



Identification of Implementation of GMP and SSOP on Processing of Balinese Traditional Food Sardine Pedetan



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Abstract

This study aims to identify the implementation of Good Manufacturing Practice (GMP) and Sanitation Standard Operating Procedures (SSOP) on the processing of the traditional food Sardine pedetan. The study was conducted on three groups of the producer of the Sardine pedetan in Jembrana, Bali. The implementation of GMP was observed in the process of collecting the raw materials, cleaning fish, giving seasoning and drying. The implementation of SSOP was observed in the surrounding environment, the condition of the building for processing, the facility equipment, the water and wastewater treatments. The results showed that the application of GMP and SSOP on the processing of pedetan in some respects is in accordance with SNI 2721.3: 2009. The microbiological analysis of the water for the processing has met the requirements, with an average value of Total Plate Count was 3.33 10¹ cfu/ml, and Escherichia coli was 0 cfu/ml. The equipment and building facilities were simple, fairly clean environment and waste disposal were handled properly. The manufacturers do not do the packaging and labeling of the products, due to the lack of knowledge about the packaging. The processing of Sardine pedetan is feasible and the implementation of GMP and SSOP are need to be intensified so that the traditionally produced food is in good quality and safety.

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1. Introduction

'Pedetan' is Balinese traditional food which is made from dried seasoned sardine that processed by people in Jembrana, Bali. Varied procedure in processing 'pedetans' from one to other villages brought certain characteristics in term of quality and safety. The 'Pedetans' were discovered to be diverse quantitatively and qualitatively [Singapurwa *et al.*, \(2014\)](#) in term of durability, hence it was hard to standardize the products. Therefore, improvements through the application of basic standardization of food processing were considered to be necessary, in which the management of quality and safety of the both foods and raw materials should be analyzed for business and marketing developments.

Research related to the development of the basic eligibility of GMP (Good Manufacturing Practice) and SSOP (Sanitation Standard Operating Procedures) applications, was considered to be necessary since there were varied processing procedures of Sardine 'pedetans'. Therefore, this research aimed to produce qualified and safety Sardine 'pedetans' ([Rodmanee and Huang, 2013](#)). To reach the aim, an effective system should be decided based on the commitment and efficiency of both processing and distribution aspects. The application of GMP and SSOP was used to guarantee product safety, improve consumer confidence and product quality ([Rauthan and Saxena, 2015](#)).

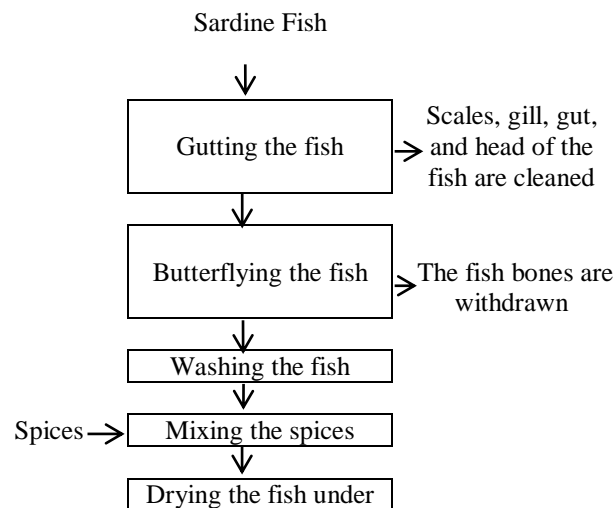
2. Materials and Methods

The research data were gained from 3 groups of a producer who were used to make 'pedetans' in Jembrana regency, Bali. The research used an observational descriptive method by collecting the data of 'pedetan's making process which was commonly done by Jembrana people. The data collection included documentation study, direct observation of the processing section, interview, and questionnaire. The samples were GMP and SSOP assessments of the processing procedures in making Sardine 'pedetans'. The assessment focused on the environmental aspect and the control of the processing means, the condition of the food processing building, the completeness of the processing means, the water supply, the raw materials' storage, the products' storage, the processing equipment, and the packaging and distribution of the products.

The laboratory analyzes were done in each four processing step, namely the receipt of the raw materials, in the water, in the spices, and in the products. The analyzes of the food quality and safety included moisture test, TPC (Total Plate Count), and Escherichia coli Test (SNI 2721-1-2009) ([National Standardization Agency, 2009](#)).

3. Results and Discussions

The application of GMP (Good Manufacturing Practice) and SSOP (Sanitation Standard Operating Procedures) covered all of the steps of Sardine '*pedetans*' processing procedure.



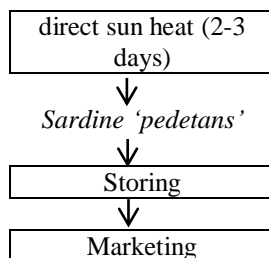


Figure 1. Processing Process of Sardine *Pedetan*

3.1 Sanitation Standard Operating Procedures (SSOP)

Water which was used in the processing step by producer 1 was water from Tap Water Company; hence the water did not contain TPC and *Escherichia coli*. On the other hand, producer 2 used well water with TPC content by $1,0 \times 10^2$ (cfu/ml) (Table 1.). Microbiological analysis of the water has met the SNI 2721.1:2009 about the requirements for food quality and safety of dried salted fish, in which the average of Total Plate Count of the products was 3.33×10^1 cfu/ml, and the *Escherichia coli* was 0 cfu/ml. The standard TPC allowed by SNI is maximally 1.0×10^5 coloni/g, while the *Escherichia coli* should be maximally 3 APM/g (National Standardization Agency, 2009).

Table 1
The Sampling of Water on the Processing Pedetan

Processing	TPC (cfu/ml)	<i>E. coli</i> (cfu/ml)
Producer 1 st	0	0
Producer 2 nd	1.0×10^2	0
Producer 3 th	0	0
Average	3.33×10^1	0

The sanitation and condition of the processing process, the hygiene of every surface which got contacts with edible materials, the washing hands facilities, and the toilet were considered to be less clean. The fish were stored in cold in the ice boxes, which leaving much unhygienic waste and dirt on the boxes' surfaces. Besides the storing boxes, the hygiene and health of the personnel have not met the standard. Means and equipment which were used in the processing process, namely baskets, plastic buckets, aluminium buckets, Styrofoam, wooden bench, chairs, pots, and ice boxes.

The floor of the processing rooms, the equipment, and the containers which were commonly used was not also guaranteed from any bacteria and possible contaminations. The processors, while processing the fish, were not using gloves condition by adding ice cubes in a rarely washed ice boxes. The gutting process was sometimes done directly, masks, hair coverings, and aprons. Even more, they did not wash their hands and feet. These conditions might lead to bacteria contaminations Sousa *et al.*, (2014), since washing hands and feet without using any jewelry was considered to be one of the procedures to hamper any contamination (Sutton, 2010).



Figure 2. Cleaning and slicing processes

The processing of Sardine '*pedetans*' started when the processors gained the raw materials, continued by gutting process, butterflying process, washing process, spicing process, and drying process under the sun heat for 2-3 days. The processing of Sardine '*pedetans*' by producer 2 was carried out outdoor, exactly in the house yard owned by the leaders of the groups. On the other hand, the processing process by producer 1 and producer 3 was carried out in kitchens. From the three groups of producer, there were not discovered any toxic materials, hence the raw materials, the equipment, and the containers were safe from toxicant.

The products were dried in the house yard by using bamboo or wire board racks. This drying process was kept from animals, though it was not safe from flies and dust. Different drying process and seasons (whether dry or rain) in which the drying process was carried out along with fluctuating temperature and humidity, were truly influencing the final products. Those factors might cause contaminations which decreased the quality and safety of the Sardine '*pedetans*' (Immaculate *et al.*, 2012; Immaclate *et al.*, 2013).

The results of laboratory analysis for swab which was carried out in each processing step showed the average of TPC by 1.56×10^7 cfu/ml and there was not any *E.coli*. The results of analysis also showed that the washing and slicing processes have not met the SNI 2721.1:2009 about the requirements for food quality and safety of dried salted fish, in which the maximum TPC allowed was 1.0×10^5 coloni/g. However, the *E. coli* content for each step of the processing has met the standard with maximally 3 APM/g (National Standardization Agency, 2009).

Table 1
TPC and E. Coli on the Processing Pedetan

Processing	TPC (cfu/ml)	<i>E. coli</i> (cfu/ml)
The washing place	1.07×10^6	0
The process of seasoning	3.90×10^7	0
The drying place	6.67×10^1	0
The sampling of water	3.33×10^1	0
Average	1.56×10^7	0

The storage of Sardine '*pedetans*' was done by wrapping the products in plastic bags and sealed cardboard boxes. The storage kept from the possibility of cross contamination and vermin. However, this wrapping process has not met the standard since the processors used secondary cardboard boxes which have been used before. The plastic bags have not labeled by the name of the products, along with netto, ingredients, information related to producers, date of production, and expiry. This storing process aimed to longer the shelf life and avoids microbial contaminations (Malhotra *et al.*, 2015).

Solid wastes such as the head, gut, scales, and gill of the fish as well as liquid waste like water to wash the fish were used as fodder, and hence the wastes did not contaminate the environment. However, there has not any particular handling toward both of those solid and liquid wastes. The wastes should be separated in term of their types, in order to ease the handling processes (Ladan, 2016).

Toilets which were used by each producer were located separately, nearly the processing places. However, the hygiene of the toilets was discovered to be low and possibly leading cross contaminations to the products.



Figure 3. Well Water Source Used to Process Sardine ‘*Pedetan*’



Figure 4. Grinding Process of Spices Mixture



Figure 5. Wet Sardine ‘*Pedetans*’

3.2 GMP (Good Manufacturing Practice)

The processing procedures of Sardine ‘*pedetans*’ were displayed on the flow diagram (Fig. 1). The procedures were started from the receipt of raw materials (fresh fish) from fishermen. In this section, the fresh fish were tested organoleptically and sorted in term of types and sizes. Further, the fish were stored temporarily in Styrofoam ice boxes. The ice aimed to maintain the freshness of the fish. Next, the fish were cleaned with well or tap water (Fig. 3) after being gutted (Fig. 2) and sliced into a butterfly shape. The procedure was continued with the draining step by using filter basin, to separate the fish from dirty water since the quantity of microbe was depended on the cleanness of the fish from the very first to the last step. Bacteria that might contaminate Sardine namely, *Total coliform*, *Fecal coliform*, *Salmonella*, dan *Clostridium spp* (Dib *et al.*, 2014).



Figure 6. Drying Process



Figure 7. Dried Sardine 'Pedetan'



Figure 8. Wrapping and Packaging Processes

Spicing process was done after the fish were free from the washing water. In this process, the fish were rubbed with spices which have been grinded by stone mortar (Fig. 4). Producer 1 used the mixture of garlic, coriander, kampferia galangal, turmeric, vinegar, salt, and ginger to spice the fish, while Producer 2 used a different mixture, namely garlic, shallot, coriander, brown sugar, tamarind, and salt. On the other hand, Producer 3 rubbed their fish with the mixture of garlic, kampferia galangal, coriander, turmeric, and salt.

Spices could be used as one of the natural preservatives for dried fish products. The addition of coriander by 0.01% in the making of dried Tawes fish could result in a product with specifications: 46.80% protein contents, 11.69% moisture contents, and 7.66 Organoleptic scores. The results of the Organoleptic score were listed as following: appearance: intact and clean; aroma: typically coriander aroma; texture: dense and crispy; taste: very delicious (Restu, 2014).

Coriander contains 0.5-1% essential oil and phytonutrients such as carvone, geraniol, limonene, borneol, camphor, elemol, and linalool. The spice is also rich in flavonoid compounds such as quercetin, kaemferol,

rhamnetin, and epigenin, as well as bioactive compounds namely phenol caffeic and chorogenic acid [13]. Coriander also contains phenolic compounds by 357.36 mg/100g wet weight [14]. On the other hand, garlic could hamper the microbial growth of *Salmonella enteritidis* and *Staphylococcus aureus*[15]. The allicin and organosulphur compounds could hamper the growth of both gram-positive and gram-negative bacteria such as *Staphylococcus*, *Salmonella*, *Vibrio*, *Mycobakteria*, *Proteus sp*, *Helicobacter pylori*, and could also be anti-parasite, anti-fungal, and anti-virus (Biradar *et al.*, 2014; Gupta *et al.*, 2015).

The drying process was done on bamboo or wire board racks under direct sun heat. During the process, the fish were arranged on the board racks and flipped frequently. This process lasted for 2-3 days and stopped after the fish have been dried well (Fig. 6).

The packing process still used secondary cardboard boxes and Polyethylene plastic bags (Fig. 8). The process was carried out traditionally without any special equipment.

Table 2
Model of Application of GMP and SSOP in Lemuru *Pedetan* Processing

a. SSOP in Lemuru *Pedetan* Processing

Sub Item	Procedure
Water and ice for processing	<ol style="list-style-type: none"> 1. Water which is used for processing should meet the applicable requirements of safety and quality. 2. Water supply should be sufficient. 3. The need of ice during processing should meet the requirements of safety and quality based on SNI Standard.
Room, tools, and equipment	<ol style="list-style-type: none"> 1. Processing room should be floored properly (at least cement-floored room) and should be cleaned after each processing. 2. Water which is used to clean up the floor should be mixed with a disinfectant such as chlorine (concentration of 100%). 3. Tools and equipment should be cleaned after being used. 4. The sanitation of processing equipment (work clothing, gloves, masks, and hair coverings) should be maintained properly.
Cross-contamination of the product	<ol style="list-style-type: none"> 1. Cross-contamination among the ingredients, spices, equipment, tools, floor, etc. should be avoided.
Toilet	<ol style="list-style-type: none"> 1. The toilet should be provided in the appropriate number based on standard, at least 1 toilet for up to 9 people. 2. The toilet should not be connected directly to the processing room. 3. The toilet should be cleaned routinely. 4. The toilet should be cleaned with chlorine (concentration of 200 ppm) which is mixed with water.
Contamination of contaminants	<ol style="list-style-type: none"> 1. The contamination of contaminants such as fuel, cleaner, and disinfectant should be avoided.
Toxic materials	<ol style="list-style-type: none"> 1. Toxic materials should be kept away from the processing room and should be kept in particular place. Toxic materials should be labeled clearly.
Hands-feet washing facilities and workers' hygiene	<ol style="list-style-type: none"> 1. Hands-feet washing facilities should be provided at the front entrance of the processing room. 2. Workers should wash their hands, gloves, and feet before entering the processing room. 3. Washing water for hands and feet should be mixed with chlorine (concentration of 50 ppm). 4. Workers should be fit and healthy.
Vermins	<ol style="list-style-type: none"> 1. Processing room should be kept away from vermins, such as rat and insect. 2. The containers and storage to store Lemuru <i>Pedetans</i>, spices, packaging materials, and products should also be kept away from vermins.
The layout of	<ol style="list-style-type: none"> 1. The location of processing room should be kept away from the source of

company and the design of processing room	contaminants.
Waste	<ol style="list-style-type: none"> The design of processing room is set to minimize contaminations toward the products, whether the raw materials, spices, or the final products. Both solid and liquid waste should be handled well for not contaminating the products and environment.

b. GMP in Lemuru *Pedetan* Processing

Processing Steps	Procedure
The receipt of raw material	<ol style="list-style-type: none"> The reception of raw materials is done fast, carefully, and shielded from the sun. Fish is stored in styrofoam ice box with 0° C – 5° C temperature in sanitary and hygienic condition based on SNI Standard. Fish is cleaned and processed immediately. Fish is processed based on First in First out System.
Sorting	<ol style="list-style-type: none"> Sorting is done in term of quality, type and size, quality deterioration, and contamination. Fish is separated based on type, quality, and size. The sorting of quality is done based on organoleptic, the sorting of type is done to separate such undesirable types, and the sorting of size is done by weighing. Sorting is done fast, carefully, accurately, and sanitarily by maintaining the temperature of the products maximally 5°C.
Trimming the head of the fish and gutting process, butterflying process	<ol style="list-style-type: none"> Fish is cleaned by following certain steps, namely scaling, trimming the head of the fish, slicing the fish through its belly line to easy the gutting process. Further, the spine of the fish should be pulled to butterfly it.
Washing the fish	<ol style="list-style-type: none"> Fish that has been butterflyed is washed with running water and cleaned from dirt that are still sticking on the outer and inner surfaces of the fish. Washing is done properly, fast, and carefully.
Draining the fish	<ol style="list-style-type: none"> Fish that has been washed is drained until the water does not drip anymore.
Making and spicing process	<ol style="list-style-type: none"> Spices are stored in a hygienic place. Spices that are used to make Lemuru <i>Pedetans</i> are the freshly qualified spices. Spices are made by using hygienic tools, in which the making and spicing process are done by heeding sanitation.
Drying process	<ol style="list-style-type: none"> Fish that has been spiced is dried on racks. The drying process is done properly. The drying racks are kept away from vermins. During the drying, the products should be covered with gauze. Spraying insecticide is banned during the drying. Drying is done by flipping the fish each 3-4 hours due to obtaining equally drying all over the surfaces. A well-dried fish would not leave finger mark after being pressed.
Packaging	<ol style="list-style-type: none"> Dried Lemuru <i>Pedetans</i> should be rested in avoiding condensation after being packaged. Dried Lemuru <i>Pedetans</i> are weighed one by one, so the products could be grouped based on size and weight. Lemuru <i>Pedetans</i> are packaged by using packaging material that would not contaminate the products and could prevent contamination from others contaminants and spoilage. The primary packaging is made from LDPE (Low-Density Poly ethylene), while the secondary packaging is made from Master carton paper. The primary packaging is sealed by using vacuum plastic seamer, while

	the secondary packaging is sealed manually by using duct tape.
	5. The primary packaging is labeled with information related to the type of product, the net weighs, the name of the producer, the address of producer, production date, the composition of nutritions, and expired date. The secondary packaging is labeled with information related to the type of product, the name of the producer, the address of producer, production date, expired date, and the number of primary packaging inside the secondary packaging.
Storing	<ol style="list-style-type: none">1. Master carton boxes that have been filled with products are stacked and stored in a particular storage. Wooden boards are placed between the floor and boxes to hamper direct contact between them.2. The arrangement of the packaged products inside the storage is set to be proper in term of air circulation and easy to uncover.3. Lemuru <i>Pedetans</i> which are stored earlier would be marketed first, based on the First in First out System.

4. Conclusion

- a) The processing process of Sardine '*pedetans*' was discovered to be modest, the condition of both building and environment in which the processing took place was discovered to be inadequate. However, the disposal of the waste has been managed well.
- b) The producers did not pack and label their products due to the lack of knowledge related to packaging.
- c) The processing process of Sardine '*pedetans*' has not met the standard of basic GMP and SSOP applications, hence it should be more intensified to result in qualified and safe traditional foods.
- d) Based on the results of laboratory analyses, there were not any *Escherichia coli* in the tap water for the processing process as well as in the swab result in some steps of processing process. However, in the washing and spicing steps, it was discovered TPC beyond the maximum value required by SNI 2721.1:2009 about the requirements for food quality and safety of dried salted fish.

Conflict of interest statement and funding sources

The author(s) declared that (s)he/they have no competing interest. The study was financed by the authors.

Statement of authorship

The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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