UNIVERSITI PUTRA MALAYSIA

COMPLIANCE TO HYGIENE STANDARD AMONG VESSEL OWNERS AND CREW ON BOARD OF PAHANG DEEP SEA FISHING VESSELS IN MALAYSIA

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By

NORAZIZAH BINTI KEMAT

Thesis Summited to the School of Graduate Studies, Universiti Putra Malaysia in Fulfillment of the Requirement for the Master of Science

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Chair: Associate Professor Dr Nor Ainy Binti Mahyudin, PhD
Faculty: Food Science And Technology

Fishing vessel is categorized as primary producer where vessel operators must ensure that measures to control environmental contamination are enforced and implemented. This study aimed to determine hygiene knowledge, attitude and practices among fishing vessel crews; to evaluate barriers and needs for on board hygiene implementation among vessel owners; to assess the microbiological quality of fish hold, fish tank and fish deck before and after loading operations; and to establish the relationship among socio demographic, hygiene practice as well as microbial quality of gloves surfaces. Data for knowledge, attitude and practices were collected from 70 fishing vessel crews using a structured questionnaire; Barriers and needs to implement current on board hygiene were assessed using a structured checklist among 17 vessel owners. Analysis of food contact surfaces on board (fish hold, fish tank, fish deck and gloves) were tested for total aerobic count, *Escherichia coli*, coliform, yeast, moulds and S*taphylococcus aureus.* Data were analysed using standard statistical method. The results showed that the vessel crews have good attitude (85.2%), sufficient knowledge (71.48 %) of on board hygiene, however they lack in practices (30.64%). There was a significant correlation between practices and knowledge ($P = 0.000$), indicating that hygiene knowledge influenced vessel crews hygiene practices but not their attitudes. Three major barriers were identified; comfortable with existing practices, less exposure on information from authority and difficulty to get public soft loan. These barriers were significantly correlated ($P < 0.05$) to education, experience, ethnic and training among the vessel owners. The hygiene level of all contact surfaces before cleaning activity was unacceptable based on the total aerobic count (> 5.0 CFU/cm^2). The microbial load on all contact surfaces were found to be at moderate hygienic level for coliform (0.2 - 1.0 CFU/cm^2) and yeast (1.0 - 5.0 CFU/cm^2). For moulds, only fish tank and fish deck surfaces contained < 0.6 CFU/ cm^2 (good hygienic level), while fish

hold and gloves were of moderate level (0.6 - 1.6 CFU/cm^2). The study also showed that after cleaning activity, hygiene level of all contact surfaces was still unacceptable for total aerobic count. All surfaces demonstrated a good hygienic level based on coliform, yeast and moulds counts, except for fish deck which was moderate for coliform. *S. aureus* was detected (< 1.0 CFU/cm^2) on all surfaces during the study. Only coliform load was significantly correlated with training. A significant relationship between microbial load (total aerobic count, coliform and yeast) and poor hygiene practices was established (P< 0.05). This study provides an insight that training and awareness on good hygiene practices should be emphasized among vessel crews and owners.

Keywords: Vessel Owner; Vessel Crew; Knowledge, Attitude and Practices; Microbiological Assessment; On Board Hygiene

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

PEMATUHAN STANDARD KEBERSIHAN ATAS VESEL PENANGKAPAN IKAN LAUT DALAM DI KALANGAN PEMILIK DAN KRU VESEL NEGERI PAHANG, MALAYSIA

Oleh

NORAZIZAH BINTI KEMAT

November 2018

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Vesel perikanan dikategorikan sebagai pengeluar utama di mana pengendali vesel mesti memastikan bahawa langkah-langkah untuk mengawal pencemaran alam sekitar diambil dan dilaksanakan. Kajian ini bertujuan untuk mengetahui tahap pengetahuan, sikap dan amalan kebersihan di kalangan kru vesel pukat tunda; untuk menilai jenis halangan dan keperluan dalam melaksanakan standard amalan kebersihan atas vesel di kalangan pemilik vesel; untuk menilai tahap mikrob pada permukaan petak ikan, tong ikan dan dek ikan sebelum dan selepas operasi pemunggahan; dan mengenalpasti kewujudan hubungan sosio-demografi, amalan kebersihan dan tahap mikrob atas permukaan sarung tangan. Data untuk pengetahuan, amalan dan sikap melibatkan seramai 70 kru vesel menggunakan soal selidik berstruktur; Halangan dan keperluan untuk melaksanakan kebersihan di atas vesel dinilai dengan menggunakan senarai semakan berstruktur membabitkan 17 pemilik vesel. Analisis permukaan sentuhan ikan di atas vesel (petak ikan, tong ikan, dek ikan dan sarung tangan) telah diuji untuk Total Aerobic Count (APC), *Escherichia coli*, koliform, yis, fungi dan *Staphylococcus aureus*. Data dianalisa menggunakan kaedah statistik standard. Keputusan menunjukkan bahawa kru vesel mempunyai sikap yang baik (85.2%), pengetahuan yang mencukupi (71.48%) tetapi tahap amalan yang rendah (30.64%). Terdapat hubungan yang signifikan antara amalan dan pengetahuan (P = 0.000), yang menunjukkan bahawa pengetahuan kebersihan mempengaruhi amalan kebersihan kru vesel tetapi tidak sikap mereka. Tiga halangan utama dikenalpasti; selesa dengan amalan sedia ada, kurang pendedahan maklumat daripada pihak berkuasa dan kesukaran mendapatkan pinjaman mudah awam. Halangan-halangan ini berkorelasi dengan ketara (P <0.05) kepada pendidikan, pengalaman, etnik dan latihan di kalangan pemilik vesel. Tahap kebersihan semua permukaan sentuhan sebelum aktiviti pembersihan didapati pada tahap tidak dibenarkan berdasarkan jumlah total aerobik (> 5.0 CFU/cm^2). Jumlah mikrob pada semua permukaan sentuhan didapati berada

pada tahap kebersihan sederhana untuk koliform (0.2 - 1.0 CFU/cm^2) dan yis (1.0 -5.0 CFU/cm^2). Untuk fungi, hanya tangki ikan dan permukaan dek ikan mengandungi <0.6 CFU/cm^2 (tahap kebersihan yang baik), manakala petak ikan dan sarung tangan adalah di tahap sederhana (0.6 - 1.6 CFU/cm^2). Kajian itu juga menunjukkan bahawa selepas aktiviti pembersihan, tahap kebersihan semua permukaan sentuhan masih tidak dapat diterima untuk APC. Semua permukaan menunjukkan tahap kebersihan yang baik berdasarkan kiraan koliform, yis dan fungi, kecuali dek ikan yang sederhana untuk koliform. Semasa kajian, *S. aureus* dikesan (<1.0 CFU/ cm^2) di semua permukaan. Jumlah koliform mempunyai hubung dengan latihan. Hubungan yang ketara antara jumlah mikrob (APC, koliform dan yis) dan amalan kebersihan yang rendah telah dikenalpasti (P <0.05). Kajian ini memberi gambaran bahawa latihan dan kesedaran mengenai amalan kebersihan yang baik harus ditekankan di kalangan kru vesel.

Kata kunci: Pemilik vessel; Kru Vesel; Pengetahuan, Sikap dan Amalan; Penilaian mikrobiologi; Kebersihan di atas vesel.

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This is to confirm that:

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LIST OF ABBREVIATIONS

%	Percentage
<	Lesser than
>	More than
^{o}C	Degree centigrade
CFU/cm^2	Colony forming unit per centimetre square
MPN/g	Most Probable Number per gram
ml	Millimetre
cm^2	Centimetre square
sec	Second
APC	Aerobic Plate Count
CA	Competent Authority
KAP	Knowledge, Attitude and Practices
BOT	Balance of Trade
CI	Confident interval
Sig	Significant
ND	Not Detect

CHAPTER 1

INTRODUCTION

1.1 Background

The demand for high quality fish and safe is generally increasing in the world. Usually customers prefer to buy fresh fish rather than frozen ones. Thus, fresh fish of high quality can become marketing advantages for those who can offer high quality unfrozen fish to the customer. Quality of fish and fish products is the most importance issue in the fisheries industries, particularly in the developing countries. The fisheries sector provides both food and employment for millions of people as well as fish for consumers who have their rights to eat food which has been caught, handled and treated in a good way. Food processing or distributing companies cannot be self-sustaining unless they recognise the importance of quality. That means the safety and quality system need to be in place and put into action in the vessel establishments.

Many fishermen only consider the needs to maintain the quality of the product in order to get better returns of the catch but neglect the aspect of food safety. Whereas, some consumers worry about what happens to their food before they eat it. They look for quality and they worry about what may have happened to the fish before they eat it. In the end, they have to trust fishermen, processors and traders to be very careful with the fish they catch and handle. Many countries that import a lot of fish have regulations to protect consumers from eating fishery products that can cause food poisoning. Failing to meet these requirements may affect the fish to be banned from entering that market. It will affect the current business and it will suffer as a consequence. Each country has established its regulation in order to ensure good and safe fish for consumption.

Food contamination may occur at any point during its journey through production, processing, distribution, and preparation (Aklilu et al., 2015). The risk of food getting contaminated depends largely on the health status of the food handlers, their personal hygiene, knowledge and practice of food hygiene (Mama & Alemu, 2016). Infections can also be acquired through contaminated unwashed fingers, insects, and circulation of bank notes and by wind during dry conditions (Isara & Isah, 2009). Certain foodstuffs may present specific hazards to human health, requiring the setting of specific hygiene rules. This is particularly the case for food of animal origin, in which microbiological and chemical hazards have frequently been reported. Under the Malaysia Food Act 1983 and Food Hygiene Regulation 2009, these act are regulated to

establish specific health rules for the production and placing on the market of the products listed. These health rules have reduced trade barriers for the products concerned, contributing to the creation of the internal market while ensuring a high level of protection of public health. Fishing vessels have been identified as one of the food business operators which are also bound by the Regulations of Malaysia Food Act 1983 and the Food Hygiene Regulations 2009. Fishermen or crews on board fishing vessels are categorized as food handlers that work in food facilities that categorized in Type II with medium risk. This is because they directly handle seafood during different stages, including transferring seafood from fishing nets to boat and while handling, sorting, grading, bleeding, gutting, washing, freezing, storing and unloading the seafood (Zanin, da Cunha, Stedefeldt, & Capriles, 2015). Sea Fish Industry Authority & Seafood Scotland (2006) also has identified that the first and foremost crew on board fishing vessels are fishermen and they are also classified as food handlers.

As food handlers, they have both legal and moral responsibility in handling the fish in such a way as to prevent its contamination. Fishermen are involved at the very start of the food supply chain; they harvest a natural resource which means they are involved in working with produce subjected to basic grading and washing, which will then be subject to further processing prior to consumption and bring it ashore for further processing. The food safety risks in handling the fish at this stage are considered low. Fish will spoil more quickly if it is contaminated as a result of poor crew hygiene practice. Good hygienic practices in the handling, manufacturing and transportation of fish and fish products, and adequate refrigeration throughout, can greatly reduce outbreaks of fish-borne illnesses. Measures that ensure high standards of quality and safety, by implication, will also reduce post-harvest losses. The International Organization for Standardization (ISO), the worldwide federation of national standards bodies, defines 'quality' in Quality Management and Quality Assurance as "the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs". The quality of fish and fish products relies principally on safe, hygienically-produced products.

The government is responsible for ensuring adequate food production, safe and quality. The global food crisis in 2008 has clearly explored the implications of the food safety guarantee in the event of high suspension continuously pledged against the import source. Suspension on import sources has not only slow down the ability of importing countries to achieve sufficiency, but also to participate in exposing the importing countries to the political pressure of the exporting country and instability in the global food market. Realizing this, the government of Malaysia is seen to be committed to ensuring the trend of long-term spending length to be increased in the future. The fishing industry must ensure that their fish handling, processing and transportation facilities meet the requisite standards.

According to Cross (1985), the most common illness among fishermen were gastrointestinal complaints, dental conditions, respiratory diseases and dermatological complaints. Diseases occurring on fishing vessel are mainly represented by gastrointestinal disorders caused by pathogenic bacteria such as *Salmonella* sp., *Shigella* sp., and *Vibrio* sp. and also enterotoxigenic *Escherichia coli*. The consumption of contaminated food or water on board of fishing vessel was responsible for most of gastrointestinal outbreaks detected. All the outbreaks had worker involvement of some kind, and the majority of food workers were infected. The most frequently reported factor associated with the involvement of the infected worker was bare hand contact with the food followed by failure to properly wash hands, inadequate cleaning of processing or preparation equipment or utensils, cross-contamination of ready-to-eat foods by contaminated raw ingredients, and temperature abuse (for bacterial pathogens) (Rooney et al., 2004). Many of the vessel crews were asymptomatic shedders or had infected family members and/or used improper hygienic practices. Outbreaks were sorted into categories based on how many workers were implicated, the origin of the infective agent (outbreak setting or off site), the degree of certainty that the worker(s) were the cause or were victims, whether or not the vessel crews denied illness, the ability of the agent to grow in the food, whether only the crews and not the skipper were ill, and whether skipper were more responsible for their illnesses than were the crews. The most frequent scenarios were:-

(i) A single crew causing an outbreak by directly infecting others;
(ii) An infected crew fecally contaminating foods that were then temperature abused, leading to an outbreak; and
(iii) Multiple crews are linked to an outbreak but with no clear initiating source.

Identified contaminated ready-to-eat foods include produce, baked goods, beverages, and meat and poultry items. In some situations, it was not clear whether some of the workers were the cause or the victims of the outbreak. However, in other situations there may have been an underestimation of the role of the crews. For instance, crews sometimes denied infection or illness for a variety of reasons, but subsequent investigation provided evidence of infection.

1.2 Situation in Malaysia

In Malaysia, fisheries capture sector plays an important role in contributing towards food security not only to supply the high quality protein into the diets of people because of its excellent multinational value but also provides generation of employment and procurement of foreign exchange earnings, a source of income as well as a solution to poverty and eviction. Increase of fish demand is mainly caused by an expanding population's economic wellbeing and taste of the consumer which goes in parallel with the national policy. In

2015, Malaysian fish consumption is estimated about 54.77 kg/person/year (N. I. Ahmad et al., 2016). This has put Malaysia as the second highest after Japan among ASEAN nation and rank at 50 in the world. Department of Fisheries Malaysia estimated that this amount will increased to 61.1 kg/person/year in year 2020 (Mazuki, 2015). Currently, the volumes of the fish population from the capture fisheries are currently declining due to depletion and fluctuation of resources. The large proportion of catch tends to be of low economic value and the quality is also poor because of improper postharvest handling and inadequate on board and shore processing and holding facilities.

A total of 2,122 fishing vessels comprising of deep sea and in shore vessel have been licensed by Pahang Fisheries Department in 2015 (Jabatan Perikanan Malaysia, 2015). A total of 411 from the total fishing vessels are using trawler nets which based in Kuantan, Pekan and Rompin district with 2,407 people are working as a skipper and crews in deep sea fishing trawler vessels. From 8,330 people registered as fishermen in Pahang, a total of 4674 employees is of Bumiputera status meanwhile 639 are Chinese, 22 are of other ethnicity and 2,995 are foreign workers. Foreign workers consist of 35.95% of total workers in the capture fisheries industry in Pahang involving deep-sea fishing and coastal fisheries. Most of the foreign workers have been working in deep sea fishing vessels industry which operate at the sea for more than 24 hours.

Application of the Sanitary and Phytosanitary (SPS) measures and the Technical Barriers to Trade (TBT) by world global markets and the World Trade Organization (WTO) is part of the initiatives that been taken to remove internal and external trade barriers in producing a more open food market place by eliminating unnecessary trade barriers. This entails that governments is paving the way for consumers to receive benefits from a greater choice of safe foods and from international competition among producers. There are three main government agencies involved in food safety enforcement for fish and fishery products in Malaysia; Ministry of Health, Department of Veterinary Services and Department of Fisheries.
Department of Fisheries (DOF) has been recognized by European Union (EU) and the Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) of China as the Malaysian Competent Authority (CA) for official control for vessels. Under the official controls, all fishing vessels which supply fish products to the establishments approved for export to EU countries, need to be approved. Approval is compulsory for those vessels that wish to export and the vessel must comply with the standards and guidelines which have been established. Vessels which fish for domestic supply are not required to follow the guidelines which have been established for EU Export purpose due to Malaysia does not have any regulations requiring vessels to comply with the guidelines and it is more to volunteering purpose. In 2015, only eight (8) vessels in Pahang have been registered and participated in the program.

In terms of food safety, fish is generally considered a low risk product. However, high standards of food safety are important to ensure public confidence in fish as a safe and wholesome food remains high. The food safety risks most often associated with fish and fishery products are physical contamination, chemical contamination, or infestation of the product. Bacterial spoilage will affect the eating quality. Beyond the basic requirements for hygiene standards that ensure food safety, high standards of care are necessary when handling fish, which is of a delicate and perishable nature, in order to achieve a level of product quality that will provide for customer satisfaction. Good care of the catch will also reduce waste and help to secure a better return from a finite and regulated resource.

Sources of bacterial hazards include dirty fish rooms/holds, equipment, boxes, and poor hygiene standards on the part of the crew, and bacteria already present on fish will multiply much more rapidly if the fish is not gutted and iced as soon as possible after being caught. Bacterial spoilage is the major factor affecting the freshness of white fish. Although it is accepted that such bacterial spoilage is not a food safety issue, it is still important with regard to fish freshness and consumer acceptability.

1.3 Problem Statement

In Pahang, there are 448 registered deep sea fishing vessels that have been frequently monitored by the competent authority, the DOF under Sanitary and Phytosanitary (SPS) Marine Monitoring Programme and Hygiene on Board (HOB) Programme. The SPS Marine Monitoring Programme monitors safety and quality of fisheries capture commodity (deep sea fishing, inshore fisheries and marine aquaculture). The parameter for safety and quality includes microbiology, histamine, freshness index and chemical contaminant and it provides baseline data for the management of safety and quality of fish for domestic market. The HOB Programme is voluntary and applied to those who intend to export their products to the EU countries. The activities involved sampling and surveillance audit which is carried out by DOF as the CA based on the EU regulations. The hygiene and sanitary level under the HOB programme is measured by two main mechanisms, namely (i) hygiene condition on the vessel and (ii) sampling of fish caught on-board for laboratory test.

Fishing vessels have been identified as one of the food business operators which are also bound by the Regulations of Malaysia Food Act 1983 and the Food Hygiene Regulations 2009. However, fishing vessel in Malaysia is under jurisdiction of DOF whereby until at present, there was no specific training module for vessel crews and skippers on good handling hygiene practices/safe fish handling. Most of the trainings that have been conducted were non-food hygiene related such as vessel operations, fishing technology and equipment maintenance such as outboard engine maintenance. Fish that have been

caught at open sea are normally free from microbial contamination. Improper post-harvest handling would affect the quality and safety of the catch. Therefore, vessel crews should be aware that their roles are crucial to assure the quality and safety of the products. To date, there has been no published data on hygiene compliance among crews on board of fishing vessel as well as barriers and needs to implement hygiene on board standard in deep sea fishing industry in Malaysia. This study is unique as it defines factors that may influence hygiene and sanitary level of deep sea fishing vessels. The findings from this study would be recommended to the fisheries authority to improve the current procedures for hygiene on board programme.

1.4 Objective

1.4.1 Research Objective

The main goal of this research is to access hygiene and sanitary level on deep sea fishing vessel in Kuantan, Pekan and Rompin districts, Pahang. Specifically, the objectives are,

1. To determine the level of hygiene knowledge, attitude and practices (KAP) among crews on board of trawlers fishing vessels
2. To evaluate barriers and needs for hygiene on board implementation among vessel owners
3. To assess the microbiological quality of fish hold, fish tank and fish deck before and after loading operations
4. To establish the relationship among socio demographic, hygiene practice, microbial quality of gloves surfaces.

1.4.2 Research Flow

The Research Flow on Compliance to Hygiene Standard By Crews On Board of Pahang Deep Sea Trawlers Fishing Vessels are as in Figure 1.1.

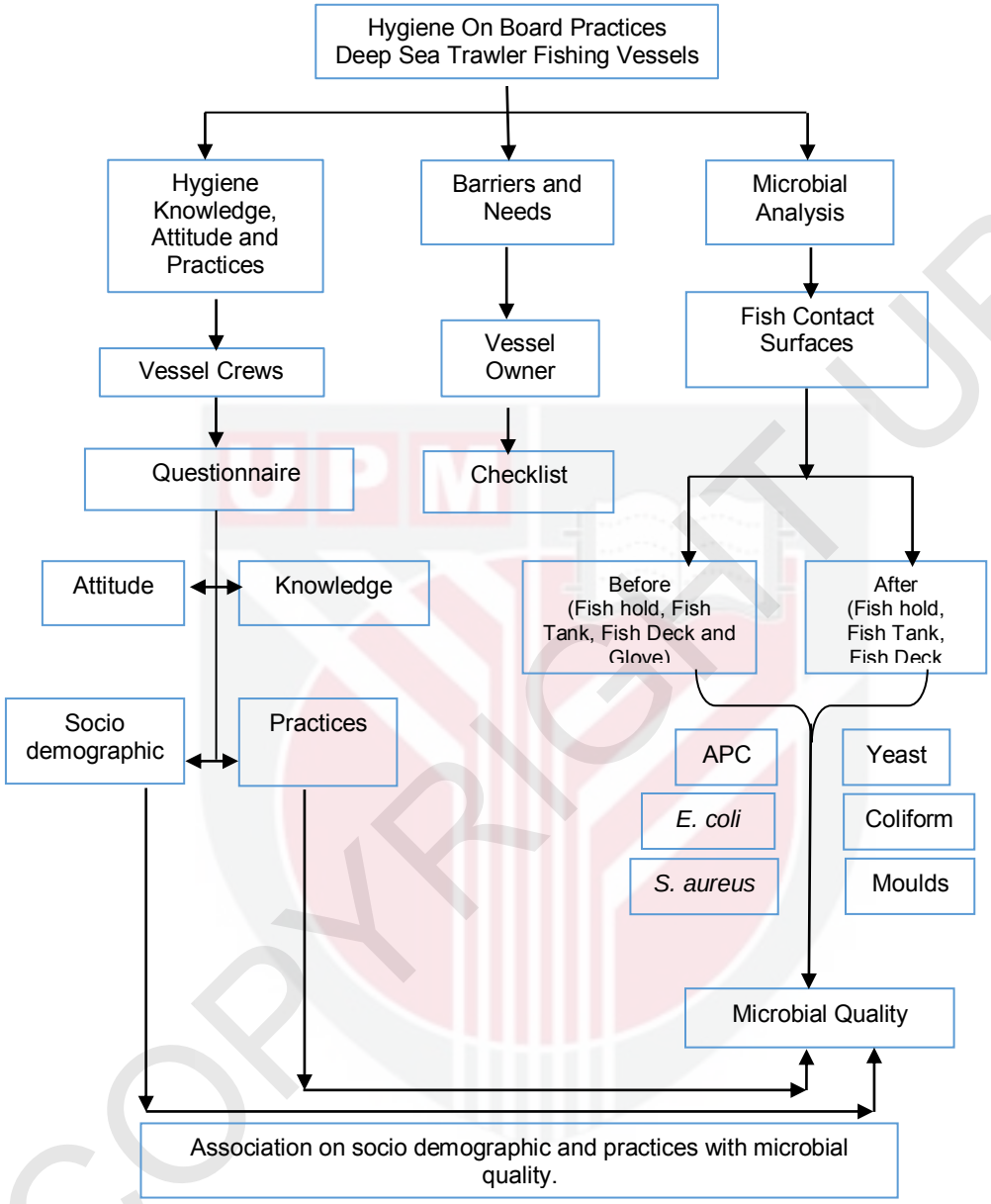

Figure 1.1 : The Research Flow on Compliance to Hygiene Standard By Crews on Board of Pahang Deep Sea Trawlers Fishing Vessels

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