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HAZARD ANALYSIS AND CRITICAL CONTROL POINTS IMPLEMENTATION IN AMPLANG PROCESSING

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ABSTRACT

Amplang is a products produced from fish in the form of crackers. Amplang is produced by SMEs (Small and Medium Enterprises) in Balikpapan. The quality standards of processing amplang in SMEs can be improved analyzed hazard and critical control point in the amplang processing. The research method is survey research with data collection conducted by interviews, field observations, and FGDs. Based on observations, the SME's quality control team needs to be determined. Food hazards are divided into raw material and production process hazards. There are four processes that consider as Critical Control Point that are thawing, frying, draining, and packaging.

Keywords: Amplang, HACCP, quality, SME

INTRODUCTION

Amplang is a products produced from fish as raw material in the form of cracker. This food is from Kalimantan. This product can support tourism in Kalimantan. Various types of materials can be used as raw materials such as fish and crabs. Generally, amplang is processed by SMEs in cities of Kalimantan. This SMEs pratically did not implement the GMP yet, thus SME still has not paid attention to food quality and food safety. SMEs didn't implement the correct method of production so that the products have different quality each production. There are still 1% of SMEs that pay attention to the GMP.

This encourage authors to build HACCP plan for amplang production. HACCP is a quality assurance system to identify, assess and control potential hazards as well as a control system that focuses on prevention. HACCP emphasizes quality control and food safety (Muhandri *et al*., 2012, Thompkins, 2009). The HACCP approach is used because HACCP has become an accepted food safety standard internationally (Muhandri *et al.*, 2012). The HACCP study on amplang production is important because the sanitation and hygiene in the SME processing was still poorly implemented, HACCP document as control process has not build yet, encuoragement of consumers and local goverment to produce similar quality of product for each production, and becomes an responsibility for SMEs to maintain food safety according to Law No. 7 of 1996.

Procedure of HACCP planning consist hazard analysis to determine many kinds of contaminant that possibly appear in the raw materials, processes, and products. Contamination of raw materials, processes, and products happen because of several things such as unclean procedures, worker rotations, and contamination of microorganisms from the air during processing (Novotny *et al.*, 2004). One of raw material used for produced amplang was fish or crabs. Contaminant in fish or crabs can be microbial pathogen, heavy metals, chemical residu and grovel from fish environment.

Microbial pathogens grow easily in the fisheries comodities because these commodities contain protein and water in the high amount. Fish contains water of 11.72-12.48%, ash 21.83-22.62%, protein 59.24-63.59%, and fat 1.20-1.91% (Asikin & Kusumaningrum, 2018). Crab contains 47.5% protein and 11.20% fat (Karim, 2005 in Katiandagho, 2012). Microorganism contamination can be prevented by apply of sanitation and hygiene in every step of the processing. So that, proper processing techniques and knowledge of production processes are needed to avoid hazards and quality degradation (Citaresmi & Wahyuni, 2018). Processing technique and production knowledge was one of the important point in the HACCP planning. This prevent potential dangerous of biological, chemical, and physical hazards as well as reducing the risk of hazard events by controlling the critical points in each production processes.

The aim of this study was to build HACCP planning in the amplang production. The HACCP consist of several steps including the preparation of the HACCP team, identification of product description and consumers, establishment of process flow diagrams, identification of hazard and CCP, and determination of control actions, corrections, monitoring, and verification procedures .

METHOD

The results were obtained by conducting survey and observation in the amplang production house located in Balikpapan city. Balikpapan's SME center (Sentra Industri Hasil Perikanan dan Kelautan Teritip) was chosen as object study because local goverment will design this center as a pilot of SME's center in Indonesia. This study was expected to help SME to produce uniform quality of product beside to assure of food safety. The data collection was done by direct observation, indepht interview, and FGD. Direct observation and in-depht interview was done to analyze amplang processing from purchasing until distribution.

Focus group discucssion was done to verify the flow processing diagram and to explain the correct GMP implementation. The selection SME as a sample was done by purposive sampling. SMEs that have P-IRT and Halal certificates were selected as object study. The data analysis method was descriptive method and literature study from several previous research about fish-processed and HACCP implementation.

Hazard or contaminant on amplang production was reviwed based on Standar Nasional Indonesia and existing condition. Identification of Critical Control Points (CCP) was carried out by implementing the CCP decision tree (Fig. 1) and using some questions that are (Lee & Hathaway, 1998):

Q: Could the hazard be present in or on the product at unacceptable levels at this step?
A: Yes (give reasons and go to next Q),
No (not a CCP; proceed to next identified hazard.
Q: Is there a control measure available at this step that would prevent unacceptable levels of the hazard?
A: Yes (this step is a CCP),
No (not a CCP and go to next Q),
Q: Is there a control measure available at a previous step that would significantly contribute to preventing unacceptable levels of the hazard at this step?
A: YeS (retrospectively assign the previous step as a CCP),
No (if the answer to Q also was no, consider whether addition of further steps could control the hazard or whether redesigning the process is necessary for ensuring the availability of a control measure). At the end one should proceed to the next identified hazard (Lee & Hathaway, 1998).

RESULT AND DISCUSSION

The implementation of HACCP in fish processing industries includes evaluating the basic feasibility and evaluating the plan for implementing the HACCP program. Basic requirements in implementing HACCP include Good Manufacturing Practices (GMP) and Sanitation Standard Operating Procedure (SSOP) (Standart National Organization, 1999). Based on the survey results, there are some SME that have not implemented the GMP.

The HACCP system refers to the Codex Alimentarius Commission guidelines in the "Guidelines for Application of Hazard

Analysis Critical Control Point System" which consists of stages which are assembling the HACCP team, describing the product, identifying intended use, constructing process flow diagram, listing all potential hazards associated with each step, conduct a hazard analysis, and consider any measures to control identified hazards, determining Control Points, establishing Critical limits for each CCP, establishing a monitoring system for each CCP, establishing corrective actions, establishing verification procedures and establishing documentation and records keeping (WHO & FAO, 2009).

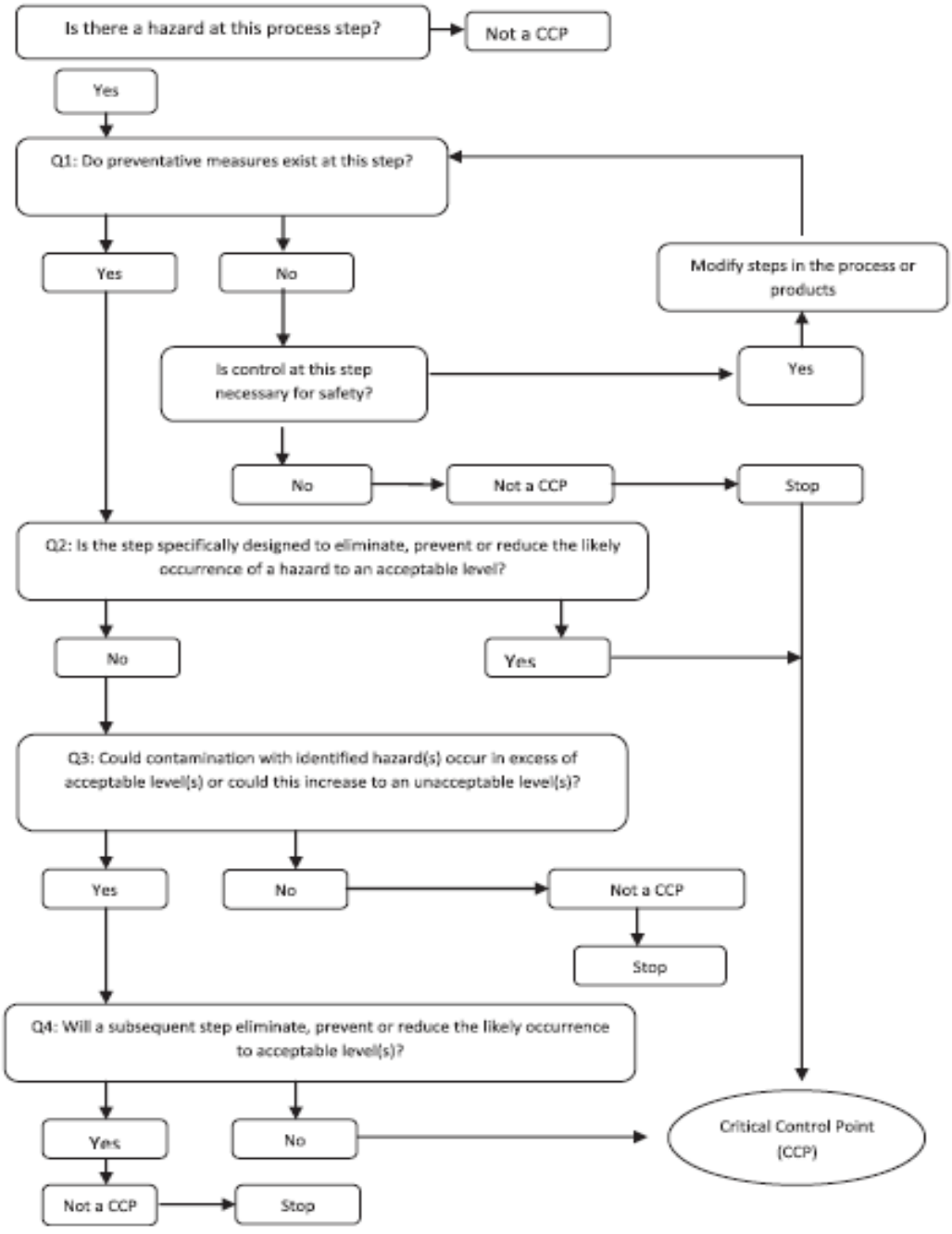

Figure 1. Process Step a Decicion Tree (Horcner *et al.*, 2006 in Ramalingam *et al.* 2013)

Assembling the HACCP Team

The team quality assurance in the SME must be determined and this team must understand the HACCP principle. This situation does not found in the SME where quality assurance only follows the flow diagram and SOP determined by bussiness leader. Based on survey, there were not HACCP team in the SME beside it was found that employee never participate in the HACCP training. Infact, the business owner acts as quality and sanitation control, and head of

marketing and production. The basic knowledge required for the members of HACCP team includes understanding the severity and hazard of pathogens and their toxins, understanding the principles and the concept of HACCP, ability to develop a flow diagram, ability to identify hazards and CCPs, ability to prescribe precautions for avoiding infections (microorganism destruction or suspension), and ability to propose solutions for hazardous food (Tzouros & Arvanitoyannis, 2000).

According to Pierson and Corlett (1992), the HACCP team may include not more than six members but all members should be qualified to identify possible hazards; recognize the severity of these hazards; propose predictive measures, critical limits, and monitoring and verification procedures; propose corrective actions; seek sources of information for the development of the HACCP plan; and validate the system.

Product Discription

Main products produced are amplang from fish and crabs. There are several types of fish that are used such as cork fish, flat fish, mackerel fish, etc. These depends on supplier's supply. Besides, SME also produced fish chips, fish crackers and abon. The description of Amplang can be seen in Table 1. Product description is a complete description of the product regarding composition, physical / chemical structure, treatment, packaging, storage conditions, and durability and distribution methods (Wicaksani & Andriyani, 2017).

However, SME does not display chemical or physical structures. The physical structure were taste, form, or other organoleptic displays. The chemical structure including AW, pH. Even the product does not include nutritional adequacy figures.

Arrange the Production Process

The amplang processing can be seen in Fig 2. This flowchart has been verified by the business owners by FGD. This processing had also socialized to the workers by displaying the flowchart on the production room wall according to the standard HACCP process where the production process is known by the whole workers and the workers work according to the flowchart. The construction of a flow diagram is important as it helps to identify all the aspects of the production process that influence product quality (Mead, 2000). The flow chart must be verified by the HACCP team to test the accuracy of the process flow diagram. The flow diagram can be modified if there is changeable processes and condition (Handayani, 2012).

Table 1. Product description of amplang

Product description	Product specifications
Raw material	Various types of sea fish and crabs, flour, seasoning, oil.
Process stages	Purchasing, washing, storaging, thawing, crushing, mixing, cutting, frying, draining, packaging, packing, storaging
Packaging	Primary packaging was using PP plastic, secondary packaging was using carton. For products 100 - 250 grams was packed using PP. For products 1 kg was packed with PP and cartons.
Storage and transportation	Raw materials (fish and crabs) were stored at -10 until -5^0 C. The product were stored at 25^{0}C. The transportation of fish / crabs was carried out by pickup trucks, where the fish / crabs are stored in containers that are given ice grains. Transporting amplangs to outlets was done by car.
Label	Product name, company name and logo, product weight, expired date, P-irt logo, and halal logo, composition, Balikpapan logo, and original Indonesian's product logo.
Product utility	Amplang is a product that can be consumed directly by consumers without further processing.
Consumer	Products are snacks of a kind of crackers intended for all kinds of consumer. This product was positioned as gift
Shelf life	The amplang has been labeled expired with a shelf life of 3 months from production.

The processes begin with raw materials handling. SME gets raw materials from fishermen or suppliers. In this proceess, QC officer should check raw material's quality. Quality testing can be done by examine the visual appearance of raw materials. Preferably, if the raw material did not meet the SNI, it was returned to the supplier. Infact, SME receives all fish supplied because the the scarce of fish or crabs. Then, fish or crabs were immediately washed by the employee and then stored in the feezer. Storage is carried out by adhering to the FIFO principle (first in first out). Fish or crabs that will be processed were half thawed then grinded. The batter mixed with flour and seasoning then formed, cutted and fried. Frying was done by submersed products into oil with periodically stirring to avoid burning.

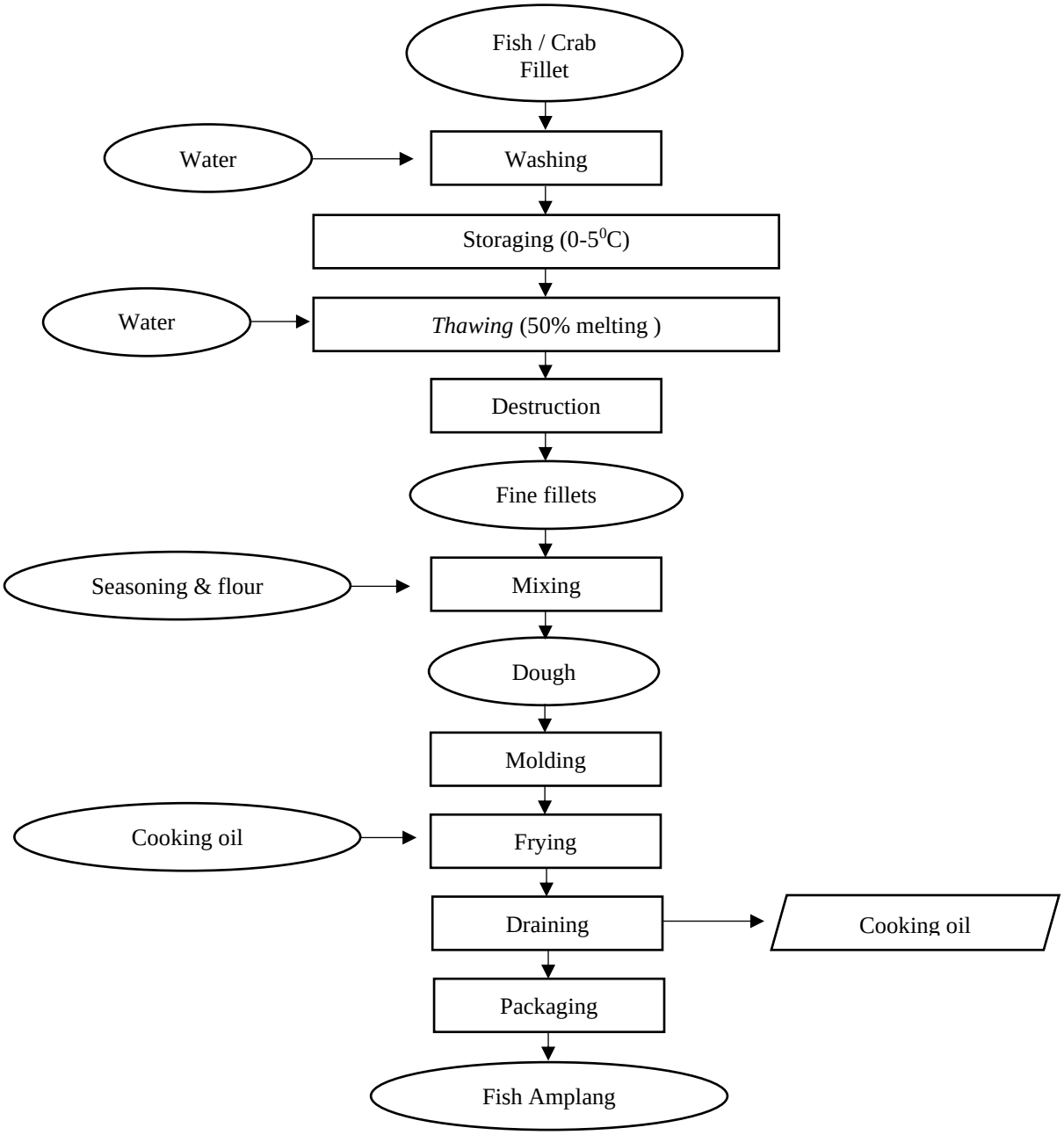

Figure 2. Production process of amplang

Application of HACCP Principles in the Production Process

a. Hazard Identification

The first principle of HACCP is identification of hazards that may arise during production process (Wicaksani & Andriyani, 2017). In the HACCP framework, the term hazard refers to any agent in, or condition of, food that is unacceptable because of its potential to cause an adverse health effect.

Hazard analysis was defined as the evaluation of the severity of a hazard and its probability to occur. Its application results in the determination of critical control points in a production line where several parameters of the product can be measured and corrective actions might be implemented (ILSI, 1997). Contamination of hazards in food may occur in any step of processing. To prevent hazard contamination, manufacturers need to apply hazard analysis. Possible hazards arising from the processing of amplang can be seen in Tables 2 and 3.

Table 2. Hazard analysis of raw material

No	Raw material	Hazard type		Cause	Control action
1	Fish	Physical	Foreign materials such as sand	Contamination from the environment, containers and transportation equipment	Based on SNI 2729-2013 Certified supplier Frozen Storage
		Chemistry	Formalin, chemical residue	Fishries live, preservation technique.	Thrown away
		Biology	Parasites, bakteri patogen	Delivery temperature above -0^{o}C	Cool storage and distribution (GMP/SSOP), SNI 2729-2013
2	Tapioca Flour, Salt, Flavoring, Flavoring (powder ingredients)	Physical	Foreign hazard such as dust, hair.	From suppliers and from packaging.	Selection of certified materials (CoA
3	Water	Physical	Foreign sand or worm	Contamination from water sources	Using ground water, PDAMs, or filtering water. Law 416/MENKES/ PER/IX/1990)
		Biology	Pathogenic bacteria	Improper water treatment	Use bacterial killers such as ozone or UV in water installation pipes. Law 416/MENKES/ PER/IX/1990)
		Chemistry	Heavy metal. Brackish water type	Inaccurate contamination from water sources and water purification	Using ground water, PDAMs, or filtering water. Law 416/MENKES/ PER/IX/1990)
4	Garlic	Physical	Foreign objects such as dust, hair, skin	Stripping less clean and not through washing	Choosing certified suppliers, SSOP/GMP procedure
		Chemistry	Heavy metal	Location of cultivation	SSOP/GMP procedure
		Physical	Foreign materials such as sand	Contamination from environment, containers and transportation equipment	SSOP/GMP procedure

Physical hazards identified in fish and crabs were sand or dust from the sea/ponds or contamination during the transportation process. In addition, fish skin, fish scale, or crab shell carried on flesh can be regarded as hazard. SME's only receive raw materials in the form of fish/crab flesh. This physical hazard can be removed by cleaning in flowing water. The biological hazard in fish/crabs can be parasites and bacterial pathogens (SNI 2729, 2013; Novotny *et al.*, 2004). In amplang processing, physical hazard can be gravel, dust ot hair. Physical hazard in flour can be dust or hair because of processing or environment.

Some patogens transmissible to human through contact with fish and aquatic environment are *Mycobacterium spp, Streptococcus iniae, Photobacterium damselae, Vibrio alginolyticus, Vibrio vulnificus, Erysipelothrix rhusiopathiae* (Novotny *et al.*, 2004). Foodborne pathogens associated with fish and fish products are *Vibrio parahaemolyticus,* V*ibrio cholerae, Escherichia coli, Aeromonas* spp.,

Salmonellosis, *Staphylococcus aureus, Listeria monocytogenes, Clostridium botulinum, Clostridium perfringens, Campylobacter jejuni* (Novotny *et al.*, 2004).

This hazard appears in the food because of unhygiene processing and sanitation or environment Chemical hazards in fish/crabs can be in the form of formaldehyde or chemical residues because of fish lives's environment (Dewi *et al.*, 2018). Possible chemical hazard in the fisheries product are Pb, Cd, As, Sn, and Hg (SNI 2729, 2013) According to Dewi *et al* (2018), there are still heavy metal of Pb and Cd residues in some fishs from rivers in Balikpapan. Referring to the SNI 7387 2009 regarding the maximum limit of heavy metals in food, the heavy metal content in fish is high and meets the permitted requirements (Dewi *et al.*, 2018). Acrylamide can be a chemical hazard in the amplang production process because of over cook/ burning.

Table 3. Review of hazard identification on amplang processing

No	Process	Possible Type of hazard		Reason	Control action
1	Purchasing	Physical	Gravel, dust, hair	Not clean raw material	SSOP/GMP
		Chemistry	-	-	-
		Biology	Parasites, bacteria pathogen	The temperature of the distribution of fish / crabs is more than 5^{o}C.	Choosing suppliers that have been certified HACCP or have CoA
2	Thawing	Physical	Dust	Air circulation	Using blower in the production house. According to GMP/SSOP.
		Chemistry	Metal	The water used was brakish. Oxygen accelerates meat decomposition.	Using ground water, PDAMs, or filtering water. According to GMP/SSOP.
		Biology	Bacteria pathogen	The temperature and time of thawing more than 5^{0}C for 24 hours, contamination from water, hand contamination of workers who do not use gloves	According to GMP/SSOP. Hafl thawing was implemented to keep cool condition.
3	Grinding	Physical	Gravel, hair, dust	Not clean fish	GMP/ SSOP procedure
		Chemistry	Oxygen	Oxygen exposure accelerates meat decomposition	GMP/SSOP procedure. Grinding was carried out when half meat had melted
		Biology	Bacteria pathogen	Contamination from equipment, worker and air.	GMP/SSOP procedure
4	Mixing	Physical	Gravel, hair, dust	the processing did not apply GMP and SSOP properly	GMP/SSOP procedure
		Chemistry	-	-	-
		Biology	Bacteria pathogen	Contamination from equipment, worker and air.	GMP/SSOP procedure
5	Rounder (shapping)	Physical	Gravel, hair, dust	The environment was not clean, the processing did not apply GMP and SSOP properly	Workers use sanitation tools during the production process such as masks, gloves, headgear, lab clothes, work shoes

					(GMP/SSOP Procedures). Cleaning the production house
		Chemistry	-	-	-
		Biology	Bacteria pathogen	Contamination from equipment, worker and air.	Using stainless steel tools GMP/SSOP procedure
6	Frying	Physical	-		
		Chemistry	Acrylamide	Burning	The frying process is carried out for a maximum of 25 minutes. Burning product was thrown away.
		Biology	Toxin from bacteria pathogen		
7	Draining	Chemical	Rancidity	The oil was oxidized, the oil is not perfectly drained, there is still oxygen in the packaging	Using spinner until t properly drain
8	Packaging	Physical	Dust, hair	Environment and worker	GMP/SSOP procedure
		Chemistry	Chemical material	Migration from packaging material.	GMP/SSOP procedure Product was properly drain.
		Biology	Bacteria pathogen		Using clean packaging. GMP/SSOP procedure

b. Determination of Critical Control Points (CCP)

The principle of HACCP is the determination of CCP. The critical cotrol point in the amplang processing is purchasing, mixing, frying and sorting. The emergence of a biological hazard during the production process is caused by the process of transportation, handling and storage that is not in accordance with GMP. Material handling was the first procsses. This process has a hazard potential, where fish are contaminated with sand, parasites, bacteria, chemicals and unfavorable conditions in fish conditions, thus affecting product quality. Fish temperature should be lowered as soon as possible to 0ºC after capture and that temperature should be carefully maintained. Capture, handling, and transportation are responsible for a great release of adrenaline and cortisol in fish tissues causing shortening of time for onset of rigor mortis, which softens fish texture and enhances the ease of penetration by pathogens. Increase of microbial load is prevented by gentle treatment of animals during transport and transfer to stunning, while a well-controlled cold chain keeps it that way (Sigholt *et al.*, 1997).

Thawing was CCP 1. In this process, thawing was done until half frozen's meat was melt. Some of biological hazard such as *E coli* may appear in this process if improper thawing was done by worker. Besides, improper thawing process can cause meat oxidation and decomposition(Cutting & Spencer, 1968). According to the observation, thawing processed used water to accelerate melting process, but if water was unclean, it may causes hazard. Water for the production is odorless, tasteless, non-turbid, microbiological, chemical and physical content in accordance with Annex II Permenkes No. 416 / Menkes / Per / IX / 1990. Thawing should be properly and thoroughly carried out, so that cooking could sufficiently lower the microbial population even at the center of each food portion (Tzouros & Arvanitoyannis, 2000).

Frying was determied as CCP 2. Frying determines the quality of the product. Frying is done by dipping the product into hot oil. The product is fried until it color changes and it may not burn. Burning will causes acrilamide appearance in the product. Acrilamide was a group og chemical hazard. This component is carcinogen and a neurotoxin (Ubaoji & Orji

2016). Acrylamide is a contamination generated during cooking as a consequence of the Maillard reaction, derived from the reaction between the free amino acid asparagine with reducing sugars or other carbonyl compounds (Ubaoji & Orji 2016).

In draining processes, the product is drained and aerated until it is warm so the air become contaminants. This can trigger the risk of hazard due to bacteria in the container and pollution from the surrounding. The drained process should be carried out in a closed place and the air is not contaminated with anything. Tools used for draining should be cleaned frequently (Pratidina *et al.*, 2018). This stage is designated as CCP 3. Packaging was determined as CCP 4. Products are packed on plastic according to the weight. Based on the observation, products will repackage if netto product improper. This process is also critical of the emergence of hazards so that this process needs to pay attention to GMP. Packaging must properly done. Migration from the plastic material to the product may happens because of heat and contact time (Bhunia 2013). Beside, the plastic is stored in clean and dry environment to prevent biological contamination.

c. Establish Critical Limits, Monitoring Procesures and Corrective Action

Critical limits are control that are carried out to eliminate hazards or reduce them to safe limits. The criteria used as critical limits are temperature, time, RH, pH, Aw, chlorine content, textures and visual appearance (Afrianto, 2008). Determination of CCP for each process can be seen in Table 4.

The amplang production's critical limit is described in each CCP. Temperature, time and contaminants are the main factors that significantly affect product safety and quality. Monitor action is carried out based on the origin of the contaminant. In the monitoring process, every contaminant must be documented and carried out to evaluate the process and avoid similar events in the future. Critical limit, monitoring procedures, and corrective actions can be seen in Table 4.

Table 4. Determination of CCP and Critical Limits

CCP	Process	Critical limits	Reference standard	Corrective action
CCP 1	Thawing	The maximum thawing temperature is 5ºC to prevent bacteria growth. (*E.coli*<2 APM/mL).	Thawing should be done quickly because it prevent meat oxidation and decomposition (Citraresmi & Wahyuni, 2018; Cutting & Spencer, 1968)	Thawing was maintain until half meat melted to keep meat in cool condition (meat are not fully melted).
CCP 2	Frying	Frying is done until the amplang turns yellowish.	Burning (over frying) will causes acrilamide appearance in the product (Ubaoji & Orji, 2016)	Product was fried in 20-25 minutes until product turn yellowish. If burning happens, the product must be discarded/thrown away.
CCP 3	Draining	Oil draining was done properly. Tools used should be cleaned frequently.	Products that still contain oil cooking will cause rancidity Processing was done according to GMP/ SSOP procedur.	Product was spinned until oil was removed, so that rancidity can be prevented. It better for using spinner equipment According to the SSOP/GMP
CCP 4	Packaging	Free of foreign matterial (workers hygiene and sanitation)	GMP/ SSOP procedur.	Accroding to Procedur SSOP, Reject product.

d. Establish a HACCP Process Verification Procedure

Internal verification is carried out by a team specifically designated to maintain product quality (SME quality management). Verification should be done twice a year (every 6 months). Verification is carried out by checking the suitability of SOP manual documents with actual HACCP practices in the field. External verification is carried out by the

HACCP system certification body within a year.

e. Make Docoments

Documentation of amplang production process includes every record of the CCP, critical limits, monitoring records, corrective actions taken against non conformities and responses to the auditor's verification process. Documentation is carried out in the process of monitoring. Documentation was shown to food safety auditors when the SME held an external audit.

CONCLUSION

Amplang is a fishery and marine product produced from fish and crabs. Based on observation, membership of HACPP need to be determined. Food hazards are divided into raw material hazards and production process hazards. The hazard is distinguished into physical contamination which includes dust, gravel, and hair. Chemical hazards can be metals, heavy metals, acrilamide, and packaging material. Biological hazards include parasites and pathogenic bacteria originating from raw materials and arise due to less hygienic production. The CCP on processing is thawing, frying, draining and packaging.

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