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**Sudan University of Science and Technology**

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**Evaluation Food Safety Knowledge and Personal Hygiene Practices  
Amongst Plant and Fish Market in Kartoum State\_Sudan**

تقييم معرفة سلامة الأغذية و الممارسات الشخصية الصحية في أسواق

و مصانع الأسماك بولاية الخرطوم-السودان

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## DEDICATION

**To the soul of my lovely mother**

**To my father**

**To the soul of my friend Affag Hassan**

**To my brothers and sisters**

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## **Abstract**

The purpose of this study is to evaluate the personal hygiene measures. was carried out in Khartoum state, covered fish processing area & market include ALmorada market, ALmarkazy market, Jubal Awlleya dam processing area & market. Checklists were used to see if the better practices described in the HACCAP personal hygiene are being used in a particular, represented in fishermen and clean workers number of individual( N =100). The results showed that the respondents if had basic knowledge of personal hygiene practices, mainly on health state if the employees had a full medical certificate, were 62.0%. If workers wear suitable and clean working clothes, were 2.0 %.The responders were washed and disinfect their hands each time before resuming work, were 7.0 %.If the wounds covering with water-proof bandages were 3.0 %. If the staff respect the instruction of not smoking spitting eating and dirking in the working and storage premises were 4.0%. If there are suffered from diarrhea and/or vomiting was 54.0%. If they suffer from: i) recurring skin or ear trouble? ii) A recurring bowel disorder? iii) Discharge from eye, ear or gums/mouth? Were 34.0%. If the staff aware of fish handling hazard were 25.0%. Its bad indicator for his knowledge of food safety includes handling fish and personal hygiene.The study showed that the food handlers have basic knowledge one good personal hygiene practices. However, some discrepancies were revealed in the proper hand washing procedure. And recommended good hand washing procedure to be reiterated among the food handlers. There is also an immediate need for continuous training among food handlers regarding good personal hygiene practices to reach a high-quality product from the fisherman through the factory to the sale.

## ملخص البحث

الغرض من هذه الدراسة هو تقييم تدابير النظافة الشخصية. نفذت في ولاية الخرطوم ، وتغطي منطقة تجهيز الأسماك والاسواق وتشمل سوق الموردة ، السوق المركزي ، منطقة تجهيز الاسماك و سوق خزان جبل اولياء. قوائم المراجعة التي استخدمت لمعرفة ما إذا كانت الممارسات الأفضل الموصوفة في النظافة الشخصية يتم استخدام نظام تحليل المخاطر على وجه الخصوص ، ممثلة في الصيادين و عمال نظافه الاسماك عدد الأفراد (ن =100). وأظهرت النتائج نسبة ما اذا كان المشاركون لديهم معرفة أساسية حول ممارسات النظافة الشخصية ، وبشكل رئيسي على الحالة الصحية إذا كان لدى الموظفين شهادة طبية كاملة ، كانت 62.0 ٪. إذا كان العاملون يرتدون ملابس عمل مناسبة ونظيفة ، فقد كانوا 2.0 ٪. كانت الأجوبة غسل وتطهير أيديهم في كل مرة قبل استئناف العمل وكانت 7.0 ٪. إذا كانت الجروح التي تغطيها ضمادات مقاومة للماء كانت 3.0 ٪. إذا كان الموظفون يحترمون تعليمات عدم التدخين ،البصق،الاكل و الشرب في أماكن العمل والتخزين كانت 4.0 ٪. إذا كان هناك من يعانون من الإسهال و / أو القيء كانت 54.0 ٪. إذا كان يعاني من: 1) متكررة الجلد أو مشكلة في الأذن؟ (ب) اضطراب الأمعاء المتكررة؟ (ج) التفرغ من العين أو الأذن أو اللثة / الفم؟ كانت 34.0 ٪. إذا كان الموظفون الذين يعرفون مخاطر تداول الأسماك 25.0 ٪. إنه مؤشر سيء لمعرفته بسلامة الغذاء ويشمل التعامل مع الأسماك والناحية الشخصية ، وأظهرت الدراسة أن العاملين في مجال الأغذية لديهم المعرفة الأساسية بممارسات صحية شخصية جيدة. ومع ذلك ، تم الكشف عن بعض التناقضات في الإجراءات الصحيح لغسل الأيدي. وأوصى لإجراء الغسل الجيد لليدين مرة أخرى بين معالجي الطعام. كما أن هناك حاجة فورية للتدريب المستمر بين مقدمي الطعام فيما يتعلق بممارسات النظافة الشخصية الجيدة للوصول إلى منتج عالي الجودة من الصياد من خلال المصنع إلى البائع.



## **Introduction**

Fish is an important source of protein and it is widely consumed for its health benefits and taste. It is believed to be a healthier choice of protein source than most other meats since it contains Omega 3 fatty acids which are claimed to aid in the treatment and prevention of Cardiovascular Diseases. However, despite this major health benefit, fish, especially fresh fish, can be detrimental to health if not handled with care as it is a highly perishable commodity. 'Fresh fish' refers to fish which has never been frozen and has an acceptable shelf life of tendays (Wedemeyer, 2003). In Sudan, the inland fisheries are based on the Nile River and its tributaries, contributing over 90% of the estimated production potential of the country. The Sudd swamps in the south and the man-made lakes on the White Nile (Gebel Aulia Reservoir), the Blue Nile (Roseires and Sennar Reservoirs), Atbara River (Khashm El Girba Reservoir) and the Main River Nile (Lake Nubian) represent the major fishing localities with respect to fish resource magnitude and exploitation thrust. The Sudd region harbors an estimated fish potential of 75 000 tons/year with a productivity of 110 kg/ha. However, the civil war disturbances, the dense cover of aquatic macrophytes and the rudimentary fishing gear and techniques had a negative impact on fish production, which did not exceed 30 000 tons annually (43%). The Gebel Aulia Reservoir has a fish potential of 15 000 tons/year and a current production of 13 000 tons/year (86.7%). Roseires Reservoir has a potential of 1 700 tons/year and fish landings of 1 500 tons/year (88.2%). Sennar Reservoir has an estimated fish capacity of 1 100 tons/year and an actual fish yield of 1 000 tons/year (91%). Lake Nubia's potential is 5 100 tons/year but is able to produce only 1 000 tons of fish annually (19.6%). Production from other Nile River localities has been estimated at 4 000 tons/year (FAO 2005).

Foodborne illness outbreaks are often caused by poor personal hygiene among food handlers. Although many efforts have been made to improve various hygiene standards and practices training and education of food handler as well as consumer awareness, food-borne illness still remain a public health dial Poor Personal Hygiene has been identified as one of the main risk factors in foodborne diseases in other reports (FDA, 2000; FDA, 2009) in many countries. Fish and fishery products play an important role in food and nutritional security around the world. Consumption of fish offers unique nutritional and health benefits and is considered a key element in a healthy diet. Increased attention is given to fish as a source of essential nutrients in our diets, not only high-value proteins but more importantly also as a unique source of micronutrients and long chain omega-3 fatty acids (FAO 1998). The production of safe food is based on the implementation and application of general preventative measures such as GMP (Reij et al. 2003). GMP is the overall management (organizing, implementing and adhering) of procedures, processes, control and other precautions that exclude, prevent, minimize, and inhibit product failures, and consistently yield safe, suitable foods of uniform quality, according to their intended use. GHP is part of GMP concerned with general hygiene, microbial safety and product spoilage (Heggum 2001). While it is not possible to achieve zero risks under GMP, the development and use of other approaches, such as HACCP, to ensuring safe food, cannot be omitted (Jay 1992).

### **Objective:**

- To evaluate the personal hygiene measures.
- To increase the awareness between the fishermen ,handler and processor in fish market and processing area .

- To introduce the trainees to the history and background of the Hazard Analysis and Critical Control Point (HACCP) system and its importance as a food safety management system in identifying and controlling food safety hazard.

# Chapter One

## Literature review

### 1.1 THE HACCP SYSTEM:

The HACCP system, which is science-based and systematic, identifies specific hazards and measures for their control to ensure the safety of food. HACCP is a tool to assess hazards and establish control systems that focus on prevention rather than relying mainly on end-product testing and inspection. Any HACCP system is capable of accommodating change, such as advances in equipment design, processing procedures or technological developments (FAO, 1998). HACCP stands for Hazard Analysis and Critical Control Points. This is a preventative food safety system in which every step in the manufacture storage and distribution of a food product is scientifically analyzed for microbiological, physical and chemical hazards. Hygiene is a set of practices performed for the preservation of health According to the World Health Organization (Ismail, F.H et al, 2015). An important outcome of the exercise was the realization that a more systematic approach was needed for the identification and control of microbial hazards in the food industry, as provided by the Hazard Analysis Critical Control Point (HACCP) system (Report 1990, 1991). It was recognized that the HACCP approach directs attention to the key factors in controlling food safety, defines both safety parameters and the action to be taken when safe limits are exceeded and provides documentary evidence of regular process monitoring. How has this modern view of food-safety control affected the UK Meat Industry? Firstly, it has highlighted the inadequacies of the traditional system of post-mortem meat inspection, which focuses on visible lesions and carcass defects, but largely fails to address the public health risks

associated with the symptomless carriage of foodborne human pathogens in meat animals and subsequent contamination of carcass meat. In considering this deficiency, Hathaway and McKenzie (1991) supported the application of HACCP principles in the abattoir and emphasized the importance of exchanging information between farm and abattoir to reinforce the preventive nature of the HACCP approach. The extent to which the HACCP system is being applied in British abattoirs and the current role of the Official Veterinary Surgeon (OVS) in hygiene assessment will be considered in the present paper. Within the context of the European Union, abattoirs must conform to meat hygiene directives that necessitate costly structural changes. Compliance with these requirements has been a major burden on the industry and, in itself has not improved the microbiological standard of the meat (Mackey and Robert s 1990). By making such changes, however, it can be argued that a suitable environment is being created for hygienic meat production. The next phase in hygiene control must be to optimize the procedures and practices used in the abattoir and cutting plant. Progress in this direction will be discussed in the following sections. The success and effectiveness of the HACCP plan in preventing foodborne diseases and reducing food safety risks to an acceptable level depend on its correct implementation and application (FAO/WHO, 2007; K ok, 2009; Lawley, 2007). When a food company adopts a HACCP system, it has to assure its performance and assess that the system is implemented effectively (CAC, 2008; Cormier et al., 2007; Domenech et al., 2008). But what is “effectiveness” of the HACCP? Stakeholders such as the government, food safety agencies and/or sector organizations are interested in this question. However, not many studies have been published regarding performance measurement of food safety (Jacxsens et al., 2010). The main purpose of HACCP assessment is to establish whether a food company is capable of

producing or distributing safe products consistently, i.e. ensuring that the HACCP program is properly implemented and it is effective in maintaining product safety (Ababouch, 2000). So, the assessment approaches of HACCP are needed to demonstrate its effectiveness. The continued auditing and verification of a HACCP system is very important for the development of the HACCP plan (Sperber, 1997). Therefore, Kvenberg and Schwalm (2000) point out that objective and direct measures need to be developed that can be used in order to measure HACCP effectiveness. Nevertheless, regulators and food processors have different perspectives on how to measure its effectiveness. Although these perspectives include checklists and guidance for auditors, there is no accepted approach or common measure methodology available to HACCP practitioners, auditors or regulatory bodies in assuring the effective management of food safety. So, there is a need to establish criteria and assessment methods to identify the effectiveness of the HACCP plan. Wallace et al. (2005) say that it is necessary to establish ways of measuring HACCP effectiveness that is not based solely on retrospective analysis of outbreak data. HACCP is a systematic approach to identification, assessment, and control of hazard during production, processing, manufacturing, preparation, and use of food, water or other substances (Kirby et al 2003). However, the approach by itself is not enough to secure fish products to be free of the pathogens. Thus, good hygiene, cleaning, and sanitation are necessary to secure low levels of microorganism on the on the final product (Huss 1997). In practice, however, this can be very difficult and (Garland 1995) demonstrated that a very low level of *Listeria monocytogenes* in final products can be obtained in products produced under hygienic conditions, but it has also been claimed as a practical experience by industry in other countries that “the more you clean the more you have” (Huss 1997). Strict hygiene during manufacture of fish products

may, therefore, decrease the risk from some pathogens and increase the risk from others (Huss 1997). Thus, in no case is the application of good hygiene sufficient to secure safety and the second line of defiance (prevention of growth) must be established (Huss 1997). On the other hand, significant specific hazards are addressed by applying the HACCP system. Factory hygiene, as well as personal hygiene and sanitation, are for example CCP's in the prevention of contamination of products with microorganism, filth and any other foreign material during processing (Huss 1994). Limits may then be established such as microbiological criteria or guides at various steps in the production process or in the final product while monitoring the CCP's points. Monitoring should measure accurately the chosen factors which control the CCP's, should be simple, give quick results, and be able to detect deviations from specifications or criteria (Huss 1994). When there is a failure, corrective actions may be taken for the CCP that is not under control, followed by verification as well as documentation concerning all procedures and records according to the HACCP principles and their application (CAC 1997a). Before applying the HACCP system, any food establishment should operate according to the Codex general principles of food hygiene, the appropriate Codex Codes of practice, and appropriate food safety legislation to achieve the goal of ensuring food safety and suitability for human consumption (CAC 1997a). The system has taken on a global perspective in the production of fish and fishery products (Limados Santos and Sophonphong 1998). The application of HACCP in many manufacturing or treatment processes has led to a more efficient prevention of adverse health effects associated with the consumption or use of the products (Kirby et al; 2003). For example the implementation of an industry-wide HACCP program for seafood processors in the US is thought to have averted 20-60% of the normal number of seafood-borne illnesses, a

similar program for the prevention of food-borne listeriosis in the US reduced the incidence and mortality by 44% and 46% respectively over a period of four years (Birley and Lock 1998). Thus, hazards related to contamination, recontamination or survival of biological hazard and the growth of pathogens, during processing can be controlled by applying GMP and a well designed HACCP program (Huss et al; 2000).

## **1.2 HISTORY OF HACCP:**

HACCP has become synonymous with food safety. It is a worldwide-recognized systematic and preventive approach that addresses biological, chemical and physical hazards through anticipation and prevention, rather than through end-product inspection and testing. The HACCP system for managing food safety concerns grew from two major developments (FAO, 1998). The first breakthrough was associated with Deming, whose theories of quality management are widely regarded as a major factor in turning around the quality of Japanese products in the (1950) Deming and others developing total quality management (TQM) systems which emphasized a total systems approach to manufacturing that could improve quality while lowering costs (FAO ,1998). The second major breakthrough was the development of the HACCP concept itself. The HACCP concept was pioneered in the (1960) by the Pillsbury Company, the United States Army and the United States National Aeronautics and Space Administration (NASA) as a collaborative developed for the production of safe foods for the United States space program (FAO, 1998). NASA wanted a "zero defects" program to guarantee the safety of the foods that astronauts would consume in space. Pillsbury, therefore, introduced and adopted HACCP as the system that could provide the greatest safety while reducing dependence on end-product inspection and testing. HACCP emphasized



control of the process as far upstream in the processing system as possible by utilizing operator control and/or continuous monitoring techniques at critical control points. Pillsbury presented the HACCP concept publicly at a conference for food protection in (1971) (FAO, 1998). The use of HACCP principles in the promulgation of regulations for low-acid canned food was completed in (1974) by the United States Food and Drug Administration (FDA). In the early (1980) the HACCP approach was adopted by other major food companies. The United States National Academy of Science recommended in (1985) that the HACCP approach is adopted in food processing establishments to ensure food safety. More recently, numerous groups, including for example the International Commission on Microbiological Specifications for Foods (ICMSF) and the International Association of Milk, Food and Environmental Sanitarians (IAMFES), have recommended the broad application of HACCP to food safety (FAO, 1998).

### **1.3 HACCP Principle:**

#### **1.3.1 PRINCIPLES OF THE HACCP SYSTEM:**

The HACCP system consists of the following seven principles: Principle 1 Conduct a hazard analysis. Identify the potential hazard(s) associated with food production at all stages, from primary production, processing, manufacture, and distribution until the point of consumption. Assess the likelihood of occurrence of the hazard(s) and identify the measures for their control. Principle 2 Determine the Critical Control Points (CCPs). Determine the points, procedures or operational steps that can be controlled to eliminate the hazard(s) or minimize its (their) likelihood of occurrence. A "step" means any stage in food production and/or manufacture including the receipt and/or production of raw materials, harvesting, transport, formulation, processing, storage, etc. Principle 3 Establish a critical

limit(s). Establish a critical limit(s) which must be met to ensure the CCP is under control. Principle 4 Establish a system to monitor control of the CCP. Establish a system to monitor control of the CCP by scheduled testing or observations. Principle 5 Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control. Principle 6 Establish procedures for verification to confirm that the HACCP system is working effectively. Principle 7 Establish documentation concerning all procedures and records appropriate to these principles and their application (FAO, 1998).

### **1.3.2 Principles of personal hygiene:**

Wear clean protective clothes, washing hands before starting work, repeatedly washing hands during work, no finger rings, watches, bracelets. Access to production areas with working clothes only, Cleaning/disinfection of hands/tools/clothes if there was contact with highly contaminated subjects or abnormal animal parts likely to contain pathogens, Fresh wounds through knife cuts etc. must be covered by a watertight bandage. Workers with purulent wounds are not allowed to work with meat. (Risk of spread of Staph. aureus bacteria), Strict toilet hygiene must be observed (removal of the apron, hand washing, and hand disinfection). Toilets must be kept clean and must not have direct access to production areas. (Risk of spread of Salmonella), Periodic medical examination of staff. ( Code of Hygienic Practice For Meat, 2005).

### **1.4 Fish Market:**

Markets at all levels had retailing arrangements that were a group of retailers who sold fish to the consumers. In major cities like Dhaka, Chittagong, Khulna, Rajshahi, Sylhet, and Barisal and in district towns, city corporations or municipalities manage the retail markets. The number of fish markets operated

seven days a week has been increasing day by day due to increasing demand for fish. In general, conditions in urban and rural retail markets were not satisfactory in terms of stalls, parking, spacing, sanitation, drainage, and management. Fish marketing in the domestic market is not competitive in view of improving hygienic problems (Alam et al; 2014). However, international trading has been facing a serious challenge in Bangladesh as with other Asian countries. Infrastructural facilities, especially fish landing centers and wholesale and retail markets were inadequate and unhygienic, often posing serious threats to public health. Quality assurance programs in the country were reported to be inadequate to cope with the developments in the industry and the consumer requirements in the major seafood markets of the world (Hussain, 1994). According to (Krishnaiah, 2011), the fish markets were commonly filthy and unhygienic. The fish markets are often characterized by wet and slimy flooring, foul smell, deposits of fish wastages, improper drainage, the presence of flies, dogs etc. High levels of noise and cacophony are symbolic of a fish market. Improving quality and sanitation issues is critical to improving marketing opportunities regionally as quality standards are becoming an important requirement for trading fish across borders, Regionally harmonized quality standards should increase competitive access for traders and help to ensure improved quality of fish for consumers, capacity building for all those involved in the value chain is an important part of improving standards and quality (Short, C et al; 2011). It is Smart Fish's aim that this trainer's manual is used as a tool by all relevant stakeholders to strengthen handling, hygiene and sanitation practices in line with COMESA and EAC standards for the betterment of regional trade, livelihoods, and food security. EAC (East African Community) made up of Kenya, Tanzania, Uganda, Rwanda and Burundi (Short, C et al; 2011). The fisheries sector provides both food and employment for millions of people as well as fish for consumers who have a right to eat food which has been caught,

handled and treated in a good way, 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 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 (Short, C et al; 2011 ). Many countries that import a lot of fish have regulations to protect consumers from eating fishery products which will make them sick. Fishermen, fish processors and traders in many countries often rely on simple low-cost equipment and live and work in remote areas where basic services and facilities are not available( Short, C et al; 2011). They may also lack the knowledge, skills and the ability to invest in new equipment and ideas. This can mean that fish is often handled and processed in unhygienic conditions causing spoilage, contamination with disease-causing germs, and a loss of income as fish are sold for a low price. ( Short, C et al; 2011). Whilst Government should ensure such services are provided and that food safety laws are in place and enforced properly, fishermen, processors and traders need to ensure that they handle fish properly and the required food hygiene and safety standards are met, it is worth remembering that all stakeholders involved in fishery activities have a responsibility to make sure that fish is handled in the best possible way and in the best conditions possible, so that the consumer receives good quality and safe fish to eat( Short, C et al; 2011).

#### **1.4.1Public health:**

Is the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private communities and individuals. It is concerned with threats to health based on population health analysis. Environmental health, community health, behavioral health, health economics, public policy, insurance, medicine and

occupational health are other important subfields of the market system (Cuter and Miller, 2005). Hygiene is a set of practices performed for the preservation of health. While in modern medical sciences, there is a set of standards of hygiene recommended for different situations, what is considered hygienic or not can vary between different cultures, genders and entrain groups. Some regular hygienic practices may be considered good habits by a society while the neglect of hygiene can be considered disgusting, disrespectful or even threatening (Aiello et al., 2008). Health care services in Bangladesh are not adequate enough to provide treatment facilities for the whole population. Moreover, poverty, illiteracy, and lack of health awareness cause miserable sufferings and premature death of the people. Communicable diseases are still the major diseases in Bangladesh. The mortality and morbidity among the general mass due to contagious diseases are very high. Infectious diseases like cholera, typhoid and parasitic diseases like malaria, filariasis, and worm infestations are responsible for major morbidity (Nickson et al., 1998). Compared to the general public health situation in terms of sanitation, the supply of drinking water has been improved a lot in Bangladesh. However, the existing situation of public health of fish market stakeholders, particularly of retailers has not been developed yet. Considering above facts, the present study was carried out to understand various issues of public health being faced by the fish retailers and to assess the potential measures to be taken to develop public health situation of fish retailers in selected areas of Bangladesh (Alam et al; 2014).

#### **1.4.2 Health problem:**

The health condition is the reflection of the livelihood status of the community. Several health problems were found with the fish retailers in the fish market. It was found that the fish retailers were commonly infected by a number of diseases such as common cold (a cough, coryza), diarrhea, lesion (lesion on hands, lesion

between fingers, lesion between toes etc.) and some other disease. Transmission of these diseases was very common in clustered communities with little immunity and poor hygiene. Such infections were brought to the home by the infected person to other members of the family. Thus the ultimate result of infection was likely to be transferred into the contagious diseases to the consumers and their other family members (Alam et al; 2014).

### **1.5. overview of Biological , Chemical and Physical Hazards:**

Studies conducted by Food Agriculture Organization (1995) recorded that poor knowledge leads to poor practices in food handling base on the assessment of microbial contamination of food sold by the mobile food handlers. Improper food preparation practices can cause foodborne illness as contended by (Park, Kwak, and Chang, 2010). When food handlers do not practice proper food safety, personal hygiene during food preparation, they may become vehicles for microorganism's for example through their hand, mouth and skin) Ismail et al 2016. As in most emerging countries, poor food hygiene and food handling practices were among the most alarming problems faced by the food control authority ( Ismail et al, 2016). This study sought to examine the influence of food safety knowledge amongst mobile food handlers with hygiene practices and to investigate to what extent does mobile food handlers' personal hygiene influence their hygiene practices (SaidatulAfazanAbdulAziz, 2013). In developing country a large amount of ready-to-eat food is sold on the street due to its convenience rather than its safety, quality, and hygiene aspects (Abdalla, Suliman&Bakiet 2009). The World Health Organization (WHO,2006) identified several factors associated with foodborne illness such as poor food safety knowledge, poor personal hygiene, cross-contamination as well time and temperature abuse during storage and preparation of food by mobile food handlers (Osaili et al ; 2013). Research on foodborne illness risk factors indicates that most outbreaks in food service

establishments can be attributed to food workers' improper food preparation practices (Bryan, 1988).

### **1.5.1. Biological hazards:**

Seafood is classified as high risk on the list of foods transmitting disease (Dias-Wanigasekera, Jaykus, & Nickelson, 2011). In fish-related outbreaks, a wide variety of fish-borne infections and fish-borne toxicity has been researched, the results of which research are reported worldwide. In the case of fish-borne infections, the causative agents include viruses, bacteria, and parasites that enter the intestine and invade the intestinal mucous membrane or other organs and lead to illness in humans. In the case of fish-borne toxicity, the products of pathogenic agents, that may include bacterial toxins or products of bacterial metabolism such as histamine, can cause intoxication to humans when these products are consumed (Karunasagar, *et al.*, 2005).

#### **1.5.1.1. Cause of infectious fish-related illness:**

Viruses can be foodborne/water-borne or transmitted to food by human, animal or other contact for example Hepatitis causing viruses, Hepatitis A virus. and Hepatitis E virus , Caliciviruses , Norovirus viruses ,Sapporo viruses , Rotavirus ,Parvoviruses , Sapporo viruses Astroviruses (Ahmed, 1991; Butt-(b), *et al.*, 2004; García & Heredia, 2009; Karunasagar, *et al.*, 2005; Novotny, Dvorska, Lorencova, Beran, & Pavlik, 2004) .the majority of reported foodborne disease outbreaks and cases are caused by pathogenic bacteria. a certain level of these microorganisms can be expected with some raw foods. Improper storage or handling of these foods can contribute to a significant increase in the level of these microorganisms. Cooked foods often provide fertile media for rapid growth of microorganisms if they are not properly handled and stored, for example, *Vibrio spp.* *Salmonella spp.*

*Aeromonas hydrophila*, *Plesiomonas shigelloides*, *Listeria monocytogenes*, *Clostridium botulinum*, *Campylobacter* spp. Group A streptococcus, *Mycobacterium* spp. *Streptococcus iniae*, *Photobacterium damsela*, *Vibrio alginolyticus*, *Vibrio vulnificus*, *Erysipelothrix rhusiopathiae* (Ahmed, 1991; Butt-(a), et al., 2004; García & Heredia, 2009; Karunasagar, et al., 2005; Novotny, Dvorska, Lorencova, Beran, & Pavlik, 2004). Parasites are most often animal host-specific and can include humans in their life cycles, Parasitic infections are commonly associated with undercooked meat products or contaminated ready-to-eat food, Parasites in products that are intended to be eaten raw, marinated or partially cooked can be killed by effective freezing techniques, for example Nematodes *Anisakis simplex*, *Gnathostom spinigerum*, Trematodes *Clonorchis sinensis*, *Opisthorchis* spp, *Metorchis conjunctus*, *Echinostoma* spp, *Paragonimus westermani*, *Metagonimus* spp. *Heterophyes heterophyes*, *Nanophyetes salmincola*, Cestodes *Diphyllobothrium latum* (Ahmed, 1991; Butt-(a), et al., 2004; García & Heredia, 2009; Karunasagar, et al., 2005; Novotny, Dvorska, Lorencova, Beran, & Pavlik, 2004). Also, not all fungi are useful, most fungi produce toxic metabolites. Microbial toxins of current concern in the United States are produced by certain species of three genera of mold: *Aspergillus* spp, *Penicillium* spp, and *Fusarium* spp. These molds are ubiquitous and grow and produce toxin under certain conditions (Lvell, 1988). Pathogen *E. coli* were linked to hands as a source of contamination. Other studies such as done by Reij et al. (2003), attributed poor hygiene, particularly deficient or absence of hand washing as the causative mode of transmission. Also, contamination of fish products through contaminated surfaces has been observed in many cases and unclean, insufficiently or inadequately cleaned processing equipment has been identified as a source of bacterial contamination in processed seafood



(Reij et al. 2003).The significance of fish mycobacteriosis as zoonosis is evident from case reports published in scientific papers. Fish have been convincing sources of many cases of mycobacteriosis diagnosed abroad. Ninety-nine publications dealing with the infection of 652 cases of human beings with *M. marinum* appeared between 1966 and 1996. Of 193 infections with known exposures, 49% were associated with aquarium environment, 27% with injury by aquarium fish and 9% with an injury during bathing in the sea or brackish water (Jernigan and Farr, 2000). *Strep. iniae* causes meningoencephalitis and death in cultured fish species but may also be an emerging human pathogen associated with injury while preparing fresh aquacultured fish. Between 1995 and 1996 four cases of bacteremia infections were identified among patients at a hospital in Ontario (Anonymous, 1996).

### **1.5.2. Chemical hazards:**

Food items sold in small retail shops can contain different types of chemical hazards. These include natural toxins, environmental contaminants, food additives, process contaminants, food contact materials and residues from pesticides, veterinary drugs, and disinfectant agents. Potential chemical hazards occurring in food items in small retail shops can be present due to their occurrence in the raw materials, chemical contamination during storage and/or chemical contamination during processing. Chemicals may be present in raw materials due to environmental contamination. Examples of such environmental contaminants are metals and organic substances. Raw materials may also contain natural toxins such as mycotoxins, plant toxins, and marine biotoxins. In raw materials, residues from veterinary drugs and pesticides could be present from compounds that are prohibited or misused, as well as compounds present in higher concentrations than allowed (Arvanitoyannis and Varzakas, 2008). Constant use of chemicals: This

includes inorganic fertilizers which are used extensively in enriching fish ponds. Others are lime, pesticides, formaldehyde, etc. Some of these are caustic and can cause severe burns or skin irritation resulting in severe cases of occupational dermatitis. Some laboratory chemicals are hazardous and. Inhalation may lead to the development of respiratory ailments such as bronchitis, rhinitis, and asthma (Uronu and Lekei, 2004). Direct contact with these chemicals could result in burns, skin irritation and allergies. It has been observed that laboratory workers that have prolonged exposure to organic solvents such as chlorinated hydrocarbons, alcohols, ester, ketone, etc. are at risk of brain and nervous system damage. The symptoms include premature aging, memory impairment, mild depression, and anxiety. (Karkkainen ,2002) has also attributed the following symptoms to formaldehyde poisoning: allergic dermatitis asthma and rhinitis. Acute and chronic pollution of waterways: Pesticides, oil spills, and other xenobiotics can pollute ponds and water sources which can also pose risks for workers that work in such farms. Flocculants: These are applied to ponds to precipitate suspended clay particles (WHO, 1999). Examples are aluminum sulfate (alum), calcium sulfate (gypsum). Disinfectants: these are used to disinfect equipment and holding units – e.g. formalin hypochlorite, etc. Fumes, smoke and soot: Fumes from water pumping machines feed mill and other machines; and the smoke inhaled by workers smoking fish or drying feed are considered serious health risks. These are associated with asthma, cancer and other serious ailments. Food safety has become of increasing concern for consumers, governments, and producers as a result of the globalization of markets, where foods are produced and distributed throughout the world, and also because of increasing public awareness about health and quality. Several worldwide incidents related to chemical contaminants in food have also attracted much media attention. Trace levels of chemical contaminants in foods can originate from natural sources (e.g. mycotoxins and phycotoxins), environmental

sources (e.g. polychlorinated biphenyls [PCBs], dioxin-like compounds, pesticide residues, and perchlorates), migration from packaging materials (e.g. phthalates and bisphenol-A) or because of their use in food production (e.g. veterinary drug residues (Krska et al., 2012).

### **1.5.3. Physical hazards:**

Illness and injury can result from hard foreign objects in food. These physical hazards can result from contamination and/or poor practices at many points in the food chain from harvest to consumer, including those within the food establishment. Examples of physical hazards: glass, wood, stones, metal, insulation, boy, plastic, personal effects (FAO, 1998). There are several physical risk factors in the aquaculture industry. Farm hands and other workers in aquafarms are susceptible to many injuries in the course of their work. The fish farmers in the informal sector are more vulnerable because according to Clarke (2002), governments in developing countries have an apathy to occupational health and safety issues. All the stakeholders – farm management, workers, and governments do not appreciate the problems that can be solved or mitigated through occupational safety and health. The list of physical hazards is as follows:

Noise: Feedmill workers (especially those that operate with locally fabricated machines in the developing countries) are exposed to excessive noise. (Ojok, 1995) attributed the following harmful defects to noise:- hearing defects, hearing loss, and mental fatigue. Injuries: Farmers are exposed to diverse injuries such as Sting from fish spines: This arises during fish handling without appropriate safety devices. It may cause severe pains and can result in tetanus infection or willow. Cuts, sprain, fracture, etc: sharp implements/objects such as knives, oyster shells, falls and other predisposing factors can cause these injuries. Hatchery workers are also exposed to the risk of needlestick injury which can open a gateway to many viruses and other diseases. Occupational asthma and rhinitis: Feedmill workers are

at risk of contracting these diseases. Karkkainen (2002) observed that the greatest risks occur in the foodstuffs and agricultural sectors. He attributes dust released from flour and animal feed mill as the second most common cause of asthma. Snake bites, crab clawing, and bites from fish (such as tigerfish, snapper, etc) are hazards workers in earthen pond fish farms are exposed to, especially when they are not using appropriate protective gear. This is prevalent in rural fish farming. **Mechanical injuries:** These are associated with laboratories and processing plants.

## **1.6 Food safety management:**

Awareness of consumer and product safety has probably never been so high as today. Significant food crises in the world during the past decades have raised doubts in the consumer's mind and created a lack of trust and confidence in products put on the market. Fortunately, most companies already take product quality and consumer safety very seriously. A lot of good practices have been developed and implemented on a voluntary basis. These practices ensure that product safety has never been as high as it is today (The Traceability Blue Book, 2004). ISO 9000 standards represent a benchmark for company management in its whole. They are not focused on the intrinsic product/service quality, but on the related processes, enlarging their action to the entire network of interactions in which the factory is acting. The extension of the application field originates from the awareness that quality is a strategic variable to be planned and managed through the whole network of the value-chain (Romano and Vinelli, 2001). The food products safety was affected in the previous years by successive crises in the alimentary chain. As a way to re-establish the confidence of the consumers, it is necessary that food organizations prevent this kind of situations. The increasing concerns among the consumers related to food safety have been addressed by the

competent authorities, through the publication of communitarian legislation and the ISO 22000:2005. In September 2005, the International Organization for Standardization (ISO) had published the ISO 22000:2005 standard - Food safety management systems - Requirements, that is applicable to any organization in the food chain". This standard integrates the requirements defined by ISO 9001 and the methodology used by HACCP (Hazard analysis and critical control point's management system) (Teixeira. S et al 2013). All countries are facing similar problems regarding food safety. The relative importance of different risks varies with sanitation status of the soil (Đukić et al,2011), climate (Đukić et al,2008.), diets, income levels i.e. state revenue, and public infrastructure. In general, the most common food safety risks and, hence, human health risks are greater in developing countries due to poor sanitation and inadequate drinking water quality than in developed countries. Safe food is produced by adhering to Good Hygienic Practices (GHP), Good Manufacturing Practices(GMP),Good Laboratory Practice (GLP), Good Agricultural Practices (GAP) etc. and by implementing food safety risk management systems such as Hazard Analysis Critical Control Points (HACCP), but the level of safety that these food safety systems are expected to deliver has seldom been defined in quantitative terms(Commission EU, 2000). Taking the new approach adopted by international organizations i.e. the FAO, WHO, Office International des Epizooties (OIE), and the International Organization for Standardization (ISO), and relying on the starting points - Codex Alimentarius and EU food, veterinary and phytosanitary regulations, the integrated food safety system provides a basis, involving quality management principles and the HACCP system. Generally, prior to implementing HACCP in any sector of the food production chain, the sector in question should operate in accordance with the food hygiene principles laid out in the Codex Alimentarius, the related GMP codex and related safety regulations (CommissionEU,2000).

## **1.7 Hygiene:**

The word Hygiene has evolved from the Greek term “Hygeia” which means “Goddess of Health”. Hygiene can be defined as, “The science and art which is associated with the preservation and promotion of health”,(Keshav ,2008). Meat hygiene is a complex field, based on regulations by competent authorities and meat plant internal hygiene programs, to be supervised by the plant management Those programs will only be successful if meat plant staff are familiar with and active in observing basic hygiene requirements (Code of Hygienic Practice For Meat , 2005) . In order to facilitate the application of hygiene requirements, it has proven useful to differentiate between Personal hygiene; Slaughter and meat processing hygiene c. Hygiene of slaughter and meat processing premises d. Hygiene of slaughter and meat processing equipment the topics a-d are of equal significance. Negligence in any of the four areas may give rise to hazards, which can cause economic losses and affect consumers’ health (Code of Hygienic Practice For Meat , 2005). Some key requirements for meat processing plants and fish market are listed below. More detailed hygiene requirements are laid down in national regulations and in international codes, such as FAO/WHO CODEX ALIMENTARIUS Code of Hygienic Practice for Meat (Code of Hygienic Practice For Meat, 2005) . Guidelines on slaughter hygiene or meat transport and storage hygiene are not included hereunder. However, as meat is the primary material for processed meat products, the application of hygienic practices in slaughterhouses and fish market and throughout the cold chain is equally important. A trend analysis on the occurrence of foodborne illness in selected food service establishments in the United States demonstrated that from 1998 – 2008, the non-compliance percentages remained high for three risk factors. Poor Personal Hygiene, Improper Holding of Food and Contaminated Food Surfaces/Equipment (FDA, 2010).Given

the wide range of processing technologies and food products, and increasing production volumes as part of the modern development of the food industry, ensuring appropriate timely implementation of sanitary practices is an essential factor in safe food production. It is in customers' interest to consume perfectly safe food products, while it is in producers' interest to achieve the longest possible shelf life of a product. To this end, maximum attention should be given to hygiene during the production process (Turubatović et al., 2013). Considering the presence of not only saprophytes but also microbial pathogens in micro-populations of production lines and work environments in the food industry, it is necessary to continuously maintain a high level of hygiene in the production plant, using appropriate cleaning and disinfection procedures (Mercade-Prieto et al., 2007). Cleaning and disinfection should be taken as a joint operation of the hygiene package (Wilson, 2005). Appropriate cleaning procedure can remove 99.99% microorganisms, in addition to removing impurities, whereas appropriate disinfection which comes afterwards can reduce microbial counts up to 99.999% (Marriott,1994). As opposed to disinfection, sterilization involves a 100% reduction in microbial counts, but it is too specific to be often used in the food industry.

### **1.8 Hygiene practical:**

Personal hygiene: The personnel who engaged in aquatic products processing and management should pass the medical examination and health training before working, the HACCP system realization this meaning.( General Administration of Quality,2009).The concept of Personal Hygiene:Personal hygiene includes different habits i.e., washing hands and brushing teeth which keep bacteria, viruses and fungal far away from our bodies. Moreover, these habits will help us to protect our mental health and activity. Also, good personal hygiene will help us to keep

feeling good about ourselves. Since those who do not take care of their personal hygiene i.e., dirty clothes, body odor, and bad breath will suffer from discrimination and this will mainly lead to mental problems. But the most important point in this subject is that all people have their own hygiene but some people do it better than others, this mainly depends on each person's culture, society and family norm, (Rasool, 2012). As hands are important mode of transmission of infectious disease among school-aged children, simple hand washing with soap helps to protect children from the two common global pediatric killers (diarrhea and lower respiratory infection) (Kinley Britt , 2011), (Aiello AE , 2008), hand hygiene significantly reduce illness-related absences in elementary school students by 26% (Nandrup-Bus , 2009). Critical times for hand washing include after using the toilet, after cleaning a child, and before handling food, (Scott BRT, 2007),( WHO , 2004). HACCP stands for Hazard Analysis and Critical Control Points. The personnel should undergo a health examination every year if necessary temporary health examination shall be affected. Persons suffering from effects of food health disease shall leave their work from the post of food processing the person who engaged in aquatic products processing and management should maintain personal hygiene, and get into the good health habit. It is prohibited to bring the things no business with work into workshop the personnel shall wear work clothes hat and boot and clean and disinfect the hands. The Gloves etc used in processing should be cleaned and disinfected, and keep intact without breaking. The work clothes shall be stored and managed concentrate, unfairly clean and disinfect unfairly grant. (General Administration of Quality,2009) .



### **1.8.1 .General personal hygiene practical:**

Personal hygiene is a public health tool that is used for disease prevention and health promotion in individuals, families, and communities. Winslow in 1920 observed that personal hygiene can be improved by educating individuals in communities on basic tips of achieving personal cleanliness through their organized efforts and informed choices(Winslow CEA, 1920). Cleanliness in individuals in communities can reduce threats, especially by communicable diseases, thereby improving the overall health of a community based on population health analysis (Winslow CEA, 1920). The focus of good personal hygiene is to prevent diseases, injuries, and other health conditions through surveillance and the promotion of healthy behavior in aspects relevant to human health. It may prevent health problems from happening or re-occurring by implementing educational programs, developing policies, administering services, and conducting research (Aiello AE et al, 2008).Personal hygiene is an important global public health issue for long. Hygiene refers to practices associated with ensuring good health and cleanliness. Personal hygiene is the practice of maintaining the cleanliness of one's own body. Good hygienic care, as well as practices in terms of personal hygiene, contributes to a large extent on factors relating to healthful living and prevention of hazards from diseases. These health risk factors are directly related to some important daily activities implicated with worthy operational actions and obligatory responsibilities, such as washing hands before meals and after defecation with soap, brushing teeth at least twice a day especially after breakfast and after meals, taking bath with soap regularly, keeping nails short and taking regular exercise (Ali et al, 2013). Transfer of microorganisms by personnel particularly from hands is of vital importance (Chen, 2001 \ Montville, 2001 \ Bloomfield 2003). During handling and preparation, bacteria are transferred from

contaminated hands of food workers to food and subsequently to other surfaces (Montville, 2002). Low infectious doses of organisms such as *Shigella* and pathogenic *Escherichia coli* have been linked to hands as a source of contamination (Snyder, 1998). Poor hygiene, particularly deficient or absence of hand washing has been identified as the causative mode of transmission (Reij, 2003). Proper hand washing and disinfection has been recognized as one of the most effective measures to control the spread of pathogens, especially when considered along with the restriction of ill workers. Germs or bacteria are everywhere and like dirty environments. They are in our stomachs and when we go to the toilet we can spread them to our hands and the environment. If we don't wash our hands and the fish come into contact with our hands or a dirty environment then they can pick up these bacteria also. So it is important to keep ourselves clean and wash our hands, particularly after going to the toilet. Also, make sure any wounds are covered up so that blood and other fluids do not come into contact with the fish. Likewise, keeping wounds covered also helps us prevent spreading bacterial infections (Adler, 1999 \ Montville, 2001).

In Zain study, the regression analysis showed that food safety knowledge is the strongest predictor of food hygiene practices. The highest standardized beta coefficient indicated that ( $\beta = 0.624$ ,  $p < 0.05$ ). Perhaps, still many mobile food handlers in Shah Alam, Selangor who did not realize the importance of food safety. The main reason for this was food handlers who involved in mobile food, stall, hawkers activities were not all registered with the local government, mobile food handlers had a low level of education and were not trained This study suggested there is a positive relationship between food safety knowledge personal hygiene and food hygiene practices among mobile food handlers. The result indicated that the food safety knowledge was significantly correlated with personal hygiene. In order to decrease the risk of cross-contamination, training which is being

incorporated into the existing principles or other related guidelines for the mobile food handlers. In addition, the study also helps the consumer to be aware that the quality of food and safe food to the consumer. (Zain & Naing, 2002).

According to Ali 2016 result in health and personal hygiene adoption of restaurant Heat Kuku. Food safety and foodborne disease knowledge of restaurant food presented, regarding knowledge by important of one of the most important responsibilities of the food handlers are washing hand to food safety measures were 56.7% agree. Using gloves is important in reducing the risk of food contamination responded were 73.3% agree. Using apron 80.0% were agree, using mask 83.3% agreed, using cap were 46.7% were agree from responding. In statements of should not touch foods without gloves were 40.0% agree. Food hygiene training for workers is an important issue in reducing the risk of food contamination the responded were agree 56.7 %. Health status of the workers should be evaluated before employment was 80.0% agree from responded (Ali, 2016).

Mohamed 2015, said food safety and foodborne disease knowledge of street food vendors are presented in next axes: Washing hands before work reduces the risk of food contamination were 63.3% true, 10% don't a know of responded. Using gloves during work reduce the risk of food contamination 63.0% true 23.3% doesn't know. proper cleaning and handling of instruments reduce the risk of food contamination were 80.0% true, 3.3% don't know of responded. Eating and drinking in the workplace increase the risk of food contamination was 13.3 % true, 40.0% dont know of responded. Diarrhea can be transmitted by food 93% true, 6.7% don't know of responded. Aid can be transmitted by food 40 % true, 0% don't know of responded. Bloody diarrhea can be transmitted by food 63.3 % true, 26.7% don't know of responded. During infectious disease of the eye, it necessary to take leave from work 63.3% true 26.7% don't know of responded. During infectious

disease of the skin, it necessary to take leave from work 56.7% true 0.0% don't know of responded. (Mohamed, 2015).

Alhaj 2012 was an assessment of the health and personal hygiene knowledge of street vendor in Gizan city. Regarding hand hygiene knowledge 40% of, the vendors agreed that hand must be washed after touching money, 2% hadn't known of responded. As well 52% of the respondents thought that hand washing was necessary even when handkerchiefs were used for sneezing agree 10% no knowledge, even when hands are not yet visible dirty during continuous food handling 50% agree, 4% hadn't known of responded. Wear hair restraint and apron when vending 72% agree, 2% hadn't known of responded. Bath regularly the responded were agree 74%, 2% hadn't known. Consider hand and arm jewelry as a source of contamination 48% agree, 2% hadn't known of responded. Street food vendors cannot safely handle food. When they have cold flow, cough and catarrh 58% agree 6% hadn't known of responded. When sick with diarrhea even if the hand is washed after a trip to the toilet 38% agree 10% hadn't known of responded. When they an open wound in hands even if it is fully bandaged 44% agree, 4% hadn't known of responded (Alhaj, 2012).

### **1.8.2 Good Hygienic Practices in fish processing area:**

Post-harvest handling of the catch is the most important step in the production of a high quality finished product (Devadasan, 2004). To achieve safe fish, the primary fish handlers and fish retailers must be educated on good hygiene and sanitation practices. Most of them are unaware that they are potential carriers of pathogenic microorganisms, and that poor personal hygiene makes the fish unsafe for consumption (Rao et al., 2005). Several studies indicate that better knowledge leads to the better adoption of hygienic practices (Sanoria & Sharma, 1983; Pathak & Sasmal, 1992). The activities in the fish markets generate wastes of varying degrees and types which, if not properly handled, will lead to contamination of the

product and degradation of the market environment (Sciortino& Ravikumar,1999)(Various handling activities such as landing, sorting, packing and distribution take place in local fish markets, where fish goes through many risk factors generating additional sources of bacteria. Proper cleaning of pieces of equipment and facilities, as well as the cleanliness of fish retailer, are effective ways to avoid risking the hygiene of fish (Das.A et al, 2013). Hygiene measures involve not only the activities that deal with handling operations but also those focusing on the infrastructural facilities. Training on proper fish handling and maintenance practices for persons concerned with local fish markets would be especially important. On-site technical support from extension staff of central/local governments and resource persons are beneficial for improving and promoting quality control and hygiene measures in local fish markets. This paper aims to present the socio-personnel profile of the fish marketing personnel and to find out the extent of adoption of hygienic practices followed in the existing fish markets in Tripura(Das.A et al, 2013). Hygiene, cleanliness and consistent Good Handling Practices (GHPs) are critical components in the environmental management of fish handling establishments. According to results of Diei-Ouadi and Mgawe study indicated that 52.5% of the respondents had a food handler's medical certificate, 51% indicated that they did not wear food hygiene protective gear such as boots, 67% indicated that they wore food hygiene protective gear such as aprons, 83% indicated that they did not wear food hygiene protective gear such as gloves. 68.5% indicated that the operators in the market participated in environmental management activities though only 12% indicated regular participation. Environmental management of fish markets is crucial, otherwise more sensory quality loss would be anticipated in fish from local markets due to unhygienic conditions and poor handling that necessitates increased bacterial loading (Diei-Ouadi, Y et al, 2011).

### **1.8.3 Hygienic requirements and practices during fishing:**

Fishermen and boat owners will understand what can lead to fish becoming unsafe to eat and how those hazards can be prevented. They will also be able to explain what can lead to fish spoilage and what they can do to stop spoilage and keep the fish quality good during fishing (Short, C et al 2011). There are a number of things that make fish unsafe to eat during fishing. Contamination of fish with physical hazards such as pieces of wood or metal. Contamination of fish with chemical hazards such as fuel or oil; Contamination of fish with disease-causing germs present in the lake water or sea-water; Contamination of fish with disease-causing germs found on the boat and other surfaces, Contamination of fish with disease-causing germs found on the fishermen's hands and clothing(Short, C et al 2011). Contamination of fish with disease-causing germs found in dirty ice or dirty salt.The main causes of fish spoilage during fishing are related to a Fishing method, Poor handling contaminating the fish with germs, Not placing the fish in ice or protecting it from the sun, Poor handling by dropping, throwing and standing on the fish(Short, C et al 2011).

### **1.8.4. Wild fish and fishery products:**

The catching vessels, processing vessels or transportation vessels of wild caught fish should be approved by official competent authorities. Fresh and alive fishery products should be transported under their suitable surviving conditions. Iced-fresh fishery products should be chilled immediately after catching, and the temperature could be maintained between 0 and 4 degree Celsius. The ice or water used for fresh fish storage should meet GB5749 or the hygiene requirements for clean seawater. Catching and the following up handling operations on board such as pre-handling, cooling, and freezing etc. should meet the national hygiene requirements. (General Administration of Quality.2009).

## **Chapter Two**

### **Material and Methods**

#### **2.1 Study area:**

The study was carried out From March to May 2017 in fish markets and processing area: ALmorada market, ALmarkazy market and Jubal Awlleya dam market, Khartoum state. Khartoum is characterized by an estimated area of the River Nile and the meeting of the Blue Nile and White Nile where the fish wealth.

#### **2.2 Study design:**

Checklists that can be use to see if the better practices described in the HACCAP personal hygiene are being used in a particular. Questions designated Knowledge (8 questions) was intended to assess the employees knowledge of personal hygiene and handling of fish in market and processing stage, respondents' habits focused on personal hygiene practice and cross contamination, and respondent's knowledge about HACCP, microbiologic hazards development, food poisoning and food borne illness, safety and health requirements, high-risk food groups, dirty and clean employee.

#### **2.3 Sample size:**

All individual responded were total 80 ( n =100) , 30 cleanworkers ,10 fisher men in ALmorada market ,40 clean workers in ALmarkazy market, 20 fisher men in Jubal Awlleya dam.

## **2.4 Checklist survey:**

The perceiver of the showed and answer of employees there are not obliges of the personal clean clothes and washing hand and instruction of not eating , smoking ,spitting ,and drinking in the working .The dealing whit the wound case by the traditional treat ,don't obliges by medical treat and use the water-proof to cover the wound .and there are some case of diarrhea and the lax employees embarkation .The handling knowledge is a good but their did not oblige of stander to protect the hazard .All the workers clean fish they have medical examination renew every 6 month or one year ,but the fisher men didn't have .

## **2.5 Data Analysis:**

Statistical methods used: To achieve the objectives of the study and to verify hypotheses, statistical methods were used the following: - frequency distribution of the answers. - Percentages. To get results as accurate as possible, SPSS statistical software has been used, which indicates a shortcut to Statistical Package for readers. To answer the questions of the study and verification of hypotheses will be calculated median for each of the phrases in the cheekiest and which show views of individuals under the study, which was given Grade (1) as a weight for each answer "yes", and grade (2) as a weight for each answer "no" to know trends answer, by calculated the frequency distribution and percentage of the answer.



## Chapter three

### Results:

The survey included the subject's demographic characteristics and general questions about food-safety perception and experience. The five food safety knowledge questions (O/X response) included: proper hand washing, medical examination, work clothes, deal with a wound, and the meaning of Hazard Analysis and Critical Control Points (HACCP) guidelines. A correct answer received a score of 1 (yes), while a wrong answer received a score of 0 (No). Eight questions were asked to assess food safety practice in clean workers and fishermen in, A total individual where interviewed in ALmorada market (30 workers clean and 10 fishermen), in Almarkazy market (40 worker clean) and (20 fishermen) in Jabal Awleya dam market. Checklists that used is:

Table 1: .Checklists to Monitor Handling and Hygiene practices of responder in ALmorada market :

<b>Element to evaluation</b>	<b>yes</b>	<b>no</b>	<b>Detail of action taken</b>
Has every worker undergone a medical examination?	30	0	All clean worker had a certificate but the fishermen had n't.
Do all the workers wear suitable and clean working clothes?	20	10	The clothes unsuitable and not clean sea figure no(1)
Do they wash and disinfect their hands each time before resuming work?	0	30	Don't wear

Are the wounds covering with water-proof bandages?	0	30	They used lemon and salt to disinfect and use the rope to bandage.
Does the staff respect the instruction of not smoking spitting and drinking in the working and storage premises?	0	30	Sea figure (2)
Have you now, or have you over the last seven Days, suffered from diarrhea and/or vomiting?	0	30	There were some cases, but they didn't talk about it.
Do you suffer from: i) Recurring skin or ear trouble? ii) A recurring bowel disorder? iii) Discharge from eye, ear or gums/mouth?	0	30	They don't a wear about the case
Are staff aware of fish handling hazard?	0	30	They were a wear bout don't practice the right.

The fishermen in ALmorada area they suffer from neglect from competent authorities also the clean worker, the medical examination not refurbished for almost of a worker, the fishermen suffer from belharsya and they haven't medical examination.

Table 2 .Checklists to Monitor Handling and Hygiene practices of responder . in

Al markazy market :

<b>Element to evaluation</b>	<b>yes</b>	<b>no</b>	<b>Detail of action taken</b>
Has every worker undergone a medical examination?	30	10	All clean worker had a certificate but not refurbished.
Do all the workers wear suitable and clean working clothes?	0	40	The clothes unsuitable and not clean sea figure no(3)
Do they wash and disinfect their hands each time before resuming work?	5	30	Don't wear about the importance of hand wash.
Are the wounds covering with water-proof bandages?	0	40	They used lemon and salt to disinfect and use the rope to pandage.
Do the staff respect the instruction of not smoking spitting and dirking in the working and storage premises?	0	40	Sea figure (4)
Have you now, or have you over the last seven Days, suffered from diarrhea and/or vomiting?	20	20	There are some cases, but they didn't talk about it.
Do you suffer from: i) Recurring skin or ear trouble? ii) A recurring bowel disorder? iii) Discharge from eye, ear or	10	30	They don't a wear about the case.

gums/mouth?			
Are staff aware of fish handling hazard?	30	10	They were aware but not practice the right.

The most of worker they knew of importance of cleaner and the effect of it, but they don't practice the role, the school children come in the market as a worker in a holy day without any wear, the medical examination every 6 months only blood test.

Table 3. Checklists to Monitor Handling and Hygiene practices of responder in Jabal Awleya dam market :

<b>Element to evaluation</b>	<b>yes</b>	<b>no</b>	<b>Detail of action taken</b>
Has every worker undergone a medical examination?	0	20	All the fisher men hadn't have a certificate.
Do all the workers wear suitable and clean working clothes?	0	20	The clothes unsuitable and not clean sea
Do they wash and disinfect their hands each time before resuming work?	5	15	Don't wear about the importance of hand wash.
Are the wounds covering with water-proof bandages?	0	20	They used lemon and salt to disinfect and use the rope to bandage.
Do the staff respect the instruction of not smoking spitting and drinking in the working and storage premises?	0	20	They made her food inside the boat.

Have you now, or have you over the last seven Days, suffered from diarrhea and/or vomiting?	2	18	There are some cases, but they didn't talk about it.
Do you suffer from: i) Recurring skin or ear trouble? ii) A recurring bowel disorder? iii) Discharge from eye, ear or gums/mouth?	1	19	They don't aware of the case.
Are staff aware of fish handling hazard?	20	0	They was a wear bout not practice the right.

The group of fishermen so neglect from competent authorities and government.

As we mentioned above we asked 100 worker divided to three areas (ALmorada market , ALmarkazy market , JabalAwleya dam ).The first question did they had medical certificate ? When we analyses there answer we found that Table4:

Answer	Frequency	Percentage
Yes	62	62.0%
No	38	38.0%
Total	100	%100

From Table 4 most of the individuals were said yes (62 /62.0%). While the total number was said no (38 /38.0%). That means its good indicator for the clean worker (70 individual) were had to certificate. but not for fishermen (30 individual) were had no certificate.

Table 5: Frequency distribution of responders (n =100) individual, have healthy appears of employees clothes (gloves, coats and boots) in Khartoum state.

Answer	Frequency	Percentage
Yes	2	2.0%
No	98	98.0%
Total	100	100%

From Table 5 most of the individuals were said no (98 /98.0%). While the total number were said yes (2/2.0%). That means it's the bad indicator for the clean worker (70 individual) and fishermen (30 individual) where had not enough knowledge of suitable and clean clothes for a work area.

Table 6: Frequency distribution of responders (n =100) individual do right hand health in work step, in Khartoum state.

Answer	Frequency	Percentage
Yes	7	7.0%
No	93	93.0%
Total	100	100%

From Table 6: most of the individuals were said no (93 /93.0%). While the total number was said yes (7/7.0%). That means it's the bad indicator for the clean worker (70 individual) and fishermen (30 individual ) where had not enough knowledge of hand wash and sanitation during work in a work area.

Table 7: Frequency distribution of responders (n =100) individual how to deal with wounds during work , in Khartoum state.

Answer	Frequency	Percentage
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Yes	3	3.0%
No	97	97.0%
Total	100	100%

From Table 7 most of the individuals were said no (97 /97.0%) While the total number was said yes (3/3.0%).That means it's a bad indicator for the clean worker (70 individual) and fishermen (30 individual ) where hadn't enough knowledge of correct first aid to wounds during work in the work area.

Table 8: Frequency distribution of responders (n =100) individual to Commitment to not eating, drinking and smoking during work, in Khartoum state.

Answer	Frequency	Percentage
Yes	4	4.0%
No	96	96.0%
Total	100	100%

From Table 8 most of the individuals were said no (96 /96.0%).While the total number were said yes (4/4.0%).That mean it's good indicator for the clean worker (70 individual) and fisher men (30 individual) where had not enough knowledge of food safety and personal hygiene during work in work area .

Table 9: Frequency distribution of responders (n =100) individual, note the condition of diarrhea or nausea in the last week, in Khartoum state.

Answer	Frequency	Percentage
Yes	54	54.0%

No	46	46.0%
Total	100	100%

From Table 9 most of the individuals were said yes (54/54.0%). While the total number were said no (46 /46.0%). That mean it's bad indicator for the clean workers (70 individual) and fisher men (30 individual ) where had not enough knowledge of food safety and personal hygiene in work area.

Table 10: Frequency distribution of responders (n =100) individual, not of health status include skin, ears, eyes and bowel disorder, in Khartoum state.

Answer	Frequency	Percentage
Yes	34	34.0%
No	66	66.0%
Total	100	100%

From Table 10 most of the individuals were said no (66 /66.0%). While the total number was said yes (34/34.0%). That means it's the bad indicator for clean workers (70 individual) and fishermen (30 individual) were had not enough knowledge of food safety and personal hygiene in the work area.

Table 11: Frequency distribution of responders (n =100) individual, aware of hazard during handling, in Khartoum state.

Answer	Frequency	Percentage
Yes	75	75.0%
No	25	25.0%



Total	100	100%
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From Table 11 of most of the individuals were said yes (75/75.0%). While the total number was said no (25 /25.0%).That means it's a bad indicator for the clean workers (70 individual) and fishermen (30 individual ) were had not enough knowledge about fish handling hazard in the work area.

## Chapter Four

### Discussion

In this study, a checklist designed for the present study has personal hygiene practices. Food hygiene legislation emphasizes every food business operator's responsibility to produce food safely by applying good hygienic practices and food safety management procedures based on hazard analysis and critical control point (HACCP) principles. The axes discussed in the study hazard due to cross contamination. In our study was poor hygiene practices in the fish market and processing plant. From Table 1 a medical certificate status, most of the (80 individuals) were said yes (62 /62.0%). While the total number was said no (38 /38.0%) it is better than Diei-Ouadi *et al*, 2011 study Trader's fish handling practices, perceptions on environmental situation and awareness on institutional guidelines which indicated that 52.5% of the respondents had a food handler's medical certificate. In Table 2 individuals which have healthy appears of employees clothes (gloves, coats, caps, and boots) most of the (80 individuals) were said no (98 /98.0%). While the total number was said yes (2/2.0%). That means it's the bad indicator for the clean worker (60 individual) and fishermen (20 individual) where had not enough knowledge of suitable and clean clothes for the work area. Ali (2016) study Assessment of bacteriological profile and the fractures that contribute to food contamination in restaurant food in Hailt Kuku. In his result had better knowledge in wearing gloves were 73.3% of respondents agree that using gloves is important in reducing risk of food contamination, 20% of them that disagree, 6.6% had no idea 80% agree using of apron is important in reducing risk of food contamination, 10% of them disagree, 10% had no idea, 83.3% agree that using mask is important in reducing risk of food contamination, 3.3% of them disagree that 13% had no idea, 46.7% of them agree that using caps is important in

reducing of food contamination, 63.7% of respondents disagreed that and 16.7% of them had no idea. the hand washing practical From Table 3 most of the (80 individuals) were said no (93 /93.0%).While the total number was said yes (7/7.0%).Is in contrast with Ali ( 2016) in his result had better knowledge in hand wash( 10.0%) did not a know( 63.3%)of them had true responses also (26.7%)had false responses. Mohamed ( 2015) of the food handlers is washing hand to safety measures and about 43.3% of them had no idea. From Table 4 individual how to deal with wounds during work, most of the (80 individuals) were said no (97 /97.0%).While the total number was said yes (3/3.0%). I agree with Jernigan and Farr, 2000 and Anonymous, 1996 wound infections have been reported after the injury to the skin in most of the infectious cases. Eating and drinking in the work . From Table 5 most of the (80 individuals) were said no (96 /96.0%).While the total number was said yes (4/4.0%). Alhaj (2012) 13.3% of respondents were true, 46.7% were false, 40% do not know eating and drinking in the workplace increases the risk of food contamination, Ali (2016)( 40.0%) of the responses did not know about the guide that means better than our study. Note the condition of diarrhea or nausea in the last week, in Khartoum state. From Table 6 most of the (80 individuals) where said yes (54/54.0%).While the total number was said no (46 /46.0%). Diarrhea can be transmitted by food. I disagree with Alhaj (2012) result is good than our study were individuals responded 93.3% had said true, 0% false and 6.7% do not know. And the result of Ali (2016) is better which indicate that diarrhea can be transmitted by food (6.7%) did not know and (93.0%) of responses true. Finding reported of health status include skin, ears, eyes and bowel disorder, in Khartoum state (During infectious diseases, its necessary to take leave from work). From Table 7 of most of the (80 individuals) were said yes (34/34.0%).While the total number was said no (66 /66.0%). Is in contrast with Ali (2016) regarding reaction to infectious diseases of eye and skin the respondent

about (63.0%) had true responses statement (During infectious diseases of the eye, its necessary to take leave from work). (10.0%) of them had false responses (26.7%) did not know, Also (56.7%) had a true response. Mohamed (2015) 80% of them agree that health status of the workers should be evaluated before employment, just (10.0 %) of them disagree and also (10.0 %) of them had no idea. Majority of them about (93.3 %) agree that foodborne illnesses can have deleterious health and economic effect on the society and only (6.7%) of them had no idea about that. And exactly in the same line with Diei-Ouadi et al, 2011 were (76%) yes (24%)no. Majority of domestic fish markets are unhygienic and the fish storing and handling facilities are poor. There is also a lack of proper and adequate fish handling facilities and basic equipment. From Table 8 aware of hazard during handling fish most of the (80 individuals) were said yes (75/75.0%). While the total number was said no (25 /25.0%).

## **Conclusion**

The study showed that food handlers have basic knowledge on good personal hygiene practices. However, some discrepancies were revealed in the proper hand washing procedure. And recommended good hand washing procedure to be reiterated among the food handlers. There is also an immediate need for continuous training among food handlers regarding good personal hygiene practices to reach a high-quality product from the fisherman through the factory to the seller.

## **Recommendation**

- All personnel have the potential to act as a source of contamination, be it biological, physical or chemical.
- Personal hygiene must be applied to everyone, and this includes management, visitors, contractors, engineers, maintenance and any other person who visits the premises. The same rules apply to everyone.
- Sound employee hygiene has been proved to Reduce Product Contamination.

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## **Appendix 1:**

### **DEFINITIONS**

***Control (verb):*** To take all necessary actions to ensure and maintain compliance with criteria established in the HACCP plan.

***Control (noun):*** To state wherein correct procedures are being followed and criteria are being met.

***Control measure:*** Any action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

***Corrective action:*** Any action to be taken when the results of monitoring at the CCP indicate a loss of control.

***Critical Control Point (CCP):*** A step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.

***Critical limit:*** A criterion which separates acceptability from unacceptability.

***Deviation:*** Failure to meet a critical limit.

***Flow diagram:*** A systematic representation of the sequence of steps or operations used in the production or manufacture of a particular food item.

***HACCP:*** A system which identifies, evaluates, and controls hazards which are significant for food safety.

***HACCP plan:*** A document prepared in accordance with the principles of HACCP to ensure control of hazards which are significant for food safety in the segment of the food chain under consideration.

***Hazard:*** A biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health effect.

***Hazard analysis:*** The process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for food safety and therefore should be addressed in the HACCP plan.

***Monitor:*** The act of conducting a planned sequence of observations or measurements of control parameters to assess whether a CCP is under control.

***Step:*** A point, procedure, operation or stage in the food chain including raw materials, from primary production to final consumption.

***Validation:*** Obtaining evidence that the elements of the HACCP plan are effective.

***Verification:*** The application of methods, procedures, tests and other evaluations, in addition to monitoring to determine compliance with the HACCP plan

## Appendix 2

### Figures:



Figure (1):

The worker in Almorada market they didn't commit to work clothes.



Figure (2):

The worker in ALmorada market they didn't respect the role of don't drink, eating and etc, of food safety knowledge.



Figure (3):

The worker in Almarkazy market they didn't wear suitable clothes to work.



Figure (4):

The worker in almarkazy market they didn't respect the role of don't drink, eating and etc, of food safety knowledge.

