

# Estimation of Knowledge, Attitude, and Practice Related (KAP) to Biosecurity Measures and Hazard Analysis Critical Control Point (HACCP) Prerequisites in Poultry Meat Production in Khartoum State, Sudan

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## Abstract

The purpose of this study was to estimate Knowledge Attitude, and Practice (KAP) of poultry meat production personnel and workers related to biosecurity measures and HACCP PRPs. in Khartoum State, Sudan from January to September, 2018. Data were collected using questionnaires from 12 close system broiler farms and their slaughterhouses according to Non-Probability Multistage Cluster Sampling Method (localities, farms, and respondents), in Khartoum, Bahri, and Omdurman localities (4 farms for each). In addition, a total of 72 swab samples were taken from workers' hands and boots for bacterial culturing as confirmatory test for hygiene level assessment, as well as a general observations recorded by the investigator. Low level of KAP regarding HACCP PRPs among workers as a preventive system was revealed. Also most of them (83.3%) even don't know that HACCP system adoption requires prerequisites that should be implemented as the percentage of correct answers about the details of HACCP plan and prerequisites was low (41.7%). However, (83.3%) of workers were willing to learn more about it. Low level of good practices in slaughterhouses was shown regarding programmed documented personal hygiene staff training and qualification for responsibilities (50.0%), preventative maintenance (41.7%), and appropriate use of personal facilities (58.3%). Furthermore, (33.3%) showed lack of sanitary facilities (dispensers, personnel changing rooms, toilets, washing basins). Unhealthy practices and habits were observed in majority of workers during work such as not washing hands before entering production areas, smoking, and eating and drinking in processing areas, beside low level of medical check in two thirds of them (66.7%). The distribution of bacterial growth showed that the most bacterial growth was detected in workers' hands which were 83.30% while 69.4% detected in boots' samples. In conclusion, negative attitude and practice (confirmed by bacterial isolation) with low level of knowledge and compliance with HACCP plan prerequisites roles to ensure hygienic and safe poultry meat production. Therefore, implementing programs to increase the level of awareness relevant to workers' KAP and restriction to hygienic roles relevant to the broiler production should be considered, since it is consequently reflected on public health.

**Keywords:** Broiler farms; Slaughterhouses; Personal hygiene; Workers KAP

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**Citation:** Ahmed MAB, Abdelgadir AA, Ismail MH. (2021) Estimation of Knowledge, Attitude, and Practice Related (KAP) to Biosecurity Measures and Hazard Analysis Critical Control Point (HACCP) Prerequisites in Poultry Meat Production in Khartoum State, Sudan. J Anim Sci Livest Prod Vol.5 No.5: 003.

**Received:** September 06, 2021; **Accepted:** September 20, 2021; **Published:** September 27, 2021

## Introduction

Production of safe poultry meat is not the sole responsibility of one participant in the production chain. All workers in broiler production field need to follow all roles hygiene practices in

all operations that prevent or minimize contamination. Broiler producers should be aware and have a legal obligation to ensure hazards are not introduced or increased during production and interventions are applied to eliminate any associated possible hazards in the poultry product [1]. Behavioral factors affecting

poultry meat producers' knowledge about biosecurity measures and Hazard Analysis Critical Control Points Prerequisite Programs, (HACCP PRPs), attitudes about safe practices, awareness on disease risk transmission, and how these Knowledge, Attitude, and Practice (KAP) affect actual safe poultry meat production are of paramount importance [2]. Unfortunately, poultry production in Sudan was identified mostly to have inadequate care and health, inappropriate housing and poor knowledge of poultry management and unsafe poultry meat production processing [3,4]. Moreover, in Khartoum State is that most of the risk factors and shortfalls are associated with biosecurity measures and the HACCP prerequisites programs since they are the base line of HACCP applications [5]. Therefore, the current study mainly aimed to estimate knowledge, attitude, and Practice awareness of poultry meat production personnel and workers related to biosecurity measures and HACCP PRPs. in Khartoum State, Sudan.

## Materials and Methods

### Description of study site

This study was conducted in Khartoum State, Sudan in which two poultry production systems are dominating: traditional type which is practiced in open system and commercial type that is practiced in the closed and semi closed-systems. The current study targeted closed system broiler farms and their corresponding slaughterhouses in three localities in Khartoum State; Khartoum, Bahri (Khartoum North), and Omdurman where most of broiler production is concentrated.

### Study design

The current study was designed as a cross sectional study to estimate knowledge attitude, and practices of poultry meat production personnel and workers related to biosecurity measures and Hazard Analysis Critical Control Points Prerequisite Programs, (HACCP PRPs) in the targeted three localities using questionnaires and microbiological tests.

### Sampling method and sample size

Non-Probability Multistage Sampling Method with different levels (site, farms, respondents) was used for both samples collection and questionnaire survey according to support of the owners as well as observations of the investigator were recorded [6]. Twelve closed system broiler farms were included on voluntary basis, four farms for each locality. Additionally, a total number of 72 swab samples were taken from hands and boat of workers in slaughterhouses for laboratory analysis.

### Data collection using questionnaires

This study was conducted throughout a period between January and September 2018 and was mainly based on qualitative, semi-structured questionnaires which were constructed to evaluate the extent of implementing requirements of biosecurity measures in respondent farms. These questionnaires included information related to Good Hygiene Practices (GHPs) and Good Management Practices (GMPs) such as staff training program, qualification for responsibilities, appropriate use of personal facilities, protective

wearing, and staff medical check. Besides that, information related to HACCP was also recorded by the mean of questionnaire.

### Collection of swab samples

A total of 72 swab samples were collected from workers' hands and boots (36 samples for each) in slaughterhouses of all respondent farms (6 samples for each slaughterhouse). All samples were put in ice box and immediately transported to the lab for microbiological testing. Primary isolation and sub culturing of isolates was performed using blood agar MacConkey's agar. Bacterial isolates were identified by Gram's staining method that smears were made from each type of colony. Then fixed by heating and stained by Gram stain according to Cowan [7].

### Data analysis and management

Statistical Package for Social Sciences (SPSS) version 19 for Windows was used for data analysis. Descriptive statistics such as frequency and percentage were used for variables. All results were presented in either tables or graphs.

## Results

### Results of estimation of personnel KAP

Estimation of awareness and assessment of knowledge level among workers revealed that 83.3% (n=10) of respondent farms stated that they know about HACCP systems. However, 58.3% (n=7) of them even don't know that HACCP system adoption requires prerequisites that should be implemented and 66.7% (n=8) of them don't know about preventive nature of HACCP systems for poultry meat production. Furthermore, the percentage of correct answers about the details of HACCP plan and prerequisites was 41.7% (n=5). However, 83.3% (n=10) of workers were willing to learn more about HACCP prerequisites and how to establish HACCP plan shown in **Table 1**.

**Table 1:** Estimation of Workers Biosecurity and HACCP Knowledge.

Parameter	Frequency (%)
<b>Knowledge about HACCP</b>	
1. Yes	10 (83.3%)
2. No	2 (16.7%)
3. I don't know	0 (0.00%)
<b>HACCP is hazards' preventive plan</b>	
1. Yes	3 (25.0%)
2. No	1 (08.3%)
3. I don't know	8 (66.7%)
<b>HACCP prerequisites plan Knowledge</b>	
1. Yes	5 (41.7%)
2. No	2 (16.7%)
3. I don't know	5 (41.7%)
<b>Workers need for more HACCP information</b>	
1. Yes	10 (83.3%)
2. No	0 (0.00%)
3. I don't know	2 (16.7%)
<b>*The total number of respondent farms was twelve.</b>	

### Questionnaires survey results in the slaughterhouses

Staff training program to keep workers' personal equipment's clean and tidy in slaughterhouses scored 91.7% (n=11). In contrast, implementing of documented staff training program, training of appropriate wearing of protective clothing and presence of written task or job descriptions for all production personnel scored 33.3% (n=4). Both giving the staff basic hygiene training and placement of emphasis on washing hands after contamination was implemented in eight slaughterhouses scoring 66.7%. Staff appropriate training and qualification for responsibilities and appropriate use of personal facilities were 50.0% (n=6) and 58.3% (n=7), respectively shown in **Table 2**.

**Table 2:** Staff training and task description of personnel in poultry slaughterhouses.

Parameter	Frequency (%)	
	Yes	No
Responsibilities qualification	6 (50.0%)	6 (50.0%)
Documented training program	4 (33.3%)	8 (66.7%)
Basic training for all staff	8 (66.7%)	4 (33.3%)
Emphasis on hands hygiene	8 (66.7%)	4 (33.3%)
Facilities usage training	7 (58.3%)	5 (41.7%)
Trained for protective wearing	4 (33.3%)	8 (66.7%)
Trained for clean and tidy equipment's	11(91.7%)	1 (08.3%)
Written task descriptions	4 (33.3%)	8 (66.7%)
*The total number of respondent farms was twelve.		

GHPs concerning staff training programs revealed that 91.7% (n=11) of participant slaughterhouses followed washing hands policy for use of hand sanitizers and wearing gloves, while only 50.0% (n=6) implemented documented personnel training program. Regarding staff medical check, the results clarified that 33.3% (n=4) of workers were certified by a medical practitioner for fitness to work with regular annually renewed medical certificates. Sanitary measures in production areas revealed that 83.3% (n=10) of participant slaughterhouses' areas and equipments were examined visually before production to ensure effective cleaning shown in **Table 3**.

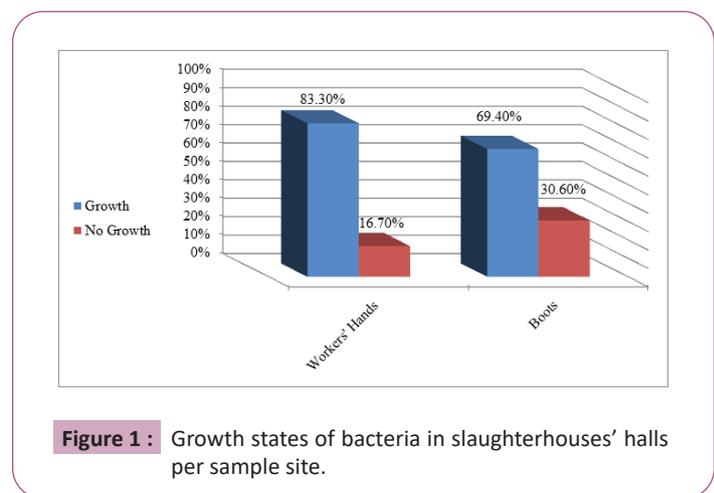
**Table 3:** Good Hygiene Practices (GHPs) regarding staff training programs, Fitness, and work practices in poultry slaughterhouses.

Parameter	Frequency (%)	
	Yes	No
<b>Personal hygiene practice and facilities</b>		
Hygiene policies and procedures	9 (75.0%)	3 (25.0%)
Suitable outer garments for the operation	5 (41.7%)	7 (58.3%)
Designated area to leave protective outer garments	3 (25.0%)	9 (75.0%)
Washing hands before entry procedures area	5 (41.7%)	7 (58.3%)
No watch wearing in processing areas	3 (25.0%)	9 (75.0%)
No jewellery wearing	3 (25.0%)	9 (75.0%)
No nail polish and false fingernails	3 (25.0%)	9 (75.0%)
No smoking	8 (66.7%)	4 (33.3%)
No eating and drinking in processing areas	8 (66.7%)	4 (33.3%)
<b>Personnel work practices</b>		
Supervised dressing in operations	8 (66.7%)	4 (33.3%)

Operators frequent wash of hands and equipment's	7 (58.3%)	5 (41.7%)
<b>Fitness to work</b>		
Staff certified annual medical check	4 (33.3%)	8 (66.7%)
*The total number of respondent farms was twelve.		

### Laboratory analysis results

The results of bacterial growth are detailed in **Figure 1**. The distribution of bacterial growth per sample sites revealed that the most bacterial growth was detected in workers' hands which was (83.30%), while boots' samples showed 69.4%.



### Discussion

Evaluation of knowledge level among broiler personnel showed that although the majority of them heard about HACCP systems, they showed poor level of knowledge about details of HACCP prerequisites plan. These facts were in contrary with recommendations of Codex (2005) that awareness, appropriate knowledge, and skills are necessary for implementation of an effective HACCP plan. Most of participants admitted that their understanding of HACCP was poor and this was also proved by the fact that the correct answers about the details of HACCP plan and prerequisites were only 41.7%. Worryingly, most of them were managers with responsibility for food safety, however, high percentage of workers and in charge personnel were willing to learn more about HACCP prerequisites and how to establish HACCP plan. In a study, Abdalla concluded that there were many gaps in food safety knowledge and practices that might result in food-borne diseases [8]. A study in the United Kingdom (UK) by Fielding revealed that the ability of the respondents to correctly define a hazard or risk or identify different types of hazard was poor [9]. This was also true for this study and may be due to the fact that most poultry producers focus on meat quantity and finance and majority of them still has misunderstanding on food safety and quality assurance systems. In a study investigating the influence of HACCP implementation on the productivity of broiler farms in Korea by Nam showed that HACCP systems were highly implemented with increased level of knowledge and awareness on almost all broiler farms [10].

With respect to staff hygiene restrictions as they may also act as mechanical vectors of several different pathogens. It was

clearly noticeable that hygienic measures were more frequently enforced for farm visitors compared to farm personnel. Lower level of visitors contact with birds was observed than farm personnel. Racicot in their investigation of eight poultry farms in Quebec, Canada, to evaluate compliance of existing biosecurity measures using hidden cameras, agreed that a lot of biosecurity errors happen when individuals enter or leave [11]. A total of 44 different mistakes were observed from 883 visits done by 102 different individuals. They concluded that both the number of visitors and the number of people involved in the daily care should therefore be limited.

The presented study revealed good hygiene implemented by owners, staff and visitors access before entry, all owners restricted to all rules for farm access, and at least 24 hours contact free period when visiting other poultry farms, and applied check in, hands washing and wearing hygienic protective wear, not rearing home poultry or other birds. However, low restriction to protective wearing beside hands washing and disinfecting were observed after contact with waste. In contrast, Maduka reported lower level of hygienic practices (50%) in their study to evaluate biosecurity practices in commercial poultry farms located in Jos, Nigeria [12]. They explained that might be due to lack of knowledge about hygiene practices among poultry farmers which are common in most developing countries in Africa.

Currently, poor results reflected in the present study regarding implementation of documented staff training program, training and qualification for responsibilities, appropriate use of personal facilities by the staff, and preventative maintenance program in most of the studied poultry slaughterhouses. Barnett stated that keeping and meeting production targets are good management practices that allow the identification and solution of problems [13]. Identifying the cause of and fixing a problem is an important part of personnel knowledge base, and can assist in preventing a recurrence of the problem.

A previous study conducted in a poultry slaughterhouse in Khartoum State, Sudan by Nasr to identify, control, eliminate or reduce chemical, physical as well as the biological hazards of poultry meat and poultry products plants and set up regulations and the HACCP rules [14]. The study revealed that most of the respondents were aware of the food hygiene program and they needed more training in the food hygiene and implementing HACCP system. The highest percentage of poultry slaughterhouses studied did not apply developed personal hygiene procedures, poultry meat product hygiene practices, and proper cleaning and disinfection procedures and all these poultry slaughterhouses had no GMPs except one company that had developed TQM program but all poultry slaughterhouses examined did not implement HACCP plan. The above findings are in agreement with Paster who considered documented staff training program and preventative maintenance program, training and qualification for responsibilities, appropriate use of personal facilities by the staff, and sanitary facility as essential prerequisites to manage cross-contamination and prevent microbial growth [15].

The distribution of bacterial growth per sample sites revealed that considerable high bacterial growth was detected in workers' hands and boots' samples. Inconsistent with Kaferstein that workers in food premises were the major sources of contamination either as carriers of pathogens or through poor personal hygienic practices, the current study detected most bacterial growth in workers' hands in poultry slaughterhouses and this can be due to unhealthy worker's practices and habits observed in majority of them during work such as not washing hands before entering production areas, smoking, and eating and drinking in processing areas specially that only few of them were restricted to annual medical check to prove fitness to work and not well trained or accustomed to appropriate protective wearing [16]. The same findings were also estimated and expressed as agreed by Phumkrachai in their study to identify perception, awareness and knowledge on food safety and quality assurance related to poultry slaughterhouses in Indonesia [17]. Another studies by Jeffery and Ali revealed that the workers' hands and the equipment's were the main sources of meat contamination which are in accordance with the present results [18,19]. The previous findings ascertained that the reduction or elimination of contamination sources is directly related to practicing good sanitary measures and application of appropriate methods during slaughtering operations, using adequate water and disinfection.

In conclusion, effectiveness of adoption of HACCP system and HACCP PRPs as a food safety control has not been given serious attention among owners, managers and workers indicating lack of knowledge and resources [20]. Besides that, most of them had misunderstanding on proper compliance of biosecurity systems and HACCP prerequisites but most of them believed that hygiene is an important issue to be considered in their farms and poultry slaughterhouses and they showed willing to know. Mostly, workers had less attention to follow hygienic practice as smoking habits, no change of clothes, absence of regular worker health check, and non-adoption of training programs to increase knowledge and awareness were observed clearly. This fact resulted in bacterial contamination found in swab samples from workers' hands and boots.

## Conclusion

According to the presented findings, enforcement of biosecurity programs and HACCP PRPs in broiler premises and continuous education and training about implementation of HACCP PRPs and biosecurity procedures before and after starting to work should be considered. Motivation of the workers and producers toward maintaining a positive attitude and good practice regarding compliance with broiler production premises hygienic measures. Similarly, for effective compliance, future educational programs in the mode of the spread of pathogens and zoonotic diseases in broiler production field should be taken into account properly.

## Conflict of Interest

None declared

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