

## Current Situation and Hygiene Practices In Seafood Processing Plants in Aegean and Marmara Regions\*

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**Özet: Ege ve Marmara Bölgesi Su Ürünleri İşleme Tesislerinin Mevcut Durumu ve Hijyen Uygulamaları.** Bu çalışma, Türkiye su ürünleri ihracat ve üretiminin büyük bir kısmını elinde bulunduran Ege ve Marmara Bölgesi'nde su ürünleri işleyen 25 adet tesisin (toplam 10 il) üretim ve hijyen durumlarının tespit edilmesi amacıyla yapılmıştır. Çalışma sonucunda elde edilen verilere göre, işletmelerin birçoğunda görülen başlıca olumsuzlukların şu şekilde olduğu belirlenmiştir. İşletmelerin önemli bir bölümünde hijyenden sorumlu personelin kalifiye eleman olmadığı, hijyen konusunda işçilerin bilgi ve uygulama eksikliklerinden kaynaklanan büyük sıkıntıların yaşandığı, kullanma suyu ile ilgili uygulamaların yönetmeliklere uygun yapılmadığı, işletmelerde havalandırma kontrolü ve temizliğine gerekli önemin verilmediği, işletmelerin birçoğunda faal durumda laboratuvarların bulunmadığı, işletmelerin HACCP planlarının yeterince ve doğru yapılandırılmamış olduğu ve hijyen akış planlarının yetersizliği gibi oldukça önem arz eden aksaklıklar görülmüştür. Elde edilen sonuçlardan birisi de işletmeler kuruluş aşamasında yetersiz kapasiteye göre dizayn edilmiş olduklarından HACCP sisteminin işlerliğinde, özellikle de proses akışında istenilen hijyen standartlarının sağlanamaması problemi ortaya çıkarmaktadır. Bu olumsuzlukların yanında, özellikle yurt dışında marka olarak tanınan ve pazar payı olan işletmelerin birçoğunda hammadde, ürün, üretim ve personel başta olmak üzere gerekli hijyen şartlarının sağlandığı ve eksiklikler konusunda da gerekli önlemlerin alındığı görülmektedir. Elde edilen bu verilere göre, Ege ve Marmara Bölgesi'nde su ürünleri işleyen işletmelerin hijyen konusunda aynı hassasiyeti göstermedikleri, işletmelerin bir kısmının olması gereken hijyen kurallarını doğru bir şekilde uygulamasına rağmen, bazı işletmelerin yeterli hassasiyeti göstermediği anlaşılmaktadır.

**Anahtar Kelimeler:** İşleme tesisi, Hijyen, Kalite, Türkiye, Su ürünleri.

**Abstract:** This study is performed to assess the production and hygiene situation of 25 seafood processing plants (total 10 province) operating in the Aegean and Marmara Regions of Turkey from where the majority of production and export is realised. According to the data obtained in the study, main deficiencies observed in the majority of plants may be given as follows. An important majority of plants lacking of a qualified personnel responsible from hygiene, difficulties originating from lack of knowledge and poor hygiene practices by the workers, absence of monitoring plans for process water quality required by the regulations, air quality in plants is not considered properly, no laboratory in the majority of the plants, poorly established HACCP systems and insufficient hygiene monitoring plans, were the deficiencies observed. The HACCP system is not functioning properly, particularly the desired hygiene standards in process flow are not achieved, because of the insufficient initial capacity of plants. Despite all these deficiencies, particularly in some of the companies with a good reputation and market shares abroad, required hygiene requirements were perfectly met. The results showed that some of the fisheries processing plants in Aegean and Marmara Regions implemented hygiene rules accordingly while some others failed to meet it properly.

**Key Words:** Seafood processing plant, hygiene, quality, Turkey, fisheries.

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### Introduction

The large majority of fisheries processing plants in Turkey are composed of small and medium-sized enterprises. The fresh or chilled fish accounts for more than 40% of fisheries products exported in 2004. About 70% of the total sea fish production is consumed fresh (in Turkey). Frozen, canned, brined, and marinated fish consumption is quite low. In Turkey, average fish consumption is 7-8 kg/year per person which is an indicator for low consumption of processed fish (Kutlu and Misir 2007). Majority of fisheries processing plants in Turkey, export their products to the European (e.g. Italy, Germany) and far eastern countries (e.g. Japan, Korean) and obtain considerable amount of hard-currency income (Çapkin et al. 2008). Processing plants meeting the legal requirements are approved by Protection and Control General Directorate of

Ministry of Agriculture and Rural Affairs. According to the statistics released in 2007, fisheries processing plants operating in Turkey are scattered in the regions of Aegean (39.8%), Marmara (27.55%) and inland Anatolia (14.29%). In 1998, the European Union banned imports of fisheries products from Turkey because of failure to comply with hygiene regulations. Following this ban, Ministry of Agriculture has adopted EU directive 91/492 for inspection of fishery processing plants (Anon 2007).

When the proper storage conditions were not provided for aquaculture products, some quality changes leading to food poisoning may occur. Such problems may be avoided by implementation of right hygiene, sanitation and preservation conditions from farm to fork (Çakır et al. 2006). Hygiene requirements and trainings is utmost important for all the

personnel working in the seafood industry. These personnel are living in the same environment with microorganisms responsible from food deterioration and poisonings. The extent of contamination caused by these microorganisms depends on environmental and sanitation conditions. Failure in implementation of hygiene and sanitation rules may cause occurrences of undesirable substances in products. Prevention of undesirable substances in foods is only possible by good hygiene control in the processing plants. Hygienic measures include cleaning and disinfection of food contact area and personnel hygiene of workers. Production of high quality and healthy products are possible by implementation of cleaning and disinfection procedures for processing tools, equipment and surfaces in contact with food and the personnel hygiene of workers (Üçok 2003).

As in other food sectors, there is a growing customer demand for the consumption of secure food from farm to fork. High quality and healthy production is maintained only when hygiene requirements are obeyed through food chain from harvesting to consumer. By the establishment of quality assurance systems in the plants, safety in fisheries production will be secured. In this study, present situation and hygiene conditions of the 25 fisheries processing plants with a big domestic and foreign market shares and located in the Aegean and Marmara regions were investigated.

#### Material and Method

The present study was performed in 25 companies located in 10 provinces within the border of Aegean and Marmara Regions between the dates of 01.10.2007 and 31.03.2008. The seafood processing plants were selected from the data bases of Provincial Directorates of Agricultural Ministry, Foreign Trade Office and Aegean Export Union, Live Animals and Seafood Export Union, Live animals and fisheries export union. The selections of processing plants were based on the following criteria; currently active and operating in the region, major production activity are fisheries processing, and had a reasonable domestic and foreign market share. The heavy production seasons were particularly chosen for plant visits. Information about processing plant and production were gathered during face to face meetings with plant or production managers. Most of the processing plants opened their production areas for inspection and therefore production work flow and hygiene situation of the plants were also inspected in place and checked against the information collected.

During visits 28 different questions were raised for collecting information about various subjects such as; product groups processed, production capacity, variety of raw materials and acceptance criteria, personal hygiene of workers, factory hygiene plans/flow charts, cold chain parameters, suitability of factory design/infrastructure for the product groups, hygiene problems faced in the plant, air conditioning of the plant, chemicals used for hygiene, liquid and solid waste disposal, pest control.

#### Results and Discussions

##### **Current situation of the plants:**

The plants inspected were established in the last ten years. The oldest plant was established in 1960, later in 1990 another five plants, in following years between 1991-1995 three, between 1996-2000 and 2001-2005 seven and after 2005 three new plants were established. Fishery products processing is a quite new and a developing sector in Turkey. Most of those processing plants were started as small family businesses whereas the plants established in the recent years are rather institutional enterprises. Aquaculture processing plants in the Aegean Sea coast were established to increase the value of their products. The investigated plants were more densely scattered throughout mainly in Izmir and Mugla provinces and the Aegean Sea coast. The plants were established particularly by the sea coast, organized industry zones and in areas where the raw materials and cheap labour are easily reached. For instance, rainbow trout processing plants (smoked) were established around Fethiye where fish farming is common while sea bream and sea bass packaging plants were established in areas where cage farming is widely practiced (Milas and Bodrum). Our inspection results showed that the plants established closer to raw material sources were running more efficiently.

##### **Raw material and product availability and hygiene issues:**

Sea bream, sea bass and rainbow trout are widely processed fish species. Majority of the plants involve packaging of fresh or chilled and frozen fishery products. These plants were located around Mugla (particularly Milas and Bodrum), Izmir, Aydın and Balıkesir where sea bream, sea bass and rainbow trout are widely cultured. Large majority of fisheries products were exported to European countries such as Netherlands, Spain, Italy Germany, Greece, France and United Kingdom. Fresh or chilled and smoked rainbow trout were the most demanded fish in the foreign market. Whereas, in local market, fishery products are generally sold fresh, chilled or frozen. There have been large investments in the areas of processed and canned fish production. Production of canned, frozen, brined, smoked and marinated fishery products were concentrated in coastlines of Marmara, Aegean and Black Sea regions. These developments largely contributed to fish consumption in Turkey (Kutlu and Mısırlı 2007). Fresh fish consumption habits have unfavourable effects on development of fisheries sector in Turkey. In order to increase both fish production and consumption per person of population, growth in consumption of processed fisheries product is vital. Most of the plants in Aegean and Marmara Regions process similar raw materials using the same method.

The criteria used by businesses subject to analysis for acceptance of raw materials differ according to their product range. An implementation of product acceptance temperature has been identified in all the plants. Those plants acquire fish from their own farms stated that they experience less trouble in product acceptance temperature. Those who buy the raw

materials from remote areas state that they try to maintain product acceptance temperature by refrigerated transportation. Although plants often mention goods acceptance temperature, such parameters like tank temperature, product temperature in the self-regulatory forms are not fully recorded and usually the temperature of the vehicle is accepted as goods acceptance temperature, furthermore it is observed that the issues like thermometer control and calibration are totally ignored. All these indicate that hygiene control is failed even at the plant entrance.

#### **Personnel status and human caused hygiene problems:**

In the majority of processing plants there is not enough manpower and qualified technical personnel. Plants visited were established mainly in small towns and villages where there are no social facilities. This hinders employment of qualified personnel on permanent base. It is a fact that personnel turnover rates in processing plants are quite high. The numbers of seasonal workers in the processing plants are expected to be very high due to hard working conditions, low payments, work risks *etc.* but in this study, it was assessed that most of the plants employed permanent personnel. Only in five plants seasonal workers (10 - 50) were employed. Number of workers employed in processing plants on full-time basis ranged between 0-160 (Table 1).

Table 1. Number of workers employed in processing plants on full-time.

Number of plants	Number of full-time workers
1	0-9
10	10-25
6	26-50
5	51-75
1	76-99
2	100-160

About 200 technical personnel and 2000 unskilled workers (fisheries engineer, fisheries technician, agricultural engineer, biologist *etc.*) were employed in fisheries sector in Mugla province (Özdemir and Dirican 2006). Numbers of workers employed in almost all of the plants operating in Black Sea region were ranged between 50 and 100 depending on the work season (Kutlu and Mısır 2007). Fisheries plants located in Beyşehir suffered the most finding qualified personnel. All of the processing plants have employed engineers on a permanent basis. The unskilled workers employed were generally consisted of women at the ages of between 16 and 25 (Çapkın et al. 2008). In a white sand mussel processing plant depending on the size and volume of business, number of workers and technical personnel ranged between 27 to 150 and 2 to 24 respectively. A total of more than 500 unskilled workers and 55 technical personnel have been employed in six sand mussels processing plants investigated by Dalgıç et al. (2006). In the same study, it was reported that total of fifteen companies applied for two shell mollusc exportation in 2001, but only two of them had white sand muscles processing plants.

Education level of workers, in plants located in small cities, were primary school whereas in plants closer to or in

the large cities educational levels increased to secondary school level. None of the workers held higher education degrees. Company executives stated that low levels of education caused considerable problems in maintaining high quality documents. The HACCP regulation requires that all self-control forms (cold room temperatures, cleaning-sanitation records *etc.*) to be completed by the plant personnel performing the job. Unsound records will danger safety in the food chain.

In 87% of the plants, 84% of the personnel were fisheries engineer and the remaining comprised of food engineers and biologists. Almost all personnel responsible for hygiene activities at the plants were also held production manager responsibilities. This situation generates serious risks from the food safety point of view. Personnel, supervising manufacture and responsibility for plant hygiene, struggle to fulfil their job because they are following developments in quality control systems in fisheries. Turkey is in line with the EU regulations in the area of fisheries, particularly the quality control system activities. Yet, there is a need for staff training and generating our own instructions in line with the "Good Laboratory Practice" practiced in EU (Diler and Bolat 2006). Regular training programmes were conducted in all the plants except the two. Of the two plants inspected, no training was given in one plant while irregular trainings were given in the other. Frequency of training ranged between twice a month and once in a six months period. At some occasions, training supports were provided by detergent companies working on a contract-based. The effectiveness of trainings was hampered due to unspecified annual training hours per person, lack of corrective actions and precautionary measures for emergency situations in the system. Reduced effectiveness results in deteriorated hygiene standards. Conditions of work uniforms of the workers are an indicator of good hygienic practice in a plant. In plants, processing various products (e.g. marinades, fillet, shellfish), working uniforms with different colours were used. In some plants, processing fumed rainbow trout, colour of work uniforms changed depending on the processing steps. In general, protective clothing such as aprons, gloves, coveralls and bonnets were provided for workers. Interviews showed that cleaning periods of the work uniforms were followed only by a few plants. This situation gives the impression that the plants were not very persistent about cleaning work uniforms. Working uniforms with different colours are very important for the control of workers crossing between different departments (e.g. from production to packaging department) and prevention of cross-contamination, particularly in plants with complex processing steps and processing different produce. In the majority of plants, work uniforms were washed by workers at their home and changing from street clothes into work clothes before commencing production activities were not programmed. Wearing the same work uniform repeatedly makes sanitation control harder and also imposes a potential risk of cross-contamination.

Despite the fact that companies with more than 50 workers are obliged to employ a full-time medical doctor, not all plants had a company doctor. It is stated that companies with more than 50 employees had a regular doctor visits on a daily base. In relatively small plants, company doctors visited plants once or twice a week. In some regions, medical support received from doctors working for local health centres. Plants located in the central areas, employed full-time doctors and nurses as assistant health officers. As is well known, so many microorganisms may be spread around in several ways such as sneezing, coughing and nose cleaning. A company doctor in the premises will provide swift medical care for workers and as a result human induced food contaminations will be minimized.

Temelli et al. (2005) report that 60% of personnel working in food production plants are not washing their hands properly and 25-40% of food originated diseases are transmitted / caused staffs who work in food processing department. They also determined that employees become carriers for pathogens that caused food poisoning because of not washing their hands sufficiently after using the toilet. It is observed that in most of the plants workers used latex gloves while others, depending on the process, preferred kitchen gloves. The kitchen gloves need to be cleaned and sanitized regularly if they were reused. However, it appears that plants did not have such a procedure of cleaning. Replacement frequency for single-use latex gloves was twice in a day. In the event that workers do have an injury in their hands, it is required that they use double gloves and waterproof bandages but we observed that workers were ignorant about these subjects and they only adopted a rule of changing gloves just after the breaks. However, this type of misuse increases the risk of cross contamination. It was seen that there no plants that integrated gloves use duration into their business standard.

#### **Hygiene conditions related to the plant structures:**

Design, operation and location of air conditioning system inside the plant have a considerable effect on microbial counts in the air. People living in cities, spend most of their time (up to 80%) in closed areas wherein more exposed to contaminants. Also, food manufacturing, stock and service areas have a direct effect on contamination of foodstuff. Therefore, indoor air quality is more important compared to outside air. In fact, air samples taken from schools, restaurants, houses, shopping centres, were found to be more heavily contaminated than outside air samples (Çöl and Aksu 2007). The use of central air conditioning systems were not very common in the plants inspected. In many plants, split type air conditioning systems were used for cooling processing areas. Air filters and air quality requirements were not defined in the hygiene and sanitation programmes of the plants. It was observed that checking air conditioning systems and air quality were among the ignored hygiene elements. The indoor and cold room temperatures were all computer-controlled and temperature readings were recorded manually. Temperature measurements of the products stored in the cold

rooms were not a common practice in the fisheries plants. This brings problems of higher processing and storage room temperatures and may cause a break in the cold chain. The plants did not get their personnel to accept the fact that control of the both processing and cold room temperatures is critical control points. In such a case, personnel cannot comprehend how the temperature related problems put the system in danger.

Most of the plants have waste storage rooms maintained at a temperature of 0-10 °C. The size of waste rooms, their location in the premises and distances from raw materials acceptance or delivery rooms did not seemed to be well studied. There is an increased risk of microbial contamination if waste storage rooms did not have any drains and were not far enough from processing areas and no designated rules exist about frequency of waste disposal. Also, temperature of the waste storage rooms needs to be monitored to prevent any hygiene problems that may arise. According to Hayes (1992) food contact surfaces in fisheries plants are one of the most obvious sources of contamination. If foods get contaminated on the processing lines with remaining of foodstuff from previous production then these surfaces create a risk on food quality and safety. In all the plants inspected, it was observed that the floors and walls were made of easily cleanable materials. For coating plant floors epoxy resins and ceramic were chosen while cold room panels and ceramic were mainly preferred materials for the walls. In this respect, even old establishments successfully adopted new technologies and conformed to the legal requirements. Drainage systems are considered as the weakest points in pest control. Therefore, it is quite important that the drains of the plants kept clean. There were two types of drainage, point and canal, used in the plants. During construction of the plant premises, drainage canals were planned without considering the liquid waste discharge potential. If the slope requirements of the floor for a processing plant floor drain were not obeyed, then easily spoiled fisheries and their waste may cause undesirable smell and sanitation problems.

Wash basins used in the plants were in different types (knee-controlled faucet, manual, elbow operated and photocell operated). With the exception of few plants, the characteristics of processing areas were not considered when they were planned. The uses of manual faucets for wash basins in toilets and at the entrance of processing areas cause cross-contamination. Use of hand disinfectants and disinfectant liquid hand soaps were considered to be quite effective for the prevention of cross-contamination. Recently, common sanitation materials (as soaps and antiseptics) were often replaced by alcohol based disinfectants. The skin friendly character and wide spectrum antimicrobial activity of alcohol based disinfectants has stimulated their use as the hand disinfectants in many areas. It is observed that staff responsible from hygiene and working personnel lacks information about the content of the disinfectants used after hand wash. The lack of control over the usage frequency of alcohol based disinfectants in preparation desks and production lines may lead to contaminations in final products.

Most of the plants did not have properly working laboratory, those had a laboratory did not use it actively. The main reason for this, as was stated, stems from the fact that outsourcing for analyses less costly than employment of laboratory personnel. It is believed that omitting the analysis of raw materials, additives (salt, vinegar, aromatic compounds, etc.), water and the final products is one of the biggest deficiencies in quality system of the most companies. The analysis of process water for bacteria (coliform, *E. coli*) is carried out by the plants with actively running laboratories.

#### **Pest control**

It is very important to have proper pest control every where food is present. Lack of pest control may cause not only hygiene problems and negative health effects in humans but also economic losses for companies. However, pest control should be conducted carefully and consciously. Primarily, proper measures needs to be taken inside and outside of the plant for pests not to shelter, premises should be designed properly and kept clean and tidy. Critical points such as waste collection areas needs to be disinfected regularly (Aksu and Çetin 2000). All the plants visited claimed that they implemented pest control. In most of the plants (76%) pest control companies provided treatment for pest control at least once a month and remaining 24% implemented pest control twice a month by their own facilities. Pest control treatments focused on pests such as flies and mice and mainly concentrated in raw materials acceptance areas.

#### **Quality of water and hygiene chemicals used in the plants**

Vieira et al. (1997) reported that the main reason for fish spoilage was the water used for production of cooling ice. It was concluded that the ice used for food applications must be produced from drinking water. Artesian water is commonly used in most of the plants. Depending of the water characteristics it is purified using ion exchange resins, sand filters and chlorination. In cases of poor water quality, additional techniques such as reverse osmosis and ozone disinfection were applied. In the most plants, there is no analysis laboratory available for water quality checks. Regular water quality monitoring is performed by the Ministry of Agriculture at 6 months intervals. When the water quality was suspected, private laboratories were used for the analyses. As water is intensely used in fisheries plants poor quality checks for water may create major hygiene risks.

Majority of the companies inspected, purchased disinfectant chemicals from expert/professional companies work on a contract-based. These companies state that they base their choice of chemicals on the effectiveness of the detergents, swap test results and price. It is also realised (understood) that some of the companies use detergents which are bought from market having no professional property. Most of the detergents purchased from the market were not suitable for industrial applications. Only visual cleaning is carried out using this type of detergents but efficient disinfection was never possible to achieve. Those

companies that work with professional companies getting a training and support from these companies make their workers conscious about not only on the use of detergents but also on the general hygiene rules and food safety. The sanitation monitoring was carried out by department chiefs using surface control tests. Since visual checks cannot provide warranty for cleanness, it is thought that use surface tests and changing detergents periodically will be helpful.

#### **HACCP-related issues**

The HACCP system was implemented by 22 plants while 3 plants failed to implement it accordingly. For establishment of the HACCP system 12 of the plants received professional help from the consulting firms, one of them from a university, two of them from the Provincial Directorate of Agriculture and 7 of them established the system without any help from outside. According to our observations, even though their processing steps were different, companies received support from the same consulting firm, determined the same points as Critical Control Points (CCP). This shows that differences between various processing lines were not considered as required by the HACCP system.

Such plants were forced either to change processes or to re-determine CCPs because of insufficiency of these points in the future times. Those plants that established the HACCP systems with the help of consulting firms experienced problems due to the lack of training and education of their staff responsible from hygiene. Although, the HACCP system seemed to be working properly, but later on failed to meet food hygiene and safety requirements and so the system was just confined to a paper work. Compared to European countries, the situation in Turkey is not very bright. In terms of number of organizations that have a quality certificate, Turkey is not placed in the world ranking but ranked last in Europe. In fact, HACCP certificate is a must for export-oriented companies trying particularly to export to European countries. It is obvious that this type of quality documents provide a competitive advantage for organizations against their competitors (İlkay and Varinli 2005). It is specified that hygiene flow plan exists in all of the plants implemented HACCP. However, it is observed that they did not transfer the changes in their processes and product differentiations to HACCP plans, but they remained loyal only to hygiene flow given in the first stage of the plan. It is a fact that unrevised hygiene plans will lead to unavoidable food safety and hygiene problems in the future. At the same time, according to our observations, the working staffs do not have a deep knowledge of HACCP and they are trying to comply with the rules determined by the responsible staff.

It is specified that the most difficult tasks for business to handle in terms of hygiene stems from the fact that their staff do not follow hygiene rules and operational problems arising from the physical conditions of the plants. Many plants report that they do not have problems, but they also state that when there is returning product, they notice the problem, and then they look for a solution. The difficulties arise from the facts that the plants were planned for a small capacity in the

beginning without considering the requirements of the HACCP system and the process flows reduce applicability and implementation of hygiene standards.

## Conclusion

Food security in fisheries requires implementation of hygiene procedures and regulations at every stage of food chain, from raw material to consumption. Safe consumption of fisheries can only be provided by awareness and honesty of both producers, company workers, marketing personnel, inspector and consumers. Shortcomings in hygiene implementations of fisheries production plants stand out on final products. No matter how hygienic production line is and how good the technology used final product will always be low in quality unless the raw materials had desired specifications. Similarly, reverse is also true. If high quality raw materials were not processed properly, such as poor hygienic conditions, ill-selected equipment in production as well as low quality chemicals used for cleaning, will cause serious problems in production. It is necessary for a company to show the most care in each production stage to have high quality production. In a company where personnel are careless, hygiene issues will arise and that will be reflected directly into production.

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In this context, as a result of the study on seafood processing plants in the Aegean and Marmara Region, the presence of following hygiene practices and deficiencies have been identified:

1. The number of staff responsible for hygiene in the companies is very few and qualified staffs were not employed,
2. Plants suffered from hygiene particularly in terms of labour,
3. Companies have not been very successful implementing hygiene requirements, except export-oriented companies, companies received their HACCP certificates from reputable international corporations and also the plants employed experienced staff for hygiene implementations,
4. It is observed that there are only one or two plants monitoring process water quality regularly and most of the plants get the water analyzed once in 6 months as forced by the law. The production carried out by such companies that use process water remained uncontrolled for a long time may be unsafe,
5. Finally, it was observed that not all plants were so sensitive about hygiene practices.

It is hoped that the number of seafood processing plants increase rapidly and reach the desired level of quality, so consumers will be able to consume healthier and better quality fisheries products.