

**Sudan University of Science and Technology  
Collage of Graduate Studies**

**Impact of Knowledge, Attitude, Practice, and Training of  
Quality Inspectors of Food Safety in Ministry of Agriculture,  
Animal Wealth, and Irrigation – Sudan**

أثر معرفة و سلوك و ممارسات, وتدريب مفتشي الجودة لسلامة الأغذية  
وزارة الزراعة والثروة الحيوانية والري-السودان

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degree of master of Total Quality Management & Excellence**

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## الإستهلال

قال تعالى:

(وَقُلْ رَبِّيَ زِدْنِي عِلْمًا)

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# **Dedication**

**This thesis is dedicated to with love to my family.**

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Praise is to Allah, the Lord of the worlds. The blessing and peace be upon our Prophet Mohammad (peace is upon him).

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# ABSTRACT

The aim of this study was to map and assess Quality inspectors Food Safety Knowledge, Attitudes, Practices, and Training according to the international standards of the Codex Alimentarius Commission, CAC /RCP 11969,Rev.4-2003 and food safety management system (ISO 22000-2005) at The Ministry of Agriculture , Animal Wealth and Irrigation - Khartoum State. Emphasis on food safety training for quality inspector is needed to ensure these employees have appropriate food safety knowledge and attitudes and to ensure that food safety practices are followed during the inspection process which is mandatory implemented as form of co-regulation scheme in Sudan. Also to analyze the current inspection procedure used by those quality inspectors. The findings are needed for the establishments of better quality and safety control system in Sudan. (Modernizing Sudanese inspection model- the case for change to optimizing confidence in food safety in Sudan). Questionnaire, observations, official records were used for the collection of informative data required for evaluation. The questionnaire was designed to collect the necessary data consisting of three dimensions include 42 phrases. The community study of Ministry had been selected from staff of the Ministry inspector. Stratified random sample of data collection were used, the total sample size of 87 inspectors, the respondents were 73, and the respond rate was 83.9%. Result of the study showed that there is a positive impact of the knowledge, attitude practice and training on ideal inspection which can improve food safety, also showed that there is positive impact of training on food safety knowledge, attitude and practice. The study recommended the hazard analysis critical control point HAACP is the preferable standard in meat industry to be adopted as a mandatory regulation to enhance food safety regulation compliance. Further studies on this topic were recommended. Study also suggests to adopt regular training to staff based on food safety ,and mandatory adopt of process and product standard according to CAC /RCP 1-1969, revision.4-2003 and ISO 22000:2005. and modernizing Sudanese inspection model.

## مستخلص البحث

هدفت الدراسة لتقييم معرفة وممارسات وسلوك مفتشي الجودة من حيث نظام ضبط الصحة والسلامة، بناء على المعايير الدولية للجنة دستور الأغذية لعام 1993 ، ومعايير جودة وسلامة الأغذية العالمية ( مواصفة الأيزو 22000-2005). وتقييم نظام تفتيش اللحوم المستخدم حالياً . النتائج مطلوبة لتأسيس نظام ضبط جودة وسلامة أفضل للحوم في السودان. استخدمت الإستبانة و الملاحظات و السجلات الرسمية لجمع المعلومات الإحصائية المطلوبة للتقييم. وقد تم إستخدام المنهج الوصفي في جمع البيانات وتحليلها. تم تصميم الإستبانة لجمع البيانات و مكونة من 3 أبعاد تشمل 42 عبارة، وقد تكون مجتمع الدراسة من المفتشين بالوزارة حيث بلغ عددهم 87 مفتش. تم إختيار عينة عشوائية لجمع البيانات الميدانية بلغ حجم العينة 73 شخصاً وبلغت نسبة الاسترداد 83.9 % . أوضحت نتائج الدراسة أنه يوجد أثر إيجابي لمعرفة وسلوك وممارسات مفتشي الجودة علي نظام التفتيش مما يؤثر علي نظام سلامة الأغذية وأوضحت ايضاً أن هنالك أثر إيجابي للتدريب علي مستوى معرفة وسلوك وممارسات مفتشي الجودة بوزارة الزراعة والثروة الحيوانية والري- ولاية الخرطوم .أوصت الدراسة بتطبيق مواصفة سلامة الغذاء " تحليل المخاطر ونقاط التحكم الحرجة " فهي المواصفة المناسبة التي يمكن أن تعتمد كلانحة لتعزيز المطابقة لقوانين سلامة الغذاء، وأوصت الدراسات اللاحقة بإجراء مزيداً من البحوث حول هذا الموضوع . وأنه يجب تفعيل نظام تدريب مستمر لرفع كفاءة المفتشين من حيث زيادة مستوى المعرفة والسلوك والممارسات.

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## CHAPTER One

## **CHAPTER ONE INTRODUCTION**

### **Introduction:**

People have the right to expect the food they eat to be safe and suitable for consumption. Food borne illness and food borne injury are at best unpleasant; at worst, they can be fatal. But there are also other consequences. Outbreaks of food borne illness can damage trade and tourism, and lead to loss of earnings, unemployment and litigation. Food spoilage is wasteful, costly and can adversely affect trade and consumer confidence. Most foods are subjected to many potential sources of microorganisms including soil, water air, plants feed or fertilizer, animals, insects, human, sewage processing equipment, product to product and packaging materials (Jackson,*et al.*, 1989)

There is social and legal responsibility for all organization in food chain to ensure that consumers have clear and easily-understood information, by way of labeling and other appropriate means, to enable them to protect their food from contamination and growth/survival of food borne pathogens by storing, handling and preparing it correctly. Everyone, including farmers and growers, manufacturers and processors, food handlers, quality inspectors and consumers, has a responsibility to assure that food is safe and suitable for consumption (Jackson ,*et al.*, 1989)

Cohen, *et al.*, (2001) stated “only knowledgeable, motivated, and skilled employees who are trained to follow the proper procedures together with management that effectively monitors employees’ performances can ensure food safety.

Inadequate hygiene training and / or instruction and supervision of all people invalid in food related activities pose a potential threat to the safety of food and its suitability for consumption. Food Agriculture Organization (FAO, WHO, 2001).

Food borne diseases have caused a significant morbidity and mortality around the world. The United States of America reports that around 76 million food borne diseases occur annually with 325,000 people hospitalized and 5200 cases of mortality (Buzby , *et al.*, 2009). WHO also reports that 18% of children aged below 5 years old in developing countries die due to diarrhea globally (Bryce, *et al.*, 2005). In one study food handlers were identified as the main cause of food contamination (Campos, *et al.*, 2009).

Food safety quality inspectors play a major role in prevention and control of outbreaks of food borne illness.

The study was to analyze the current Sudanese inspection system and establishments of better quality and safety control system in Sudan.

And to examine the knowledge, attitude and practice of Quality inspector during the inspection process which is necessary to provide compliance to food regulations based on food safety concepts .and achieve the mission of quality inspectors which is ensure that

the nation commercial supply of meat and poultry and eggs is safe ,wholesome and correctly labeled and packaged .

This study was examined the skills and competencies required for a modern food inspection workforce. The food inspectors of today – and tomorrow will require new skills, a greater understanding of the relevant science and technologies, continuous training and modern information management tools to do their jobs. Their work remains central to a modern and effective food safety system.

**Objectives of the study:**

- Identify the perception or level of awareness of quality inspector based on the essential principles of food safety in co-regulation scheme.
- Analyze inspection procedure in order to modernization of Sudanese inspection model (the case of change) and to optimizing confidence in food safety in Sudan.

## Chapter two

## CHAPTER TWO

### LITERATURE REVIEW

#### **2.1 Knowledge, Attitudes and Practices (KAP):**

**Knowledge** is defined as “a complex process of remembering, relating, or judging an idea or abstract phenomenon (cognitive abilities)” (Gotsch et al. 2012).

The relationship between knowledge, attitudes and behavior is often explained Through the KAP model (Simelane, 2005). Knowledge accumulates through learning processes and these may be formal or informal instruction, personal Experience and experiential sharing (Glanz, *et al.*; 2002). It has been traditionally assumed that knowledge is automatically translated into behavior (Glanz, *et al.*; 2002). However behavior change theorists and experiences in the HIV field, have indicated that knowledge alone does not translate into appropriate behavior modification (UNAIDS 2004, Shisana,*et al.*; 2002, Glanz,*et al.*; 2002).

Attitude involves evaluative concepts associated with the way people think, feel and behave (Keller, 1998). It has also been postulated that attitudes may influence one’s intention to perform a given behavior or practice (Rutter, *et al.*; 2003). They are thus correlated with behavior, for instance if a person has a positive attitude towards appropriate hand washing, they are more likely to wash their hands (Simelane, 2005). However, some social scientists have argued that KAP surveys are not necessarily adequate or sufficient to provide information especially for programmatic planning. It is argued that critical elements relating to a variable may not be captured in the use of a questionnaire and that in depth information gathering using qualitative methods may be additionally beneficial in eliciting information, as surveys fail to explain the logic behind the behavior (Launiala, 2009). Another concern is that there is an assumption that there is direct relationship between knowledge and behavior. In health related studies, however, it has been found that knowledge is not the only factor that influences treatment seeking practice and in order to change behavior, health programs need to address a number of issues including socio-cultural, environmental, economic and structural factors (Launiala, 2009). Behaviorists further add that a number of factors can influence one or more of the KAP variables such as self-esteem, self-efficacy and misconception (Ajzen, 2002, Keller, 1998, Glanz,*et al.*; 2002).

#### **2.2 Definition of food safety:**

Food safety is concept that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (ISO 22000-2005).

Food safety is related to the occurrence of **food safety hazards** (3.3) and does not include other human health aspects related to, for example, malnutrition.

Henson and Traill defined food safety as the inverse of food risk - the probability of not suffering some hazard from consuming a specific food (Henson, *et al.*; 1998). Food safety is considered as a concept of central importance because it plays an essential public health function (WHO, 2000).

### **2.3 History of food safety:**

Food safety remains a critical issue with outbreaks of food borne illness resulting in substantial costs to individuals, the food industry and the economy (Kaferstein, *et al.*; 1997). Within England and Wales the number of food poisoning notifications rose steadily from approximately 15,000 cases in the early 1980s to a peak of over 60,000 cases in 1996 (Wheeler, *et al.*; 1999). This may be partly attributed to improved surveillance (GriYth, *et al.*; 1995, Kaferstein, *et al.*; 1999) but may equally reflect increased global trade and travel, changes in modern food production, the impact of modern lifestyles, changes in food consumption and the emergence of new pathogens (Collins, *et al.*, 1997). Recent years have seen a reversal in this trend but food poisoning remains a high priority for the public and government (Parliamentary Office of Science and Technology, 2003). Mishandling of food plays a significant role in the occurrence of food borne illness. Improper food handling may be implicated in 97% of all food borne illness associated with catering outlets (Howes, *et al.*; 1996). Improper practices responsible for microbial food borne illnesses have been well documented (Bryan, 1988) and typically involve cross-contamination of raw and cooked foodstuffs, inadequate cooking and storage at inappropriate temperatures.

Food safety is related to the presence of food-borne hazards in food at the point of consumption (intake by the consumer). As the introduction of food safety hazards can occur at any stage of the food chain, adequate control throughout the food chain is essential. Thus, food safety is ensured through the combined efforts of all the parties participating in the food chain. FAO / WHO, (2001) required that people who do not maintain an appropriate degree of personal cleanliness, who have certain illnesses or conditions who behave inappropriately, can contaminate food and transmit illness to consumers.

According to a rough estimate, 48 million food-borne diseases occur each year in the United States (USA) alone, leading to 128,000 hospitalizations and 3000 deaths (Center of Disease Control (CDC), 2010). In Europe, it was reported that approximately 5,196 food-borne outbreaks (including water-borne outbreaks) occurred in 2013 (European Food Safety Authority (EFSA), 2015). It is also reported by the World Health Organization (WHO) that food-borne diseases largely reduce the health and economic growth of both developed and developing countries (WHO, 2013). According to the WHO, food- and water-borne outbreaks of diarrhea kill nearly 2.2 million people worldwide every year. Apart from diarrhea, food-borne illnesses can also trigger other serious complications such as kidney and liver failure, brain and neural disorders, reactive arthritis, cancer and death (WHO, 2013). Therefore, the causes of food-borne outbreaks need to be investigated carefully to prevent these outbreaks (Center of Disease Control (CDC), 2010).

A study to assess knowledge, attitudes, and behavior concerning food borne diseases and food safety issues amongst formal food handlers conducted in Italy found that the majority of food handlers who had attended a training course had knowledge and positive attitude toward food borne diseases control and preventive measures (. The positive attitude was not supported when asked about self-reported behaviors and when observed during food preparation for practice of hygienic principles. This was on the basis that only 21% used gloves when touching raw, unwrapped food. Predictors of the use of gloves were educational level and attending training courses. The authors suggested that emphasis should continue on improving knowledge and control of food borne diseases amongst food handlers (Angelillo, *et al.*; 2000).

Wie, *et al.*; 1997) studied the impact of a sanitation and food safety course on attitudes and knowledge of hospitality students. These researchers' analyzed data from 68 students required to take a sanitation and safety course in the hospitality major. Researchers compared students' knowledge and attitudes toward sanitation and food safety before and after completion of the course. Results of this study showed students' knowledge and attitudes improved after completion of the course. They concluded that offering a foodservice sanitation and safety training course, coupled with continuing education, was very important for increasing knowledge.

Hsu, *et al.*; 1995) studied sanitation knowledge, attitudes, and behaviors of 178 university foodservice non-managerial workers in nine universities. Results indicated that foodservice workers were most knowledgeable about dishwashing procedures (91.9%) and mold-related food poisoning issues (88.6%). Respondents were least knowledgeable about microorganisms (68.2%). Results also showed that respondents had positive attitudes and behaviors. Variables influencing sanitation knowledge, attitudes, and behaviors were educational level, age, gender, work experience, and amount of employee training. These researchers concluded that design of future training programs should allow employees to apply the new knowledge they learn in real life situations and work environments. It is recommended that managers of university foodservice conduct food safety training on a routine basis for both new employees and current employees and update new food safety knowledge and materials when those become available. Repeated training could improve employees' food safety knowledge, increase employees' positive attitudes toward food safety, and influence their food safety behaviors.

Mukhola (1998) in assessing the factors influencing the safety and quality of street food in a rural area in Limpopo examined the knowledge, attitude and perceptions in both street food vendors and consumers. Her findings indicated that the majority of street food vendors and consumers had little information regarding the proper preparation and storage of food as well as environmental conditions that may be detrimental to health. Furthermore 64.4% of consumers thought that street food is sold under unacceptable conditions and these needed improvement.

Noor (April 2012) evaluates the knowledge, attitude and practices (KAP) of food handlers working in restaurants in Kuala Pilah, Malaysia. Data were collected in 2010 involving 64 food handlers. The results show that the food handlers have excellent knowledge and attitude, and good practices toward food hygiene with mean score (SD) of 83.98 (13.26), 82.8 (10.94) and 77.04 (14.98), respectively. There is significant correlation between



educational level and attitude (p = .008), knowledge and attitude (p = .001), knowledge and practice (p = .007) and attitude and practice (p = .041). Even though the result shows satisfactory KAP levels of the food handlers, some aspects on hygiene measures like refreezing food item, clean working area and wearing of jewelry and watch need to be emphasized

Literature indicates that consumer attitudes towards food safety in general differ according to demographic and socio-economic factors such as gender, age, educational level and economic status. An American multi-state survey conducted in 1995/1996 found that men were more likely to report risky practices than women (Altekruse, *et al.*; 1999). The survey results also indicated that the prevalence of risky behaviors increased with increasing socio-economic status. On the other hand, a study carried out to measure knowledge, risk perception and practices of food safety of consumers in the Caribbean - Vietnam, revealed that consumers had an acceptable awareness of appropriate safety practices; however, a considerable number of consumers did not attribute certain illnesses to being food-borne and believed that it was possibly due to their own actions (Jackson *et al.* 1989).

To be effective food hygiene training needs to target changing those behaviors most likely to result in food borne illness. Most food hygiene training courses rely heavily on the provision of information. There is an implied assumption that such training leads to changes in behavior, based on the Knowledge, Attitudes and Practices (KAP) model. This model has been criticized for its limitations (Ehiri, *et al.*; 1997; Griffith, 2000). It is accepted that knowledge alone is insufficient to trigger preventive practices and that some mechanism is needed to motivate action and generate positive attitudes (Tones, *et al.*; 1994). In an evaluation of food hygiene education, the study was concluded that knowledge alone does not result in changes in food handling practices. Various studies have shown that the efficacy of training in terms of changing behavior and attitudes to food safety is questionable (Mortlock, *et al.*; 1999).

#### **2.4 food safety management system (ISO 22000-2005):**

is an International Standard specifies requirements for a food safety management system where an organization in the food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption. This International Standard integrates the principles of the Hazard Analysis and Critical Control Point (HACCP) system and application steps developed by the Codex Alimentations Commission. By means of auditable requirements, it combines the HACCP plan with prerequisite programs (PRPs). Hazard analysis is the key to an effective food safety management system, since conducting a hazard analysis assists in organizing the knowledge required to establish an effective combination of control measures. This International Standard requires that all hazards that may be reasonably expected to occur in the food chain, including hazards that may be associated with the type of process and facilities used, are identified and assessed. Thus it provides the means to determine and document why certain identified hazards need to be controlled by a particular organization and why others need not. During hazard analysis, the organization determines the strategy to be used to ensure hazard control by combining the PRP(s), operational PRP(s) and the

HACCP plan. The aim of this International Standard is to harmonize on a global level the requirements for food safety management for businesses within the food chain. It is particularly intended for application by organizations that seek a more focused, coherent and integrated food safety management system than is normally required by law. It requires an organization to meet any applicable food safety related statutory and regulatory requirements through its food safety management system. This International Standard allows an organization, such as a small and/or less developed organization (e.g. a small farm, a small packer-distributor, a small retail or food service outlet), to implement an externally developed combination of control measures.

Introduction of HACCP is being widely promoted in the United States as a means of improving hygiene standards and reducing contamination with pathogens. Similar principles can be applied to assuring the quality of meat. Varnam, *et al*; (1995).

FAO / WHO, (1993) stated that the application of HACCP systems can aid inspection by regulatory authorities and promote international trade by increasing confidence in food safety.

## **2.5 Food Safety and Inspection Service**

The 1906 Meat Inspection Act required the USDA to inspect all cattle, sheep, goats, and horses when slaughtered and processed into products for human consumption. The regulation applied to facilities that conducted business across state lines. Regulatory institutions and technologies of production have changed significantly since 1906 but, essentially, food safety laws have remained the same since then. For more than a hundred years, inspections have been the basis of the regulation of meat safety; still, regulatory enforcement by the FSIS has evolved. For instance, in 1922 the FSIS adopted new standards for the meat and poultry industries.

Today, FSIS continuously inspects plants during the slaughtering and the processing of all cattle, sheep, swine, goats, equines, catfish, and domesticated birds (chickens, turkeys, ducks, geese, emus, ostriches, and guineas). The FSIS also has jurisdiction over the safety of liquid, frozen and dried egg products. The staff of the FSIS comprises around 9,400 employees, of whom 8,000 inspect 6,300 meat slaughtering and/or processing plants. Taxpayers fund continuous inspection, but plants pay for overtime costs. The total budget allocated to the FSIS program for FY 2010 was about \$1 billion (USDA 2010).

Regulation of food products other than meat was initiated in 1906 with the Food and Drug Act (also known as the Wiley Act). The Bureau of Chemistry of the USDA, which later became the Food and Drug Administration, was responsible of enforcing provisions regarding labeling of food and drugs, interstate transport of unlawful food and drugs and adulteration of food. In 1938, President Roosevelt signed the Food, Drug, and Cosmetic Act. This was a more comprehensive law that mandated enforceable food standards, authorized factory inspections and added enforcement tools to the Food and Drug Administration (FDA). In 1940, the FDA was included in the Federal Security Agency, which, in 1953, became the Department of Health, Education, and Welfare, now known as the DHHS. (FDA, 2009).

The FDA regulates food products that are not under the responsibility of the FSIS. These include produce, dairy products, seafood, fresh eggs and eggs used as ingredients. The

FDA has oversight of more than 44,000 domestic food manufacturers, more than 100,000 registered food facilities and about 200,000 foreign facilities registered with the FDA. Unlike the FSIS, the FDA does not continuously inspect plants and facilities but instead conducts sporadic inspections and relies on notifications within the industry and from other sources to target plants and facilities at risk. In FY 2010, the budget of the FDA for enforcing food safety regulation was about \$1 billion (FDA, 2009).

## **2.6 Inspections:**

All operations and practices should be carried out in a manner that limits contamination to as low level as possible. Good personal hygiene and adequate training programs are important components, to ensure compliance with operational requirements. FAO/WHO, (1993).

Recognition of the dangers inherent to handling and consumption of meat is governed by food laws, slaughter rituals and inspection regulations. The slaughter of animal is governed by rules and regulations which are often linked with religion. Islam has different rituals and taboos regarding animal slaughtering, meat handling, and meat consumption. Islam for example, prescribes several forbidden meat sources as clearly stated in the Holy Quran Ayah 3. SoratElMaaida( Forbidden unto you ( for food ) are carrion and blood and swine flesh and that which hath been dedicated unto you any other than Allah, and the strangled and the dead through beating, and the dead through falling from a height and that which have been killed (goring of ) horns and the devoured of wild beast, saving that which ye make lawful ( by the death stroke ) and that which hath been immolated into idols ... " (Ibrahim, 1990).

Regulatory agencies utilize inspections and education of food handlers as two methods of ensuring food safety in the formal sector. The effectiveness of food handler education and inspections in ensuring food safety has, however been questioned owing to the variation in implementation of these two measures in the United States of America. (Riben, *et al.*; 1998). Riben, *et al.*; 1998) reviewed the training and inspection reports of the Boston Inspectional Services Department (ISD) in order to assess the effectiveness of inspections and training. The inspection records reflected scores obtained by restaurants that were inspected, or risk assessed using standardized form that identified 42 types of violations including items defined as "critical" - likely to be associated with foodborne illness or "non-critical" - likely to play a minor role in causing illness. Scores were calculated by deleting points from perfect inspection score of 100 (no noted violations). Thus inspection scores could range from 0 to 100. In 1988, a training program was initiated by the Boston ISD. Participation was mandatory for managers of restaurants with suspended licenses due to conditions found on inspection that constituted an immediate threat to health and for restaurants linked epidemiologically to cases of foodborne illness. Participation by restaurant managers outside these categories were voluntary. Riben, *et al.*; 1998) then analyzed the routine inspection records, following the training from 1989 to 1992 for three groups of restaurants: a mandatory group, a voluntary group and a control group (no staff attended the training). The authors looked at records before the training (baseline), one year after training and two years after training (Riben, *et al.*; 1998). The evidence regarding the effectiveness of foodhandler training in improving food safety was weak,

but it appeared that some training resulted in improved inspection scores (Ribben, *et al.*; 1998). It also appeared that inspections were beneficial as worse inspection scores were noted where no inspections were previously conducted (Ribben, *et al.*; 1998).

In the United Kingdom, a time-series experimental study was conducted as a result of the identification of unsatisfactory conformance to food safety standards following inspections (Rudder, 2006). The aim of the study was to identify barriers to compliance in the 40 food retail businesses. Environmental Health Officers (EHOs) conducted risk assessments on food safety through inspections at the establishments and categorized the businesses according to their performance. Over a period of six months the businesses were offered advice, seminars and one to one support. Thereafter, a further risk assessment was done and Rudder (2006) reported that 65% of the businesses had improved their risk profile, 15% had remained the same, 10% had some deterioration and a further 10% had completely deteriorated (Rudder, 2006). The authors concluded that lack of knowledge and understanding of the principles of food safety coupled with language difficulties, were significant barriers to promoting food safety and that supportive activities can make a significant impact on practices (Rudder, 2006).

A systematic review to investigate the effectiveness of food safety training as an intervention was conducted by Campbell and colleagues in Canada (Campbell, *et al.*; 1998). The inclusion criteria for the studies were multiple; including study design (controlled trials, cohort, case-control, pre-test/post-test without control, cross-sectional, ecological and time series); studies with specific interventions (inspection-based, food handler training and community based education); study selection of participants (food handlers working in the formal environment) and study outcomes (changes in inspection scores, knowledge of food safety practices and violation of inspection criteria). Quality assessment of the 34 studies included on the basis of the inclusion criteria categorized and rated 1 study as strong, 14 were moderate and 19 were weak. Therefore, only 15 studies were included in the systematic review. Interventions from the 15 studies were grouped into three categories of public health interventions regarded as important to enhance food safety: inspections, food handler training, and community-based education (Campbell *et al.*, 1998). Findings from the systematic review suggest that these multiple public health interventions are effective in assuring food safety, since routine inspection of food service premises (at least one inspection per annum) was effective in reducing the risk of food-borne illness as determined through improved inspection scores; food handler training can improve the knowledge and practices of food handlers, particularly if combined with certification; and selected community based education programs can increase public knowledge of food safety (Campbell, *et al.*; 1998).

## **2.7 Knowledge and skill requirements for food inspectors**

According to the training manual for food safety regulators, (WHO, 2010) are involved in implementing food safety and standards act 2006 across the country, and stated that food processing involves many disciplines because food matrices are extremely complex. In addition to proteins, carbohydrates, fats and minerals, the basic blocks of food, there are innumerable interactions between food components and with multiple external factors that may have an effect on the quality and safety of food. These factors may be

microbiological, chemical, physical or sensory. Even human perception plays an important role in food quality. In addition, the ultimate objective of food inspection is consumer protection against food borne disease and fraud. Consequently, the modern food inspector must be a professional who has a solid background in food science and technology and in public health. Essential areas of knowledge and skill for the food inspector are the following:

**2.7.1. Thorough knowledge of food law(s) and pertinent regulations:**

It is essential that the food inspector has a thorough knowledge of the law(s) and regulations governing the operation of food processing facilities and the corresponding inspection procedures. In addition, the inspector must know other pertinent regulations such as those dealing with environmental issues and workplace safety. Also of importance to product quality and safety are regulations affecting agricultural practices, food transportation and food distribution.

**2.7.2. Background information on the field of food safety and quality:**

Inspectors must know and understand all elements of a quality and safety management system, the role these play in food safety and the way these elements interact with one another. Central to this understanding is knowledge of food processing operations, food microbiology and food chemistry.

**2.7.3. Prerequisite sanitation, hygiene, and pest control practices:**

A thorough understanding of prerequisite programs requires prior knowledge of the properties of various types of cleaning and sanitizing compounds, and their interactions with food matter, with each other and with other materials, particularly those materials that equipment is made of (e.g. chlorine and steel). Moreover, it is important that the inspector is aware of the characteristics and effects of sanitizing compounds on target bacterial groups and the accepted limits for residues of such compounds in food. The inspector must also be knowledgeable about hygiene practices, including personnel hygiene, and must be able to convey this knowledge to management and employees so that the objectives of relevant regulations are easily understood. The field of pest control products and practices is another area in which inspectors must be knowledgeable. Most pest control products can be deleterious if they find their way into food. The inspector should be able to communicate this knowledge to food processors.

**2.7.4. HACCP principles**

Although this topic does not specifically cover Hazard Analysis and Critical Control Point (HACCP) systems, the HACCP approach is risk-based and its elements are helpful to use during an inspection. As such, it should be thoroughly understood by the inspector. Furthermore, the inspector should use inspections as an opportunity to promote HACCP to businesses. Ideally, food inspectors will have taken courses and been certified in the application of HACCP.

**2.7.5. Inspection techniques:**

Food inspection, as approached by this topic, is a review of the food safety and quality aspects of a primary processing operation or a food processing facility. It is expected that the topic will provide the inspector with sufficient insight into inspection techniques to properly fulfill his/her task.

**2.7.6. Sampling techniques for product testing:**

Knowledge of sampling techniques, particularly aseptic techniques, and of sample handling for transportation to a laboratory are essential to guarantee the integrity of samples taken for verification. In addition, the inspector must have a good knowledge of testing techniques so that he/she can make informed decisions about sampling methods and properly interpret the results of testing.

**2.7.7. Compliance verification skills:**

Beyond academic and practical knowledge of food regulations, food processing, food microbiology and chemistry, it is essential that inspectors have sufficient professional experience and criteria to be able to focus the inspection on the truly important factors affecting food product safety: the risk factors associated with food-borne disease.

**2.7.8. Communication and other skills:**

The food inspector must also possess good communication skills to enable him/her to adequately convey technical and regulatory information regarding safe food handling to others. In addition, the inspector must have professionalism and confidence and exhibit dignity and integrity.

**2.7.9. Original training certificate and required certificate updates:**

The food industry is in constant change. New food processing technologies, new controls, new equipment and new ingredients constantly come onto the market, as do new testing methods. The food inspector needs appropriate training and must have a diploma/certificate attesting to his/her professional standing and must attend certified continuing education courses to stay up to date with new developments. Mentoring of new inspectors by experienced colleagues is highly desirable.

It has become a universally adopted food safety requirement that prior to slaughter all animals must receive an ante-mortem inspection to ensure that: those displaying disease symptoms or conditions that would render their meat unfit for human consumption are not processed for human food; and only healthy animals are killed on the slaughter floor and that separate arrangements are made for slaughter (FAO, 1991). Animals should be inspected by veterinary inspector, to ensure their fitness for human consumption. Ante-mortem inspection procedure should be carried out to meet the behavior of animals and signs of disease, clean less of slaughter animals, Saudi Arabian Standards (1977).

Warris, (2000) said that animals are inspected before they are slaughtered. This may enable identification of clinical signs of diseases which could either be transmitted to human (zoonosis) or other animals or make the meat unfit for human consumption. FAO /WHO, (1993) reported that animals have been identified as being affected by any disease or defect that affects or might affect, the suitability of their meat for human consumption, should be segregated, from other animals.

According to (Gracey, *et al.*; 1999) the provision of a veterinary inspection of the live animal prior to slaughter is a basic requirement of most meat inspection system. Ante-mortem inspection has three main area of concern: Public health purposes, animal health and animal welfare. For public health purposes the veterinarian must separate normal animals from those which may be suffering a potentially zoonotic disease. The animal health aspect requires the veterinarian to identify notifiable disease. The ante-mortem procedure allows the veterinarian to assess the welfare implications of the structures and procedures within the lairage (Gracey, *et al.*; 1999).

Meat inspection was practiced in France as early as the year 1162. The main objective of meat hygiene and inspection is to avert meat spoilage and to prevent meat borne infections. The economic benefits gained from these objectives cannot be neglected Ibrahim, (1990).

Historically meat inspection to ensure the qualification of meat for sale involved visual detection of meat from animals suffering disease such as Tuberculosis, or which were infected with parasites. Inspection takes place immediately after slaughter in the early stages of dressing. Varnam and Sutherland, (1995).

The inspector examines each organ as its removal from the carcass, without the possibility of being confused. Martin, (1978). FAO, (1991) required that inspection should be made of head, carcass and viscera by fully qualified inspectors under conditions which enable them to readily detect defective material. For example, adequate lighting is required together with specially designated inspection areas equipped with examination tables and other equipment essential to the completion of satisfactory inspection.

Martin, (1978) reported that after 1965 no carcasses or part removed from a slaughter house until it has been inspected and passed as fit for human consumption and marked by the inspector accordingly. It is recognized that the essentials of an efficient system of meat inspection are: - a competent inspectorial staff, and concentration of slaughtering, which are of administrative character, will be a definite methods of inspection. Martin, (1978 ). It is desirable that the management of each abattoir or establishment, in its interest, have access to laboratory services. Analytical procedures used should follow recognized or standard methods in order that the results may be readily interpreted (FAO, WHO, 1993).

FAO / WHO, (1993) Stated that all meat hygiene requirements should be supervised by an official veterinarian. For every abattoir or establishment there should be at least one official veterinarian appointed to supervise hygiene, including meat inspection. An inspector should monitor the application and results of the process control program with respect to all matters touching on the safety and hygiene of fresh meat as well as all matters relating to additional requirements imposed by the controlling authority. Varnam, et al.; (1995) observed that in several European countries, where inspection is by veterinarians, the prime function was animal welfare, while elsewhere it was seen as a means of preventing fraudulent practice. In many countries, especially those with major export interests, meat is also inspected as a quality assurance function to ensure that the expectations of the customer are met.

According to Saudi Arabian standards organization, (1978 ) veterinary inspector defined as a medical veterinarian, appointed by the authorities to inspect animals and carcasses, ensuring their fitness for human consumption as well as to supervise abattoirs, quarantine and general meat hygiene.

According to Gracey et al, (1999) the duty of the official veterinarian must be taken seriously if satisfactory hygiene standards are to be maintained.

HACCP has provided a framework for meat inspection to move into the 21st century. The HACCP approach provides a science-based approach to controlling potential food safety hazards, whether they are physical, chemical or microbiological. Reducing microbiological contamination in the food supply is a priority for the meat and poultry

industry. Because microbial pathogens, if present, typically are present only in very low numbers, eliminating the possibility of a single microbial pathogen creates unique challenges. While recognized by international experts, such as those of the International Commission on Microbiological Specifications for Foods, that microbiological testing cannot ensure food safety, testing is used to help verify that the HACCP procedures are working to control, reduce or eliminate potential microbial hazards.

Hazard Analysis of Critical Control Point (HACCP) system and meat surveillance programs are two types of meat safety. Assurance programs used for pathogenic control on meat products provide documentation that abattoir methods of preparing and handling of meat are conducive to the production of clean and safe meat products. The meat surveillance programs are complementary to HACCP system, Elsebaey, (2001). An adequate supply of potable water with appropriate facilities for its storage, distribution and temperature control, should be available whenever necessary to ensure the safety and suitability of food, FAO/WHO, (2001).

Primary production should be managed in a way that ensures that food is safe and suitable for its intended use where necessary this include: controlling contaminations, pests and diseases of animals and plant in such away as not to pose a threat to food safety, FAO / WHO, (2001).

HACCP program is a detailed and systemic investigations used to control microbiological hazards associated with food during its preparation and distribution to ensure quality and whole-sameness of high risk foods through determinations of possible sources of contamination and how to reduce it. Fathi, (1998).

## **2.8 Regulatory basis for effective quality and safety management systems:**

### **2.8.1. Applicable food law(s):**

The inspector and the inspection process must necessarily be empowered by food safety laws and regulations. The inspector must be thoroughly knowledgeable about these laws and regulations and about the scope of the authority vested in him/her. The inspector should have copies of all pertinent law(s) and regulations for consultation in case of any disagreement.

In the absence of laws and regulations to allow an inspector to implement a risk-based approach to food inspection, areas for improvement identified during the inspection can be raised as recommendations instead of non-compliances while legislation is reviewed.

### **2.8.2 Other pertinent regulation(s):**

In addition to food law(s) and regulations, the inspector should be aware of other laws and regulations that may have food safety implications, such as environmental laws and regulations addressing such issues as sewage and waste disposal. Food processing, in general, is very water intensive, and this issue and the potential need to treat effluents may be an important consideration in areas where water is scarce.

There are food processing facilities that cater for export markets and therefore must comply with particular national or international food safety and quality regulations.

## **2.9 The U.S. inspection models :**



The U.S. meat and poultry inspection system has augmented industry efforts to create the safest meat and poultry food supply in the world. Under the Federal Meat Inspection Act, FMIA (21 U.S.C. 601 et seq.), and the Poultry Products Inspection Act (21 U.S.C. 451 et seq.), the United States Department of Agriculture's Food Safety and Inspection Service (USDA FSIS) issues regulations governing the production of meat and poultry products prepared for distribution in commerce. FSIS and its nearly 7,000 employees inspect about 6,500 establishments producing meat, poultry and egg products. Veterinary inspectors check animals before and after slaughter, visually and physically examining more than 5 billion poultry carcasses and 100 million livestock carcasses each year. Federal inspectors also monitor products during processing, handling, and packaging to ensure that they are safe and accurately labeled. Federal inspectors have the authority to shut plants down for food safety violations, by withholding the federal inspection mark on products. Companies under federal inspection apply the USDA mark to all products. The mark contains an establishment number, which indicates the facility that produced the product. The presence of the mark indicates that the product was produced in compliance with one of the most comprehensive set of regulations applied to an industry. At the close of the twentieth century, American Meat Institute, NAMI's predecessor, National Academy of Science, Government Accounting Office, and National Advisory Committee on Microbiological Criteria for Foods called for changes in the existing inspection system to better address microbial pathogens. A major shift in the approach to meat and poultry inspection began in 1996, with the issuance of the Pathogen Reduction and Hazard Analysis and Critical Control Point (PR/HACCP) Rule. The PR/HACCP Rule established that critical limits must be designed to satisfy FSIS regulations, including performance standards for specific products. FSIS claimed that performance standards would help ensure the safety of products, give establishments the incentive and flexibility to adopt innovative, science-based, food safety processing procedures and controls, and provide objective, measurable standards that could be verified by FSIS oversight. FSIS wanted to minimize regulatory burdens on the industry and the performance criteria would be implemented on the basis of a statistical evaluation of the prevalence of bacteria in each establishment's products compared with national prevalence. In addition to reorganization, FSIS wanted to: Implement a modernized system of risk-based inspection, Initiate a major redeployment of its inspection resources to successfully implement HACCP and Better target food safety hazards during transportation, storage and retail sale. FSIS publishes guidance (Directives & Notices) for their inspection staff on "how they are to protect the public health by properly verifying an establishment's compliance with the pathogen reduction, sanitation, and HACCP regulations." FSIS inspectors use expertise and judgment in determining whether sanitation performance standard requirements are met. Inspectors also take verification samples that are tested for the presence of potentially pathogenic microorganisms, selected tissues, and certain drug and chemical residues. (NAMIS, 2015).

## **2.10 Analyzing the current Sudanese inspection model:**

According to Meat Hygiene Law at Khartoum State (1997) the veterinary inspection means the veterinary inspection doing by the official authority to the food animals before and after slaughtering. Meat Hygiene and Inspection Legislation at Khartoum, (1999), has been defined. Meat inspector means that a person who appointed by the official authority to inspect the food animals before and after slaughter and decide it's suitability for human consumption.

Food safety being promoted by public authorities as form of co-regulation in Sudan (Ministry of Agriculture & Animal Wealth and Irrigation) and mandatory implemented by quality inspectors; The Ministry is typically employ number of quality inspectors; It is not uncommon that Ministry Managers hire many fresh graduate employees with no food safety experience. In addition, many employees work in Ministry for only one or two years and leave for employment in other fields. As a result, employees may have less awareness of and concern about principles of food safety unless they interested in. It is very important for regulated agencies and managers to educate all quality inspectors about food safety train them to use appropriate inspection procedures, and monitor their performance according to food safety regulations.

From the last decade through the present, the meat and poultry industry has become one of the most heavily regulated industries in the Sudan. The Sudanese meat and poultry inspection system has augmented industry efforts to create the safest meat and poultry food supply in the country. Veterinary inspectors check animals before and after slaughter, visually and physically examining more than 5 billion poultry carcasses and 100 million livestock carcasses each year. Sudanese quality inspectors also monitor products during processing, handling, and packaging to ensure that they are safe and accurately labeled.

Quality inspectors have the authority to shut plants down for food safety violations, by withholding the Sudan inspection label on products. Companies under ministry inspection apply the label to all products. The label contains the state name, which indicates the state that produced the product. The presence of the label indicates that the product was produced in compliance with one of the most comprehensive set of food safety regulations applied to an industry.

## **2.11 Modernizing the Sudanese inspection model (The case for change):**

The goals of the model are to standardize the inspection approach and provide for consistent and appropriate oversight across all regulated food commodities. Oversight should be based on risk and focused on prevention of non-compliance, using science and technology.

The improved food inspection model should apply to all food inspection conducted by, or on behalf of, the Ministry of Agriculture, Animal Wealth, and Irrigation. Common components of the improved food inspection model should also be applied to the ministry's plant and animal health programs, wherever appropriate.

### **2.11.1. Why change:**

The way that food is produced and distributed has undergone fundamental changes in recent decades. The food safety landscape has become more complex, driven by

widespread changes in methods of food production and processing, coupled with rapid increases in global food trade. These changes have been created by population and income growth in emerging economies and by consumer demands for more diverse and innovative food choices (e.g., ready-to-eat meals).

The food processing industry has also become more technologically advanced, significantly increasing the speed and volume of production. At the same time, industry is seeking to remain competitive by developing new products and accessing new markets.

New food safety risks are emerging as a result of globalization and innovation in the food industry; and the ability to detect those risks is improving due to advances in science and technology. Mass distribution networks mean that problems – when they

do occur – can quickly become widespread. Recent international incidents of foodborne illness have shown that outbreaks are not necessarily contained within national borders.

Food safety regulators rely upon sophisticated technologies and integrated surveillance information to prevent or respond to food safety incidents.

Consumers today are demanding more meaningful information about food safety and quality. To meet this demand, some companies are engaging external audit bodies to provide greater assurance that their products meet quality and safety requirements. At the same time, regulators are increasingly being asked by the public to demonstrate that food safety oversight systems and approaches are effective.

Ultimately, all partners in food safety must remain vigilant and responsive to the changing environment, to keep pace with the increasing speed of commerce and the challenges it brings. Against this backdrop, the science of food safety is advancing and approaches to food safety oversight are changing around the world.

The international standard setting body for food safety, the Codex Alimentarius Commission, promotes the use of a systems-based approach as an effective means of delivering food safety outcomes.

A systems-based approach means that those who have the primary responsibility for the safety of the food they produce or sell – that is, food producers, processors and importers – implement preventative programs to identify and control food safety risks. An example of a systems-based approach is a Hazard Analysis and Critical Control Points (HACCP) system.

Currently, a HACCP system is not mandatory in Sudan but HACCP principles can be incorporated into preventative controls across all commodities. Many of Sudan's trading partners are moving to more preventative and systems based approaches to manage risk. For example, the Saudi Arabia has recently introduced a new Food Safety Modernization Act which focuses on using preventative controls across the food supply.

Approaches used by regulators have also changed to emphasize industry's responsibility to put in place effective hazard control programs. Government's role is to verify industry's implementation of these programs. Overall, this approach is more rigorous and provides better food safety outcomes by focusing on preventing problems before they occur.

The role of the inspector is changing as well; the primary role of a food inspector has always been to verify industry's compliance with the requirements of legislation. But how this is done has changed significantly over the past 15 years. Traditional inspection

methods that focused on the processing environment and end-product have been supplemented by more sophisticated science and risk-based approaches that rely on systems such as HACCP.

As a result of these discussions, five common components of food inspection were identified and design principles were articulated as a starting point for the development of the improved food inspection model.

**Table(2.1) Components of the improved food inspection model**

<b>Components of the improved food inspection model</b>	<b>What this means for the design of the improved food inspection model</b>
Licensing/registration	The regulator should be able to identify all regulated parties and understand the nature and risk of their regulated activities. Industry is responsible for its products and processes and would demonstrate ongoing compliance with requirements
Ministry oversight	The level of the ministry's oversight should correspond to the level of residual risk which would take into account factors associated with the product/process, the regulated party's controls and compliance history.
Inspection	Standardized inspection and verification approaches across all foods should promote consistent and risk-based application of food safety and other regulatory requirements.
Compliance and enforcement	The ministry response to non-compliance should be predictable, transparent, graduated and based on risk.
System performance	The overall effectiveness of an inspection system should be validated on an on-going basis through the use of objective performance measures.

(Sourced: modification of the draft of improved food inspection model – the case of change)

## **2.11.2 Components of the improved food inspection model**

From the table above, there were the Components of the improved food inspection model:

### **2.11.2.1 Licensing/registration**

Knowing who the regulated parties are, what they produce and how they produce it is crucial to determining the required level of oversight and to making risk-based inspection

decisions. The model proposes that industry who import or export food, or operate as manufacturers or processors of food products for trade between provinces would be required to obtain a license/registration to operate. Through the ministry's licensing/registration process, manufacturers and importers would demonstrate their commitment to providing safe and compliant food. A condition for licensing/registration would be the development and implementation of a preventative control plan, suitable to the regulated party's products and operations. The conditions would depend on the regulated party's initial risk profile.

#### **2.11.2.2 The Ministry oversight:**

The model proposes that industry be held responsible for designing and implementing preventative control plans for their unique operations. The Ministry would then verify that these plans appropriately prevent, eliminate or reduce hazards to acceptable levels. Residual risk - the risk that remains once these effective preventative controls have been applied as well as compliance history – would determine the required level of inspection oversight by the ministry (e.g. normal, enhanced or reduced). Inspection In the proposed model, inspection and verification processes would be standardized across food processing establishments and importers. The frequency and scope of the inspection activities would be based on risk level and would be adaptable, as required, to the size and complexity of the regulated parties' operation. Third-party verification on behalf of the retail sector is becoming more prevalent as a tool to ensure that suppliers meet buyer requirements for safety and quality. Where there is alignment with government requirements, third-party verification could potentially complement Agency inspection. However, the Ministry needs to determine how it may recognize the third-party verifiers and how they may complement the government's inspection activities.

#### **2.11.2.3 Compliance and enforcement:**

The model proposes applying a single compliance and enforcement strategy that is based on the principle that industry is responsible for producing safe food that complies with regulatory requirements. When non-compliance is found, industry would be responsible for taking appropriate action to correct the situation. The model aims to make compliance and enforcement transparent, predictable and appropriate to the level of non-compliance. For critical or repeated non-compliance, licenses to operate may be suspended or revoked.

#### **2.11.2.4 System performance:**

It is important for decision-makers to know whether the inspection system is achieving its objectives. This can be accomplished through a validation process that measures quality of program design and delivery. In the proposed model, a comprehensive validation process would be an integral component to promote continuous improvement. The objectives of validation would be to assess overall effectiveness of the food inspection system, ensure that inspection program is delivered consistently, effectively and efficiently, and identify gaps. Ultimately, knowing where the problems are occurring allows the Ministry to mitigate risks and prevent future food safety challenges.

#### **2.11.2.5 The path forward**

The improved food inspection model is being developed using the ideas and principles outlined in this study. The Ministry is also taking into consideration the best practices of

food inspection organizations in other countries. The Agency is working towards a model that is focused on prevention and is aligned with the most up-to-date science and risk management approaches. An improved food inspection model would allow the ministry to standardize its inspection approach and provide for the right coverage across different foods and different risks.

#### **2.11.2.6 Opportunities for input**

The success of the improved food inspection model requires the engagement and support of everyone who has any responsibility for food safety in Sudan. The Ministry shall start to create engagement opportunities with interested parties at each stage of the process.

# Chapter three

## **CHAPTER THREE:**

## MATERIALS AND METHODS

### 3.1 Subjects:

An exploratory research at Ministry of Agriculture Animal Wealth, and Irrigation – Khartoum with one qualitative method used are focus group of administrations and inspectors interviewed by a questionnaire.

A convenience sample of quality inspectors (N=73) working in Ministry of Agriculture, Animal Wealth, and Irrigations in May 2017 was used for the study. The research protocol and questionnaires were approved by the meat manufacturing administration prior to data collection. Approval of the project also was obtained from the director and assistant director of ministry.

### 3.2 Questionnaire design:

A 3-part questionnaire was developed to identify governmental quality inspectors' food safety knowledge, attitudes, practices, and the training received from ministry of agriculture, animal wealth, and irrigations related to food safety.

Part one was designed to measure quality inspectors' knowledge related to food safety and included 27 questions. A 5-point Likert-type rating scale, ranging from one (1) "strongly disagree" to five (5) "strongly agree", was used. These questions were related to general food safety knowledge such as personal hygiene, definition of foodborne illness, time and temperature control, cross contamination, gloves use, and sanitizing and food safety standard, Low and regulations. The Cronbach alpha reliability coefficient for the 27 knowledge items was 0.97 which indicated a high level of internal consistency for these scales with this specific sample. Part two of the questionnaire included 8 questions to determine employees' attitudes and practice toward food safety. Also A 5-point Likert-type rating scale, ranging from one (1) "strongly disagree" to five (5) "strongly agree", was used. The Cronbach alpha reliability coefficient for the 12 attitude items was 0.97. Part three of the questionnaire consisted of 7 questions measuring employees' training was developed to identify food safety topics taught to inspectors during orientation or on-the-job training. The respondents answered these statements by checking yes or no or don't know. The Cronbach alpha reliability coefficient for the training items was 0.97. The final section collected demographic characteristics of quality inspectors.

### 3.3 Pilot Test

The questionnaire was pre-tested by 10 Quality inspectors who work in the Ministry. These inspectors were asked to complete the questionnaire and to identify concerns and suggestions. All suggestions were considered and used to revise the questionnaire before data collection.

### 3.4 Data Collection

The questionnaire and a cover letter were distributed to quality inspectors before or after they had clocked out for a shift and placed under the time clock for quality inspectors who were willing to participate in this study but were unable to be present at the time of distribution. The questionnaire and a cover letter were placed in quality inspectors' email and whatsapp applications and in the Ministry offices. Employees placed completed questionnaires in email or Ministry offices.

### 3.5 Data Analyses



SPSS version 11.5 for Windows was used for all data analyses. Descriptive statistics including frequencies, medians, and standard deviations were calculated for all variables as appropriate. Chi Square parametric test was used to examine food safety knowledge, attitudes, practices, and training for governmental inspectors.

# Chapter four

## **CHAPTER FOUR**

### **RESULTS**

Quality inspectors returned 73 questionnaires for a 83.9% response rate. Thirty-five questionnaires were completed by inspectors of meat manufacturing and inspection administration for a 47.9% response rate, and thirty eight questionnaires were completed by inspectors of the control and monitoring administration for a 52.1% response rate.

**4.1 Descriptive data:**

Demographic characteristics of quality inspectors are presented in Tables (4.1) below.

This first part of the analysis calculated the frequencies and percentages for each of the descriptive questions.

**Table (4.1) Demographic Characteristics of Inspectors and administrations (N = 73)**

#	characteristic	Frequency	total	percentage	total	
1	EDUCATION	Diploma	2	73	2.7	100%
		Bachelor	45		61.6	
		Master	23		31.5	
		PHD	3		4.1	
2	BACKGROUND	Veterinary	42	73	57.5	100%
		Agriculture	2		2.7	
		food technology	2		2.7	
		animal production	27		37.0	
3	EXPERIENCE	fresh graduate	19	73	26.0	100%
		(3-5) years	21		28.8	
		above 5 years	33		45.2	
4	JOB	Inspector	62	73	84.9	100%
		Administration	11		15.1	
5	DEPARTMENT	Meat manufacturing inspection administration	35	73	47.9	100%
		Control and monitoring administration	38		52.1	

Table (4.1) shows that:

- The educational level of most individual in the study was (Bachelor Degree) (45) and (61.6%), followed by (Master Degree) (23) (31.5%), followed other educational levels (PHD Degree) (3) (4.1%) , while the total number of the educational levels (Diploma) is (2) (2.7%).

- Most of the individual background was Veterinary (42) and (57.5%), followed by Animal production background (27) (37.0%), followed by equal percentage of (Agriculture and Food Technology (2) (2.7%).

- The experience level of the most individual (above 5 years) (33) (45.2%), followed by (3-5 years) (21) (28.8%), followed by fresh graduate (19) (26.0%).

- The occupation of most individual study are (inspectors) (62) and (84.9%), followed by occupations (administrations) by (11) with (15.1%).

- Most of the individuals were in the department of Control and monitoring administration (38) (52.1%), followed by Meat manufacturing inspection administration (35) (47.9%).

#### 4.2 Results of Statistical Testing (Descriptive analysis):

##### 4.2.1: Descriptive analysis for questionnaire (part A):

Table (4.2) shows the percentage, and median and trends, the percentage for responses to the part A of the questionnaire

**Table (4.2) Descriptive analysis for questionnaire (part A)**

NO	Question	Median	Trend	Percentage%
1	People who do not maintain an appropriate degree of personal cleanliness, who have certain illnesses or conditions or who behave inappropriately, can contaminate food and transmit illness to consumers.	5	Strongly Agree	58.9
2	To ensure that those who come directly or indirectly into contact with food are not likely to contaminate food by behaving and operating in an appropriate manner	4	Agree	31.5
3	Food handlers should maintain a high degree of personal cleanliness and, where appropriate, wear suitable protective clothing, head covering, and footwear	5	Strongly Agree	58.9
4	Conditions which should be reported to management so that any need for medical examination and/or possible exclusion from food handling can be considered include: sore throat with fever; visibly infected skin lesions (boils, cuts, etc.); discharges from the ear, eye or nose.	4	Agree	52.1

5	Cuts and wounds, where personnel are permitted to continue working, should be covered by suitable waterproof dressings.	4	Agree	57.5
6	Personnel should always wash their hands when personal cleanliness may affect food safety, immediately after using the toilet; after handling raw food or any contaminated material, where this could result in contamination of other food items; they should avoid handling ready-to-eat food, where appropriate	5	Strongly Agree	52.1
7	Personal effects such as jewelry, watches, pins or other items should not be worn or brought into food handling areas if they pose a threat to the safety and suitability of food.	5	Strongly Agree	53.4
8	People engaged in food handling activities should refrain from behavior which could result in contamination of food, for example: smoking; spitting; chewing or eating; sneezing or coughing over unprotected food.	5	Strongly Agree	78.1
9	Visitors to food manufacturing, processing or handling areas should, where appropriate, wear protective clothing and adhere to the other personal hygiene provisions in this section.	5	Strongly Agree	84.9
10	From your perspective the physical, chemical and biological hazards are cause food contamination	5	Strongly Agree	64.4
11	Failures in slaughter hygiene, meat cutting and meat handling, transportation and in the hygiene of by-products and additives will all contribute to quality losses and deterioration of the final processed meat products.	5	Strongly Agree	50.7
12	Prevent microbial contamination of raw materials, intermediate (semi-manufactured) goods and final products during meat product manufacture through absolute cleanliness of tools, working tables, machines as well as hands and outfits of personnel.	4	Agree	49.3

13	Minimize microbial growth in raw materials, semi manufactured Goods and final products by storing them at a low temperature.	5	Strongly Agree	61.6
14	Time and temp systems should also specify tolerable limits for time and temperature variations and the records thereof shall be maintained in a register for inspection.	4	Agree	47.9
15	Ventilation systems natural and /or mechanical including air filters, exhaust fans, wherever required, shall be designed and constructed so that air does not flow from contaminated areas to clean areas.	5	Strongly Agree	64.4
16	Ice and steam used in direct contact with food shall be made from potable water and shall comply with specified requirements (shall be produced, handled and stored in such a manner that no contamination can happen).	4	Agree	53.4
17	food safety being promoted by public authorities as form of co-regulation in Sudan (ministry of agriculture & animal wealth and irrigation) and mandatory implemented by quality inspectors.	5	Strongly Agree	72.6
18	The food safety regulation and inspection procedure Science based risk assessment and prevention method	4	Agree	49.3
19	regulatory impact analysis RIA is required when new food safety regulation is adopted	4	Agree	52.1
20	According to Meat Hygiene Law at Khartoum State (1997) the veterinary inspection means the veterinary inspection doing by the official authority to the food animals before and after slaughtering	5	Strongly Agree	73.5
21	Official inspection can be performed by both process and product oriented	4	Agree	52.1
22	Hazard Analysis Critical Control Point HACCP is the preferable standard in meat industry.	5	Strongly Agree	69.9
23	Pathogen Reduction - Hazard Analysis Critical Control Point PR-HAACP is the preferable standard in meat industry	4	Agree	53.4
24	Currently, a HACCP system is not mandatory	4	Agree	60.3

	in Sudan but HACCP principles can be incorporated into preventative controls across all commodities.			
25	The Sudanese inspection model now needs to move to more preventative and systems based approaches to manage risk. (Need for change).	5	Strongly Agree	78.1

Table (4.2) shows the descriptive analysis of the sample distribution based on their department .the highest frequency was 38 individuals were in control and monitoring administrations. The Table also shows the median and the interpretation of the answers of each question, Most of the answers regarding (Section A) was tending towards Strongly Agree also a few has tended to answer Agree.

**4.2.2: Descriptive analysis for questionnaire (part B- attitude and practice):**

**Table (4.3) shows** the percentage, median, and trends to the part B of the questionnaire (attitude and practice).

**Table(4.3) Descriptive analysis for questionnaire (part B)**

<b>NO</b>	<b>Question</b>	<b>median</b>	<b>trend</b>	<b>Percentage%</b>
<b>1</b>	Good personal hygiene practices help keep food safe to eat.	5	Strongly Agree	52.1
<b>2</b>	The quality inspector has a responsibility to teach worker how to keep food safe.	4	Agree	47.9
<b>3</b>	As quality inspector I believe that my decisions impact the safety of food at the facility.	5	Strongly Agree	50.7
<b>4</b>	As quality inspector I believe that It is important to improve food handling practices to reduce the risk of illness.	5	Strongly Agree	52.1
<b>5</b>	As quality inspector I believe that Written food safety policies and procedures are necessary to keep food safe.	4	Agree	50.7
<b>6</b>	As quality inspectors I monitor products during processing, handling, and packaging to ensure that they are safe and accurately labeled.	5	Strongly Agree	60.3
<b>7</b>	As Quality inspectors I have the authority to shut plants down for food safety violations, by withholding the Sudan inspection label on products.	5	Strongly Agree	65.8
<b>8</b>	As quality inspector I believe that The presence of the label indicates that the product was produced in compliance with one of the most comprehensive set of food safety regulations applied to an industry.	5	Strongly Agree	67.1

The Table (4.3) shows the median and the interpretation of the answers of each question, Most of the answers regarding (Section B) were tending towards Strongly Agree also a few has tended to answer Agree.

#### **4.2.2: Descriptive analysis for questionnaire (Part c- Training):**

**Table (4.4) Descriptive analysis for questionnaire (Part C – Training)**



<b>no</b>	<b>Question</b>	<b>median</b>	<b>Trend</b>	<b>Percentage%</b>
<b>1</b>	The food inspectors of today – and tomorrow will require new skills, a greater understanding of the relevant science and technologies, continuous training and modern information management tools to do their jobs.	<b>3</b>	<b>Yes</b>	<b>79.5</b>
<b>2</b>	Do you think that the training was important for your job?	<b>3</b>	<b>Yes</b>	<b>86.3</b>
<b>3</b>	Have you ever received any training in Food Safety?	<b>3</b>	<b>Yes</b>	<b>50.7</b>
<b>4</b>	If you receive training; Does the material reinforce the core information Are local food practices discussed? _ Does the material reflect local facilities (i.e., running water, refrigerators, etc.)?	<b>3</b>	<b>Yes</b>	<b>58.9</b>
<b>5</b>	Have you receive on job training before you start the working in the ministry?	<b>3</b>	<b>Yes</b>	<b>75.3</b>
<b>6</b>	Do you have a Certificate of these training?	<b>1</b>	<b>No</b>	<b>67.1</b>
<b>7</b>	Do you believe that the ministry trains their employee sufficient courses on food safety?	<b>1</b>	<b>No</b>	<b>72.6</b>

Table (4.4) shows the percentage, median and the trends, most of the answers were trending toward Yes expect two answers trending toward No.

### **4.3: Hypotheses Test**

This part of the analysis tested the answers with Chi Square nonparametric test, the following Tables show the value of Chi Square, the Significant and the interpretation. Two main Hypotheses regarding the relationship of the KAP with both ideal inspection and the training were tested.

**4.3.1 FirstHypothesis:**

**H<sub>0</sub>: There is no relationship between the KAP and the ideal inspection**

**H<sub>1</sub>: There is a relationship between the KAP and the ideal inspection**

Chi Square test was used and resulted (3569.593) for the Chi square value and a degree of freedom equal 4 and Significant value was (0.00), to test the hypothesis, the significant value was compared with (alpha=0.05), the Significant was lower than the alpha value which indicate thatH<sub>0</sub>was Rejected and AcceptH<sub>1</sub>hypothesis that stated “There is a relationship between the **KAP** and the **ideal inspection**”.

**Table (4.5) Chi squire analysis for the questionnaire (part A- Knowledge)**

NO	Question	Chi Squire	Sig.	Interpretation
1	People who do not maintain an appropriate degree of personal cleanliness, who have certain illnesses or conditions or who behave inappropriately, can contaminate food and transmit illness to consumers.	31.425	.000	No significant Differences
2	To ensure that those who come directly or indirectly into contact with food are not likely to contaminate food by behaving and operating in an appropriate manner	28.027	.000	No significant Differences
3	Food handlers should maintain a high degree of personal cleanliness and, where appropriate, wear suitable protective clothing, head covering, and footwear	35.37	.000	No significant Differences
4	Conditions which should be reported to management so that any need for medical	33.890	.000	No significant Differences

	examination and/or possible exclusion from food handling can be considered include: sore throat with fever; visibly infected skin lesions (boils, cuts, etc.); discharges from the ear, eye or nose.			
5	Cuts and wounds, where personnel are permitted to continue working, should be covered by suitable waterproof dressings.	64.151	.000	No significant Differences
6	Personnel should always wash their hands when personal cleanliness may affect food safety, immediately after using the toilet; after handling raw food or any contaminated material, where this could result in contamination of other food items; they should avoid handling ready-to-eat food, where appropriate	33.890	.000	No significant Differences
7	Personal effects such as jewelry, watches, pins or other items should not be worn or brought into food handling areas if they pose a threat to the safety and suitability of food.	34.301	.000	No significant Differences
8	People engaged in food handling activities should refrain from behavior which could result in contamination of food, for example: smoking; spitting; chewing or eating; sneezing or coughing over unprotected food.	68.740	.000	No significant Differences
9	Visitors to food manufacturing, processing or handling areas should, where appropriate, wear protective clothing and adhere to	35.630	.000	No significant Differences

	the other personal hygiene provisions in this section.			
10	From your perspective the physical, chemical and biological hazards are cause food contamination	39.890	.000	No significant Differences
11	Failures in slaughter hygiene, meat cutting and meat handling, transportation and in the hygiene of by-products and additives will all contribute to quality losses and deterioration of the final processed meat products.	33.644	.000	No significant Differences
12	Prevent microbial contamination of raw materials, intermediate (semi-manufactured) goods and final products during meat product manufacture through absolute cleanliness of tools, working tables, machines as well as hands and outfits of personnel.	33.562	.000	No significant Differences
13	Minimize microbial growth in raw materials, semi manufactured Goods and final products by storing them at a low temperature.	72.479	.000	No significant Differences
14	Time and temp systems should also specify tolerable limits for time and temperature variations and the records thereof shall be maintained in a register for inspection.	30.767	.000	No significant Differences
15	Ventilation systems natural and /or mechanical including air filters, exhaust fans, wherever required, shall be designed and constructed so that air does not flow from contaminated areas to clean areas.	43.507	.000	No significant Differences
16	Ice and steam used in direct contact with food shall be made	.342	.558	There is significant Differences <sup>1</sup>

<sup>1</sup> There were significant differences between the answers of the sample individuals to the question 16, see the descriptive analysis of the questions on table (4.5).

	from potable water and shall comply with specified requirements (shall be produced, handled and stored in such a manner that no contamination can happen).			
17	food safety being promoted by public authorities as form of co-regulation in Sudan (ministry of agriculture & animal wealth and irrigation) and mandatory implemented by quality inspectors.	93.082	.000	No significant Differences
18	The food safety regulation and inspection procedure Science based risk assessment and prevention method	33.562	.000	No significant Differences
19	regulatory impact analysis RIA is required when new food safety regulation is adopted	53.63	.000	No significant Differences
20	According to Meat Hygiene Law at Khartoum State (1997) the veterinary inspection means the veterinary inspection doing by the official authority to the food animals before and after slaughtering	20.836	.000	No significant Differences
21	Official inspection can be performed by both process and product oriented	33.89	.000	No significant Differences
22	Hazard Analysis Critical Control Point HACCP is the preferable standard in meat industry.	11.521	.001	No significant Differences
23	Pathogen Reduction - Hazard Analysis Critical Control Point PR-HAACP is the preferable standard in meat industry	63.274	.000	No significant Differences
24	Currently, a HACCP system is not mandatory in Sudan but HACCP principles can be incorporated into preventative controls across all commodities.	70.397	.000	No significant Differences

25	The Sudanese inspection model now need to moving to more preventative and systems based approaches to manage risk.(need for change ).	115.877	.000	No significant Differences
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**Table (4.6) Chi square analysis for the questionnaire (part B – attitude and practice)**

<b>NO</b>	<b>Question</b>	<b>Chi Square</b>	<b>Sig.</b>	<b>Interpretation</b>
<b>1</b>	Good personal hygiene practices help keep food safe to eat.	.123	.725	There is significant Differences <sup>2</sup>
<b>2</b>	The quality inspector has a responsibility to teach worker how to keep food safe.	61.521	.000	No significant Differences
<b>3</b>	As quality inspector I believe that my decisions impact the safety of food at the facility.	58.562	.000	No significant Differences
<b>4</b>	As quality inspector I believe that It is important to improve food handling practices to reduce the risk of illness.	.123	.725	There is significant Differences <sup>3</sup>
<b>5</b>	As quality inspector I believe that Written food safety policies and procedures are necessary to keep food safe.	.014	.907	There is significant Differences <sup>4</sup>
<b>6</b>	As quality inspectors I monitor products during processing, handling, and packaging to ensure that they are safe and accurately labeled.	38.822	.000	No significant Differences
<b>7</b>	As Quality inspectors I have the authority to shut plants down for food safety violations, by withholding the Sudan inspection label on products.	45.397	.000	No significant Differences
<b>8</b>	As quality inspector I believe that The presence of the label indicates that the product was produced in compliance with one of the most comprehensive set of food safety regulations applied to an industry.	85.192	.000	No significant Differences

Table (4.6) shows the value of the Chi Square for each question and the significantvalue, to interpret these values.

<sup>2</sup> There were significant differences between the answers of the sample individuals to the question 1, see the descriptive analysis of the questions on table (4.6).

<sup>3</sup> There were significant differences between the answers of the sample individuals to the question 4, see the descriptive analysis of the questions on table (4.6).

<sup>4</sup> There were significant differences between the answers of the sample individuals to the question 5, see the descriptive analysis of the questions on table (4.6).

### 4.3.2 Second Hypothesis:

**H<sub>0</sub>: There is no relationship between the KAP and the training**

**H<sub>1</sub>: There is a relationship between the KAP and the training**

To test this hypothesis, chi Square was used.

**Table (4.7) Chi square analysis for the questionnaire (part C-training)**

<b>no</b>	<b>Question</b>	<b>Chi Square</b>	<b>Sig.</b>	<b>Interpretation</b>
<b>1</b>	The food inspectors of today – and tomorrow will require new skills, a greater understanding of the relevant science and technologies, continuous training and modern information management tools to do their jobs.	25.329	.000	No significant Differences
<b>2</b>	Do you think that the training was important for your job?	38.479	.000	No significant Differences
<b>3</b>	Have you ever received any training in Food Safety?	30.932	.000	No significant Differences
<b>4</b>	If you receive training; Does the material reinforce the core information Are local food practices discussed? _ Does the material reflect local facilities (i.e., running water, refrigerators, etc.)?	26.740	.000	No significant Differences
<b>5</b>	Have you receive on job training before you start the working in the ministry?	60.932	.000	No significant Differences
<b>6</b>	Do you have a Certificate of these training?	47.452	.000	No significant Differences
<b>7</b>	Do you believe that the ministry trains their employee sufficient courses on food safety?	53.616	.000	No significant Differences

The above table shows the value of the Chi Square for each question and the Sig value, to interpret these values. The test resulted (199.255) for the chi square value and a degree of freedom equal 2 and Sig. value was (0.00) to test the hypothesis we compare the sig value with (alpha=0.05), we find that the Sig. is lower than the alpha value which indicate that



we should Reject  $H_0$  and Accept  $H_1$  hypothesis that says " There is a relationship between the **KAP** and the **training**".

# Chapter five

## CHAPTER FIVE

### DISCUSSION

This study considered as the first in the Khartoum-Sudan on the knowledge of researcher because it deals with governmental quality inspectors.

This discussion includes a presentation and discussion of the most important finding of the study and providing the conclusion and a set of recommendations that come out

from the study results. The study was conducted on a sample of inspectors of Ministry of Agriculture, Animal Wealth and Irrigation. A questionnaire was distributed to (87) inspectors and received (73). The data were input into the computer and processed statistically using the Statistical Package for Social Sciences (SPSS).

Observed from the study results, the knowledge, attitude, practice, and training of governmental quality inspectors to food safety in the Ministry of Agriculture, Animal Wealth and Irrigation is ranging between (having knowledge, positive attitude, and hygienic practice) and (low training level) with main goals to provide compliance to food regulations based on food safety concepts and achieve the mission of quality inspectors and establishment of better quality system in Sudan and enhance or modernizing Sudanese inspection system as the result showed.

In general the results revealed that there is positive impact of the knowledge, attitude practice and training on ideal inspection which can improve food safety, also showed that there is positive impact of training on food safety knowledge, attitude and practice.

This study distinguishes from other previous studies, because its focus on assess the knowledge, attitude, and practice of quality inspectors and to what extend the training of inspectors affect the knowledge attitude and practice.

Several studies have been conducted to assess college students' and foodservice employees' food safety knowledge, attitudes, practices, and training.

Unklesbay, *et al*, (1998) studied college students' attitudes, practices, and knowledge of food safety. Results showed that students in dietetics, food science, nutrition, and health programs had higher attitude scores compared to students in other majors. Females, upperclassmen, graduate students, and those who took at least one course related to food safety had higher mean scores for food safety knowledge, attitudes, and practices than males, freshmen and sophomores, and those who had not taken a food safety course. These researchers suggested that all educators in food-related disciplines should educate college students about the importance of consumer food handling behaviors and the fact that consumers share responsibility for food safety.

Wie, *et al*, (1997) studied the impact of a sanitation and food safety course on attitudes and knowledge of hospitality students. These researchers' analyzed data from 68 students required to take a sanitation and safety course in the hospitality major. Researchers compared students' knowledge and attitudes toward sanitation and food safety before and after completion of the course. Results of this study showed students' knowledge and attitudes improved after completion of the course. They concluded that offering a foodservice sanitation and safety training course, coupled with continuing education, was very important for increasing knowledge.

Hsu, *et al*, (1995) studied sanitation knowledge, attitudes, and behaviors of 178 university foodservice non-managerial workers in nine universities. Results indicated that foodservice workers were most knowledgeable about dishwashing procedures (91.9%) and mold-related food poisoning issues (88.6%). Respondents were least knowledgeable

about microorganisms (68.2%). Results also showed that respondents had positive attitudes and behaviors. Variables influencing sanitation knowledge, attitudes, and behaviors were educational level, age, gender, work experience, and amount of employee training. These researchers concluded that design of future training programs should allow employees to apply the new knowledge they learn in real life situations and work environments. It is recommended that managers of university foodservice conduct food safety training on a routine basis for both new employees and current employees and update new food safety knowledge and materials when those become available. Repeated training could improve employees' food safety knowledge, increase employees' positive attitudes toward food safety, and influence their food safety behaviors.

Henroid and Sneed (2004) evaluated food handling practices, presence of prerequisite food safety programs, and employees' food safety knowledge and attitudes in 40 Iowa school foodservice operations to determine readiness for implementing hazard analysis critical control point (HACCP) programs in school foodservice operations. These researchers found that employees had high food safety knowledge ( $15.9 \pm 2.4$  out of 20 points) and overall positive food safety attitudes (ranging from 4.2 to 4.8 out of 5 points). However, observations of food handling practices indicated that proper food handling practices sometimes were not followed. Areas identified for improvement included inadequate taking and recording of food temperatures, infrequent and improper handwashing, inappropriate food cooling and thawing, and inadequate checking and recording of sanitizer concentrations.

In a study of food safety practices and readiness to implement HACCP programs in assisted-living facilities in Iowa, Sneed, *et al*, (2004) identified a number of food safety practice concerns. These researchers found that employees were least knowledgeable about food cooling and thawing practices, sanitizer concentration, and minimum end-point cooking temperatures. Researchers observed that hand washing sometimes was inappropriate, effective hair restraints often were not used, food temperature monitoring and recording were infrequent, and sanitizer concentration was not checked regularly. Researchers concluded that employees in assisted-living foodservice had sufficient food safety knowledge and positive attitudes toward food safety, but food safety practices still needed to improve, which was consistent with findings in the Henroid,*et al*, (2004).

Previous research studies have focused on employees' food safety knowledge, attitudes, and practices in restaurants, temporary food facilities, and institutional foodservices with little research has focused on student employees. But the present study was to assess Quality inspectors' food safety knowledge, attitudes, practices, and training at the governmental sectors.

### **Conclusion and Recommendations:**

The present study concluded that:

- There is positive impact for knowledge attitude, and practice on ideal inspection which can affect food safety.

- There is positive impact for training in improves the level of knowledge attitude, and practice on ideal inspection which can affect food safety.

### **Recommendations:**

Recommendations for managers in the Ministry, based on results of this study, include:

- ◆ the hazard analysis critical control point HAACP is the preferable standard in meat industry to be adopted as a mandatory regulation to enhance food safety regulation compliance.
- ◆ To Implement an efficient food safety training program for inspectors to ensure inspectors have appropriate levels of food safety knowledge and positive attitudes, and demonstrate these in practice and Consider providing food safety training not only during inspectors orientation, which usually is held at the beginning of the job, but also on regular basis as a reminder to quality inspectors.
- ◆ Develop a checklist to ensure all food safety components are covered during food safety orientation and training.
- ◆ modernizing Sudanese inspection model- the case for change to optimizing confidence on food safety on Sudan.

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## **Appendix**

### **Questionnaire**

**Sudan University for Science and Technology**

**College of Graduate Studies**

## Introduction

In the last decade, the concept of inspection has been developed and increasingly promoted as an important instrument of regulation in Sudan. In the context of food safety, The study was examine the knowledge, attitude, and practice of quality inspector during the inspection process which is necessary to provide compliance to food regulations based on food safety concepts. Emphasis on food safety training for quality inspector is needed to ensure these employees have appropriate food safety knowledge and attitudes and to ensure that food safety practices are followed during the inspection process which is mandatory implemented as form of co-regulation scheme. And also analyze the current Sudanese inspection model in order to modernizing this model.

إستبيان لدراسة وتقييم معرفة وسلوكيات وممارسات مفتشي الجودة اتجاه سلامة الأغذية

السادة / مفتشي الجودة بوزارة الزراعة و الثروة الحيوانية والري :

تحية طيبة وبعد

في البدء اتقدم بالشكر لكل من تعاون معي ووافق على ملء هذا الإستبيان .

أقدم لسيدتكم الإستبيان التالي حول ( قياس وتقييم معرفة وسلوكيات وممارسات مفتشي الجودة بالقطاع الحكومي ووضع نموذج تطويري لطريقة التفتيش بالقطاع الحكومي ) من أجل بحث تكميلي بغرض الحصول على شهادة الماجستير في إدارة الجودة الشاملة والتميز .

للتفضل بالإجابة عن الأسئلة الواردة بهذا الإستبيان والتي تحتوي على معلومات فقط سيتم إستخدامها لأغراض البحث العلمي ؛ للتفضل بالإدلاء بالإجابات المناسبة والتي تعكس الواقع من أجل أن تكون الدراسة واقعية ومفيدة .

شاكرين حسن تعاونكم معنا,,,,,,,,,,,,,

إسم الباحث : فيحاء الوليد يحي يوسف.

إسم المشرف : بروف/ أمل عمر بخيت .

**The aim of this questionnaire is to analyze knowledge, Attitude, Practice of Quality inspectors toward food safety, and also analyze the current Sudanese inspection model**

**Personal Data:**

**Name:**

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**Education:**

- Diploma
- Bachelors.
- Master
- PhD.

**Background:**

- Veterinary
- Agriculture
- Food technology
- Animal Production.

**Experience:**

- Fresh graduate
- 3 – 5 years
- Above 5 years

**Job:**

- Inspector
- Administration.

**Department:**

- Inspection administration of meat factories and chopping labs.
- Control and Monitoring Administration.

**Section A: Measure inspector's knowledge related to food safety:**

		<b>Strongly agree</b>	<b>Agree</b>	<b>Neither agree or disagree</b>	<b>Disagree</b>	<b>Strongly disagree</b>
1	People who do not maintain an appropriate degree of personal cleanliness, who have certain illnesses or conditions or who behave inappropriately, can contaminate food and transmit illness to consumers.					
2	To ensure that those who come directly or indirectly into contact with food are not likely to contaminate food by behaving and operating in an appropriate manner					
3	Food handlers should maintain a high degree of personal cleanliness and, where appropriate, wear suitable protective clothing, head covering, and footwear					
4	Conditions which should be reported to management so that any need for medical examination and/or possible exclusion from food handling can be considered include: sore throat with fever; visibly infected skin lesions (boils, cuts, etc.); discharges from the ear, eye or nose.					
5	Cuts and wounds, where personnel are permitted to continue working, should be covered by suitable waterproof dressings.					
6	Personnel should always wash their hands when personal cleanliness may affect food safety, immediately after using the toilet; after handling raw food or any					

	contaminated material, where this could result in contamination of other food items; they should avoid handling ready-to-eat food, where appropriate					
7	Personal effects such as jewelry, watches, pins or other items should not be worn or brought into food handling areas if they pose a threat to the safety and suitability of food.					
8	People engaged in food handling activities should refrain from behavior which could result in contamination of food, for example: smoking; spitting; chewing or eating; sneezing or coughing over unprotected food.					
9	Visitors to food manufacturing, processing or handling areas should, where appropriate, wear protective clothing and adhere to the other personal hygiene provisions in this section.					
	<b>Food borne illness</b>					
10	From your perspective the physical, chemical and biological hazards are cause food contamination					
11	Failures in slaughterhygiene, meat cutting and meat handling, transportation and in the hygiene of by-products and additives will all contribute to quality losses and deterioration of the final processed meat products.					
12	Prevent microbial contamination of raw materials, intermediate (semi-manufactured) goods and final products during meat product manufacture through absolute cleanliness of tools, working tables, machines as well as hands and outfits of personnel.					
13	Minimize microbial growth in raw materials, semi manufactured					

	Goods and final products by storing them at a low temperature.					
	<b>Time and temperature:</b>					
14	Time and temp systems should also specify tolerable limits for time and temperature variations and the records thereof shall be maintained in a register for inspection.					
15	Ventilation systems natural and /or mechanical including air filters, exhaust fans, wherever required, shall be designed and constructed so that air does not flow from contaminated areas to clean areas.					
16	Ice and steam used in direct contact with food shall be made from potable water and shall comply with specified requirements (shall be produced, handled and stored in such a manner that no contamination can happen).					
	<b>food safety standers, law and regulation</b>					
17	food safety being promoted by public authorities as form of co-regulation in Sudan (ministry of agriculture & animal wealth and irrigation) and mandatory implemented by quality inspectors.					
18	The food safety regulation and inspection procedure Science based risk assessment and prevention method					
19	regulatory impact analysis RIA is required when new food safety regulation is adopted					
20	According to Meat Hygiene Law at Khartoum State (1997) the veterinary inspection means the veterinary inspection doing by the official authority to the food animals before and after slaughtering					
21	Official inspection can be performed by both process and product oriented					
22	Hazard Analysis Critical Control Point HACCP is the preferable standard in meat industry.					

23	Pathogen Reduction - Hazard Analysis Critical Control Point PR-HAACP is the preferable standard in meat industry					
24	Currently, a HACCP system is not mandatory in Sudan but HACCP principles can be incorporated into preventative controls across all commodities.					
25	The Sudanese inspection model now need to moving to more preventative and systems based approaches to manage risk.(need for change ).					

**Section B: attitude, practice toward food safety:**

	Good personal hygiene practices help keep food safe to eat.					
2	The quality inspector has a responsibility to teach worker how to keep food safe.					
3	As quality inspector I believe that my decisions impact the safety of food at the facility.					
4	As quality inspector I believe that It is important to improve food handling practices to reduce the risk of illness.					
5	As quality inspector I believe that Written food safety policies and procedures are necessary to keep food safe.					
6	As quality inspectors I monitor products during processing, handling, and packaging to ensure that they are safe and accurately labeled.					
7	As Quality inspectors I have the authority to shut plants down for food safety violations, by withholding the Sudan inspection label on products.					
8	As quality inspector I believe that The presence of the label indicates that the product was					



	produced in compliance with one of the most comprehensive set of food safety regulations applied to an industry.					
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**Section c: training toward food safety:**

		<b>yes</b>	<b>no</b>	<b>Don't Know</b>
<b>1</b>	The food inspectors of today – and tomorrow will require new skills, a greater understanding of the relevant science and technologies, continuous training and modern information management tools to do their jobs.			
<b>2</b>	Do you think that the training was important for your job?			
<b>3</b>	Have you ever received any training in Food Safety?			
<b>4</b>	If you receive training; Does the material reinforce the core information Are local food practices discussed? _ Does the material reflect local facilities (i.e., running water, refrigerators, etc.)?			
<b>5</b>	Have you receive on job training before you start the working in the ministry?			
<b>6</b>	Do you have a Certificate of these training?			
<b>7</b>	Do you believe that the ministry trains their employee sufficient courses on food safety?			