses was as follow :

The glass transition temperatures of fish dried products (fish crackers) were determined using DSC analysis.
Sample (5-10 mg) was weighed into aluminum DSC pan, hermetically sealed and then loaded onto the Shimadzu DSC-50 instrument at room temperature.
Sample was then cooled at 3^{o}C /min to −40^{o}C and heated up at the same rate to 80^{o}C. The obtained DSC curves were then analyzed using software of Shimadzu TA60.
In these thermal analyses, powder form of samples was used.

RESULTS AND DISCUSSION

Water activity (Aw)

In this experiment, the value of water content and water activity (Aw) of the samples were analysed to determine the shelf life of the product. Based on the results, the water activity of the samples was ranged between 0,57 to 0,87. This values represent that the samples showed variety in their shelflife.

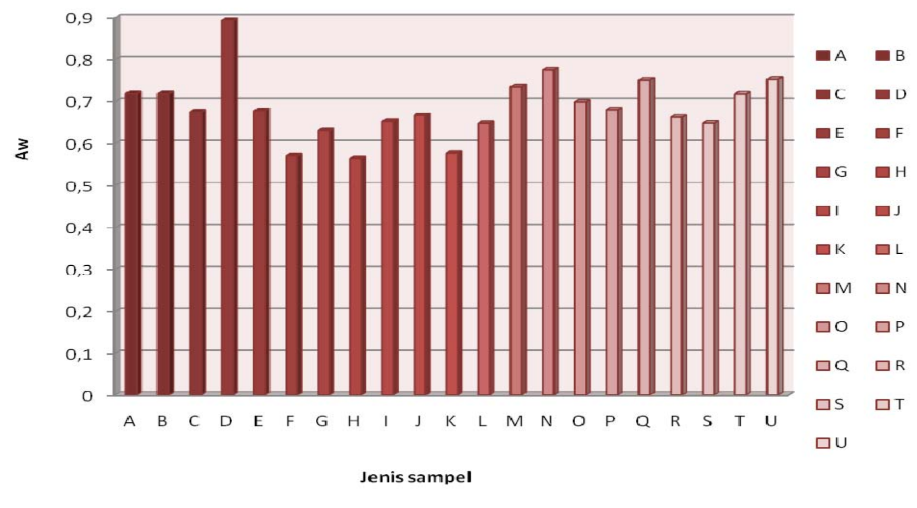

Fig 1. Aw value of some dried fish products used in the experiment

Water activity gives potential effect to the chemical reaction rate occurring in the food product as well as to the microbiological growth rate. (Labuza, 1970). Stability of food product is significantly affected by water activity (Aw). Modeling studies of sorption properties are important in predicting shelf life of low and intermediate-moisture food (Labuza, 1970; and 1980; Roos, *et.al*., 1996). Aw has main effect to the food shelf life because it can involve in deterioration which can subsequently affect the quality of food in general. Water content and water activity (Aw) determine the development of deterioration rate (chemical and microbiological reaction) taking place in the food system. Most of enzymes will be prevented when the food system has Aw below 0,85. Most of bacteria cannot grow at Aw below 0.91 and for yeast cannot grow at Aw below 0.80 (Buckle, *et al*., 1987). Such enzymes that can be prevented include amylase, phenoloxidase and peroxydase. However, for lipase cannot be prevented because it can stand in low Aw of 0,3 or even at Aw 0,1. Poernomo (1995) stated that Aw affect in determining shelf life of food, because Aw give influence on physical properties (hardness), chemical properties, microbiological and enzymatic deterioration especially for processed food.

Non enzymatic browning reaction (Maillard reaction) is one of important factor that can cause deterioration of food. Other reaction that can affect water activity of food is hydrolysis of protopectine, degradation and demethylation of pectin, hydrolysis of fat by autocatalytic, and conversion of chlorophyll to pheophitin. (Lonsin, *et al*., 1968).

Based on the results it was showed that the range of Aw of the samples lies between Zone II in Labuza graph (Labuza, 1977 *in* Winarno, 2002). These results has consequences on the products susceptible in food deterioration due to some chemical reaction such as lipid oxidation, lipid hydrolysis, non enzymatic browning, deterioration due to enzymatic activity. In this Zone II, water molecule has two layer and the water do not tightly bond on food component, the water also do not in the form of free water, therefore some deterioration can possibly occur in this zone.

Based on the results, each sample of dried fish products has different Aw value which impact on their shelf life of the product. Desrosier, N (1988) stated that generally humidity is related to Aw. Naturally, food commodity (before ar after processing) is hygroscopic and they absorb and release water containing in the food to the air which in turn affect the Aw value of the product. Different Aw value was resulted from different processing techniques and characteristic of the product.

Water Content

Water content of food product determine acceptability of the product by consumers, as well as determine shelf life of the product. Most of reactions taken place in the food materials is derived from water content whether it is coming from outside or from the food itself and will affecting on quality changing of the product. (Winarno, 2002). Based on the experiment the water content of the products ranged between 8.28% - 37.28%.

Free water plays an important role in deterioration process of food including fish product through microbial process, chemical, and enzymatic. Water in other different form (bound water, capillary form etc.) does not involve in such deterioration process. Therefore, water content cannot be considered as absolute parameter in determining and predicting the rate of food deterioration. Other parameter such as water activity (Aw) is more appropriate in determining the ability of water in deterioration process of food. (Sudarmadji, 1996).

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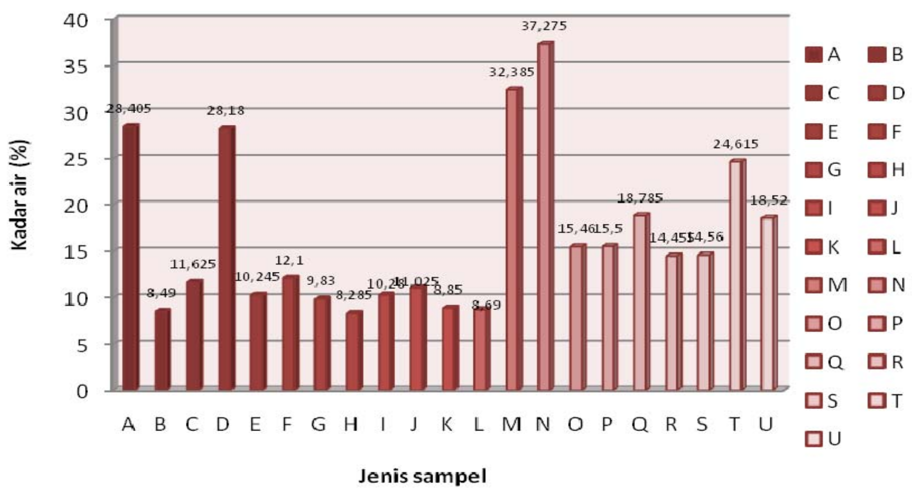

Fig 2. Water content of some dried fish products used in the experiment

Prolonging shelf life of food can be done by huge reduction in water content through some processing technology depending upon the characteristic of the product. Process involved in decreasing water content can be conducted by drying, evaporation, and dehydration process.

Glass transition temperature (Tg)

In this experiment glass transition temperature (Tg) was determined as a mid point of the shift from the glass transition temperature range. Based on the results, glass transition temperature of the samples were ranged from 38.4°C – 76.4°C.

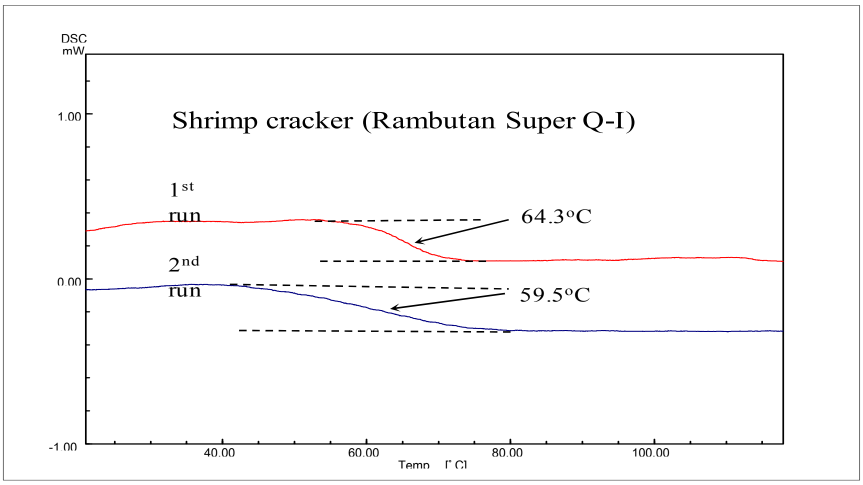

Fig 3. Glass transition of fish cracker analysed by DSC method

From the results it can be seen that the higher the water content of the sample , the Tg of the product tend to be lower. Roos, Karel and Kokini (1996) has stated that Tg of food

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materials varies from that of water at about –135°C to those of polysacharides and important Tg value of food component are those of sugars, oligosacharides and protein. Moreover, some biopolymers such as polysacharides and protein and also non fat food solid become plastizised by water which in turn resulted in depression of glass transition temperature. Prediction of Tg depression as a result of water plasticization is usefull in evaluating effect of food composition on Tg since glass transition-related change may affect shelf life and quality of the product. From the results it can be seen that the lower the water content of the product, the higher is the glass transition temperature.

CONCLUSION

The water content of the samples were varied from 8.28% - 37.28%.
The water activity of the samples was varied from 0.57 – 0.87
The glass transition temperature of the sample was affected by water content of the product. The glass trnasition temperautre of the product ranged between 38.4°C – 76.4°C

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