STUDI NILAI STERILITAS DAN KARAKTERISTIK KIMIA PRODUK OLAHAN KEUMAMAH KALENG UNTUK PENGEMBANGAN PRODUK USAHA KECIL DAN MENENGAH

(STUDY OF LETHALITY VALUE AND CHEMICAL CHARACTERISTICS OF "KEUMAMAH-PROCESSED CUISINE" FOR DEVELOPMENT OFSMALL AND MEDIUM ENTERPRISE PRODUCT)

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Diajukan: 13-06-2017, Direvisi: 06-10-2017, Disetujui: 09-10-2017

ABSTRAK

Keumamah atau ikan kayu khas Aceh terbuat dari ikan Tuna dan biasanya diolah kembali menjadi masakan tradisiona loleh Usaha Kecil Menengah, salah satunya Kuah santan khas Aceh. Masa simpan produk Kuah santan Aceh yang pendek menyebabkan keterbatasan pemasaran produk. Salah satu cara untuk mengatasi permasalahan tersebut dilakukan proses pengalengan menggunakan proses sterilisasi. Tujuan dari penelitian ini adalah menentukan nilai sterilitas, mikrobiologi, cemaran logam dan sifat kimia yang meliputi kadar air, abu, protein, lemak dan karbohidrat produkdari Usaha Kecil menengah. Sterilisasi dilakukan menggunakan alat autoclave dengan suhu operasi 121°C selama 20 menit. Produk dikemas menggunakan kaleng silinder dengan ukuran 72.63 x 53.04 mm (Ø x h). Faktor penentu sterilnya produk adalah nilai sterilitas (Fo). Selama proses sterilisasi berlangsung, tekanan pada autoclave berbanding lurus dengan kenaikan suhu. Dari hasil penelitian diperoleh kadar air 68.3%, abu 2.29%, protein 16.6%, lemak 10.8% dan karbohidrat 2.01%. Cemaran logam berupa timbal, timah, merkuri dan arsen berturut-turut yaitu <0.042; <0.8; <0.005 dan <0.003 mg/kg sedangkan total bakteri didalam produk yaitu<10 koloni/g dengan total Salmonella negative/25g. Nilai sterilitas pada produk yaitu 9,58 menit dengan total energi 127.69 kcal/100g.

Kata kunci : keumamah, makanan tradisional, kaleng, sterilisasi

ABSTRACT

Keumamah or Aceh dried-fish was made from Tuna fish and usually it was processed into traditional cuisine, Kuah-Santan Aceh, by Small and Medium Enterprise (SME). Kuah-santan Aceh cuisine has a short period of shelf life so it caused limited market of its product. From these problem, packaging technology using sterilizationis needed. The aim of this research were to determine lethality value, microbial total, metal contamination and chemical characteristics of the product. Sterilization method where thermal process is used as media to destroy spoilage microorganisms.Sterilization process had been done in an autoclave machine that operated at temperature of 121°C during 20 minutes, determined by lethality value (Fo).In this research the product was packaged in cylindrical cans of 72.63 x 53.04 mm (Ø x h). In sterilization process, autoclave's pressure values were linear with temperature.

The result showed that water 68.3%, ash 2.29%, protein 16.6%, fat 10.8% and carbohydrate 2.01%. Metal contamination i.e Lead (Pb), Tin (Sn), Mercury (Hg) and Arsen (Ar) respectively were <0.042; <0.8; <0.005 and<0.003 mg/kg while microbial total in product was <10 colony/g with the total of Salmonella was negative/25g. Lethality value (Fo) of the product canned was 9,58 minutes with the total energy of 127.69 kcal/100g.

Keywords: *keumamah, traditional food, can, sterilization*

INTRODUCTION

Keumamah is a dried-fish from Aceh, Indonesia that has a hard texture after the cooking process. The small and medium enterprise (SME) in Aceh, *Keumamah* was made from Tuna, from a sub-grouping of the mackerel family.

The fish were processed become dried-fish through several stages, generally including of cleaning, a cooking process in a container where in mixture with water and salt. The next step, dried-fish are boiled at 100 °C and dried in solar drying for one day until it had a hard texture. Dried time of dried-fish depends on the weather. Before processing into traditional cuisine, dried-fish were smoked and saved in a container.

Keumamah was processed into traditional cuisine i.e. Kuah-Santan Aceh by the small and medium enterprise product. However, it has a short-time period of shelf life that it caused limited market of its products. One of the solution to solve that problem was packaging process through the canning process.

Generally the steps of canning process included;cancleaning and sterilization,raw material pre-treatment (blanching) filling process, exhausting, seaming, sterilization process, cooling, and products quarantine. *Keumamah* heating pre-treatment or blanching for 60 minutes, aimed for decreasing microbes, texture softening and decreasing oxygen content inside foodstuffs (Alonso et al. 1998; Rastogi et al. 2015).The Sterilization process is an essential step for commercially sterile products. In this research, sterilization process used autoclave machine which set up at required time and temperature.

Autoclave principle for sterilization process was heating medium in the form of steam produced from water boiled in an autoclave. In autoclave, steam formed by pressed air that autoclave chamber was filled with steam after air valve closed.The increase of temperature as an increase of pressure in the autoclave occurred.

In sterilization process, the high temperature of 110° - 120 °C was used to kill microbes for commercially sterile products (Ghani & Farid 2007). Thermal process in sterilization causes microbes does not grow so it cannot decay food in cans(Nurhikmat et al. 2016). Many research had been done to optimize the thermal process of fish product. High - pressure processing (HPP) for fish muscles has shown a great potential for improving the physicochemical, microbial, and sensory quality of fish muscles. High pressure results in the inactivation of microorganisms and autolytic enzymes and leads to an extension of fish muscles shelf-life. In the previous research,High Pressure Processing (HPP) at room temperature and pressure of 400 Mpacannot be achieved total inactivation of spore and vegetative micro-organisms. Combination sterilization method and HPP is needed to accelerate lipid oxidation in fish muscles(Truong et al. 2015).

Moreover, according to Tenore et al (2014), Italian commercial canned bluefin tuna could be indicated as a functional food potentially health benefits for the prevention and care of cardiovascular disorders(Tenore et al. 2014). Tang et al (2014) examined that Sterilization at

different temperature at the same value of 4.5 minute affected the selected quality attributes of SSC (Sweet and Sour Carp)(Tang et al. 2014). Thermal processing parameters, including C-value and C-value/Fo decreased with the increasing sterilization temperature. Shortening the heating time of SSC products at the same lethality level boosted the sensory qualities, which was consistent with the variations of C-value/Fo ratio value(Tang et al. 2014). Whereas the result that had been studied by Majumdar et al (2015) showed that the Fo value of 8 minutes was optimized for a specialized preparation of Rohu fish (Rohu-Kalia) using retort pouches while it was in prime quality based on the sensory evaluation(Majumdar et al. 2015).

Canning process was related with the thermal process for preserve food products(Ogbulie et al. 2014). Total thermal was needed for sterile products which were determined by lethality value (Fo). Sterilization process was used to kill *Clostridium Botulinum* microorganism and their spores because this microorganism tolerance with the thermal process and generally contaminate food canned products(Kitazaki et al. 2014). The aim of this research was to determine lethality value (Fo), microbial analysis, metal contamination and chemical characteristics i.e water, ash, protein, fat and carbohydrate of product,so that the product became durable and marketed more widely for the small and medium enterprise and safe for consumers.

RESEARCH METHOD

Ingredients

Keumamah and seasoning were processed became food products using the secret recipe from Belia Indah small and medium enterprise (SME), Aceh. Ingredients for *Keumamah*cuisine canned, Kuahsantan Aceh, were tuna , red pepper, red pepper curls, cayenne pepper, onion, garlic, turmeric, ginger, coriander, lemongrass, coconut oil, bay leaves, curry leaves and salt.

Instruments

Cylindrical cans of 72.63 x 53.04 mm (Ø x h), Autoclave vertical Tomy SS-325, Data logger,Thermocouple Ellab CTF9004 (DC-Input 1.2A, 12 V, T max 350 °C with accuracy of 0.1 °C, T ref = 121 °C and Z value = 10 °C), Seamer machine "Varine" were used in this research

Canning Process

First, can cleaning and sterilization then raw material of *Keumamah* was blanched (as a pre-treatment) at 60 minutes before cooking process. After cooking process into *KuahSantan Aceh*, 128 g of each product was filled in can. The next step was exhausting process at 100°C for 20 minutes, then seaming can process. Products were sterilized in an autoclave at 121°C for 20 minutes. After sterilization process, products were cooled in the cooler box at 27 °C. The last process was products quarantine during 2 weeks.
One of the sample product was taken and then analyzed with three times repititions

Analytical Methods

In Lethality value analysis, Keumamah issliced into an average size of 0.5 x 2 cm and thermocouple needle was set up in the center of cans(Nurhikmat et al. 2009). Lethality value (Fo) equation(Gonçalves et al. 2005):

$$Fo = \int_{t=0}^{t} \left(10^{\left[\frac{T\,autoclave-121}{z}\right]}\right) dt$$

Z value is defined as differences of heating temperatures which cause D value changes into 1 cycles log or 1 decimal. Z value was 10. D value showed that heating time that decreases of 1 cycles log microbes population at 121 °C. *Microsoft Excel software* was usedfor lethality value measurement

Water, ash, protein and fatwere determined according toOfficial methods of analysis of the association of official analytical chemistry(AOAC 1984).Theresults were expressed in g/100g wet weight of productcanned and

The Energy value was expressed as kcal/100g : *= (fat x 4) + (protein x 4) + (carbohydrate x 9)*

Metal contaminations i.e lead (Pb), Arsen (As), tin (Sn) and mercury (Hg) based on SNI 01-2896-1998 method.

Microbial analysis (TPC) for the canned product was incubated of 30° C for 72 hours according to ISO 4833:2003(Frediansyah et al. 2017).

RESULTS AND DISCUSSION

The temperature profile was released from thermocouple sensor that maintained and recorded in the data logger. Pressure chamber was measured by manometer in an autoclave machine.

Steam sterilization using autoclave is an unreliable method because quickly process, non-toxic and a high lethality(Frediansyah et al. 2017). The Temperature of product in early process unstable followed by temperature in autoclave. Sterilization time of 20 minutes starts from autoclave temperature at 121 °C. Autoclave temperature in sterilization process will not attain required temperature (121 °C) because the heat was distributed into cans slowly(Veerabadran & Parkinson 2010). Therefore product temperature is lower than autoclave temperature. However, at the start time of sterilization (t=0), product temperature is higher than autoclave temperature because of heat from the product after the exhausting process. The pressure was linear with temperature in sterilization process(Ghani& Farid 2007). The result had shown in autoclave pressure's data at Table 1. In an autoclave, water medium was changed into steam as a heat medium on sterilization process. However, it caused air trapped within the autoclave. Some methods were used to determine air trapped within autoclave among the air detector tools and P – t equation (pressure and temperature). Air trapped within autoclave during sterilization process due to extra energy loss(Nurhikmat et al. 2009; Truong et al. 2015)**.**

Table 1. Temperatures and Pressure Profile in Sterilization Process

Time (minute)	*Autoclave temperature (°C)*	*Product temperature (°C)*	*Autoclave Pressure (Kpa)*
0	45.3	53.4	0
5	56.9	53.1	0
10	76.3	54.3	0
15	85.2	57.7	1
20	91.1	62.3	1
25	95.6	67.1	1
30	97.8	71.8	2
35	100.3	76.5	10
40	103.4	81.2	30
45	106.3	86.0	33
50	109.5	90.4	50
55	112.6	94.7	62
60	116.1	98.7	81
65	118.7	102.4	100
70	120.2	106.1	110
75	120.2	109.4	110
80	120.2	112.1	110
85	119.8	114.3	100

Lethality value (Fo) measurement had been done by setting up thermocouple needle in coldest point inside the can. The coldest point is defined as the area in a can that the slowest receive of heat in the sterilization process. For solid material food such as meat loaf, heat is transferred by conduction where in thermocouple needle is maintained in the center of the can (geometric point)(Praharasti et al. 2017). While for liquid food, heat is transferred by convection. The liquid receives heat transfer and move spin around in the can. Heat transfer of liquid food in the can moves faster and uniform(Kiziltas et al. 2010; Chinesta et al. 2002). In this product, thermocouple needle is maintained in can geometric point because *Keumamah* product's material is solid.

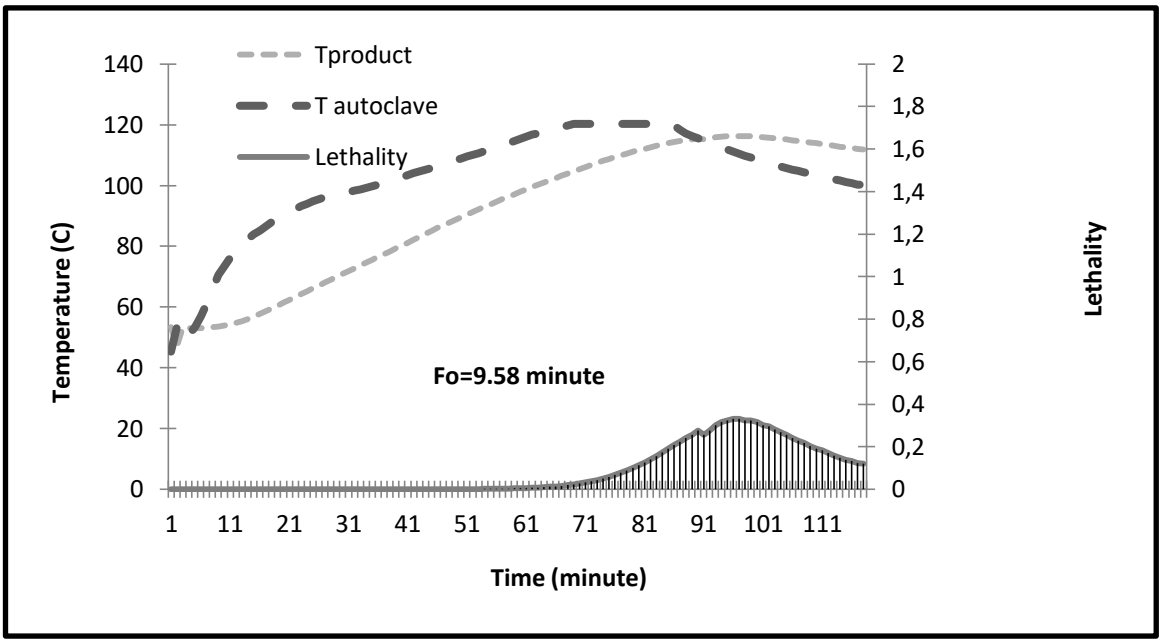

Figure 1. Lethality Value (Fo) Chart For Product

Sterilization process was used to kill *Clostridium Botulinum* microorganism and their spores because this microorganism tolerance with the thermal process and generally contaminate food canned products(Kitazaki et al. 2014). Lethality value for food canned in 12D is 3 minutes. 12D process shows that the decreased value of *Clostridium Botulinum* population was as much as 12 logarithm cycles. It means that between cans amount of 10^{12}, only one can possibly contaminated *Clostridium Botulinum* spores. In this research, D value reference for *Clostridium Botulinum* microorganism was 0,21 minute(van Doornmalen & Kopinga 2008).

Lethality value (Fo) for products was 9.58 minutes means that thermal process in sterilization process at t= 0 to t = 116.25 minutes was equals with a constant temperature at 121 °C for 9.58 minutes. If lethality value in thermal process higher than 9.58 minutes, it is possible for products became overcooked(Praharasti et al. 2017; Chinesta et al. 2002). Usually, the Fo value set in larger amount than 3 minutes in order to assure the efficacy of the heat treatment in the worst scenario of product preparation and handling (Kiziltas et al. 2010).

Table 2. ChemicalCharacteristics of Product

Water (%)	68.3
Ash (%)	2.29
Protein (%)	16.6
Fat (%)	10.8
Carbohydrate (%)	2.01
Energy value (kcal/100g)	127.69

Table 2. shows that productnutrition for the consumer. According to Advice on fish consumption and The National Food Agency Report, for mackerel canned should be obtained 5-20% fat and protein, water, ash respectively 11.7; 68.3 and 2.2% for consumption(National Food Agency 2012; SACN 2011). The chief food sources energy to the human body are fat, carbohydrate, and protein(SACN 2011). Energy requirement is the amount of food energy needed to balance energy expenditure in order to maintain body size, body composition and a level of necessary and desirable physical activity consistent with long-term good health.

Metal contamination analysis is used to determine quantities of can components that possibly to move in product

cuisineafter thermal process. In sterilization process, autoclave machine was set up at temperature of 121°C for 20 minutes. The high temperature operation possibly to occur chemical interaction between product and can components.

Heavy metals are the toxic element for human body that have a high mass atom and density. Indonesian Standarization required maximum limit any kind of heavy metals i.eArsen (As), Mercury (Hg), Tin (Sn) and Lead (Pb) that allowed in food products (Table 3)(SNI 7387:2009).

Sterilization process is the essensial step in canning process because this process aims for killing pathogenic microorganism in food product so the product has a long period of shelf life. Thermal process in sterilization used a high temperature to destroy microbial cells(Frediansyah et al. 2017).

Indonesian Standarization and Drug and Food Control were released a regulation about maximum limit metal contamination and microbial analysis that required in food product(SNI 7387: 2009; Badan Pengawas Obat dan Makanan Republik Indonesia 2016).

Table 3. Metal Contamination of Product

Parameter	Result	Indonesia Standarization (SNI) 7387:2009
Lead (Pb)	<0.042 mg/kg	0.3 mg/kg
Tin (Sn)	< 0.8 mg/kg	200 mg/kg
Mercury (Hg)	<0.005 mg/kg	0.5 mg/kg
Arsen (As)	<0.003 mg/kg	1.0 mg/kg

Table 4. Microbial Total of Product

Parameter	Result	The National of Drug and Food Control Indonesia Regulation No 16 : 2016
Total Bacteria (30°C, 72H)	<10 colony/g	10^4 colony/g
Salmonella	Negative/25 g	Negative/25 g

Future research is needed to determine shelf-life and nutrition changes during a retention time. Product sample after sterilization processing can be shown in Figure 2.

Figure 2. Product sample after Sterilization processing

CONCLUSION

Lethality value of *Keumamah-cuisine* canned for small and enterprise products was 9.58 minutes and the total energy was 127.69 kcal/100g.Chemical characteristics of the product were water 68.3%, ash 2.29%, protein 16.6%, fat 10.8% and carbohydrate 2.01%. Metal contamination i.e Lead (Pb), Tin (Sn), Mercury (Hg) and Arsen (Ar) respectively were <0.042; <0.8; <0.005 and<0.003 mg/kg while microbial total in product was <10 colony/g with the total of Salmonella was negative/25g.

ACKNOWLEDGEMENT

The authors are grateful to The Research Center for Marine and Fisheries Socio -Economics, Superior Research LIPI 2016, Mrs. EmaDamayanti, UD Tuna and UD Belia Indah Small and Medium Enterprise Aceh for the grant and cooperation of this research.

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