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Research Article

Assessment of the Haccp Prerequiste Programs in Al Seeb Slaughterhouse, Al Seeb State, Sultanate of Oman

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Abstract

This descriptive study was conducted during June, 2025 in Al Seeb slaughterhouse in the Sultanate of Oman with the objective of assessing HACCP PRPs as a step towards HACCP implementation. The slaughterhouse facility was investigated using a standardized and structured checklist for assessment of HACCP Pre-requisite programmes (PRPs). PRPs mainly comprise Good Manufacturing Practices (GMPs) and Good Hygiene Practices (GHPs). The checklist was divided into 13 elements which were further assigned to a series of parameters (150) to accurately describe the status of each assessed element. Each item under assessment was scored and points were assigned. A scoring system was used to distribute marks for each element of the PRPs according to the standard descriptive indicators. A score of zero (0%) was assigned when the factor posed a very high degree of the risk for meat safety, whereas full marks (100%) were given when there was no risk for meat safety. The total score of each meat process was split into three categories depending on the risk of contamination and the possibility of cross-contamination as follows: a) Satisfactory = covered assessment scores of 75% or more, b) Acceptable: covered assessment scores from 55% to 74%, where the HACCP plan, as well as the HACCP team is applicable, c) Unsatisfactory: covered assessment scores below 55%, where HACCP system is not applicable. The result of this assessment showed that the average of total score was found to be 69.1%, which was classified as 'Acceptable.' The results also indicated that 6 of the PRPs were 'Satisfactory' which equaled 46.1% of the total elements, 4 were 'Acceptable' which equaled 30.8% and 3 were 'Unsatisfactory' which equaled 23.1%. The results also showed that equipment design, pest management and document control & records scored 'Unsatisfactory' assessment. It could be concluded that about 77% of the total elements were made up of both 'Satisfactory' and 'Acceptable' PRPs. The slaughterhouse passed the PRPs and adequacy assessment, according to this result, which means that the HACCP system may be implemented if the unacceptable parameters are adjusted to satisfactory. It is recommended that the relevant authorities encourage this slaughterhouse to implement HACCP system and ensure enforcement.

Keywords: *HACCP Prerequisite programs; GMPs; GHPs; Slaughterhouse; Sultanate of Oman.*

INTRODUCTION

Hazard Analysis and Critical Control Points (HACCP) and Good Manufacturing Practices are recommended by WHO, FAO, and Codex Alimentarius Commission for safe meat processing (Hassan et al, 2010). HACCP is recognized as an effective way to ensure food safety from production to consumption. The system aims to prevent, manage, or control risks proactively.

Training, facilities and equipment, storage, upkeep, cleaning and sanitation, residue control program, services (water and pest control), waste management, product recall/withdrawal, and traceability are a few examples of pre-requisite programs. Before putting the HACCP into practice, these programs must be properly monitored and validated. Numerous studies have emphasized the need of strengthening staff training when verification findings show that cleaning programs are not as effective as they might be (Nasopoulou et al. 2012; Garayoa et al. 2017).

To achieve sanitary conditions and enhance the microbiological quality of the product, the responsible specialists in meat processing businesses have created proper manufacturing and good hygiene practices (Howlett et al., 2005).

According to FAO (2004) and Codex Alimentarius (2005), good hygiene practices (GHP) are all procedures pertaining to the conditions and precautions required to guarantee the safety and appropriateness of food at every level of the food chain. A Hazard Analysis and Critical Control Point (HACCP) strategy that is unique to each facility must be developed and written using GMPs, Good Manufacturing Practices (GMPs), Good Hygiene Practices (GHPs) and Sanitation Standard Operating Procedures (SSOPs) as prerequisites.

Numerous scientific investigations have documented the issues surrounding inadequate sanitation of surfaces that come into touch with food, showing that these issues not only shorten a product's shelf life but also raise the risk of foodborne disease due to the presence of germs. In addition, they could also help biofilms form (Barril et al. 2019; Fysun et al. 2019; Sibanyoni and Tabit 2019).

Hence, the objective of this study was to assess the HACCP PRPs at Al Seeb slaughterhouse as a step towards HACCP implementation.

MATERIALS AND METHODS

• Study site

The Al Seeb slaughterhouse is situated in the Almabilah district of Al Seeb State, Muscat Governorate, on the Muscat highway, just across from the Almabilah bridge. It is the next road from the Albatna highway that leads to Boucher State. Al Seeb State has a population of around 400,000. The temperature is mild in the winter (20 to 25 °C) and scorching in the summer (around 45 °C). The wet season with few levels is winter. The Al Seeb slaughterhouse was established with the intention of supplying nutritious, safe meat that is free of diseases-causing microorganisms for local consumption. Slaughtered animals include Omani sheep, goats, and cows as well as cattle brought from other countries, including Somalia, Australia, India, and others. Between 30,000 and 40,000 sheep and goats are slaughtered each year, along with 3,000 to 4,000 cows and 300 to 400 camels.

• Study design

The method used in this study was a descriptive. The slaughterhouse facility and workers were investigated using a checklist for assessment of the Pre-requisite programmes (PRPs). The efficacy of the food safety management system (PRPs/HACCP) employed in food enterprises is evaluated by audit activities or checklists. Many research (Garayoa et al. 2016; Abd El-Razik et al. 2017; Garayoa et al. 2017; Xiong et al. 2017) included checklists as a means of gathering data.

• Data collection method:

— Pre-requisite programmes (PRPs) assessment

A standardized and structured checklist was developed and applied to all meat processing. The purpose was to assess the status of PRPs and other related activities that could adversely affect meat safety and subsequent application of HACCP system. The checklist was divided into 13 elements which were further assigned to a series of parameters (150) to accurately describe the status of each assessed element. Each item under assessment was scored and points were assigned.

• Scoring system

A scoring system was used to distribute marks for each element of the PRPs according to the standard descriptive indicators. The comparison of facilities and prerequisite programmes (PRPs) status was achieved based on the scoring of these elements.

The numerical scoring system employed allowed for benchmarking, the setting of targets and the tracking performance and each element was divided into parameters, with each parameter having its own set of characteristics.

Each characteristic was rated depending on the significant risk of raw meat product being contaminated with the microorganisms or becoming contaminated with microorganisms or their toxins.

• Determination of the risk and assigned scores

The most significant food safety parameters for each categorized element were determined during inspections of the meat processing facilities. The risk assessment was made based on the most significant food safety parameters.

The adequacies of the food safety parameters were assessed and a score was assigned for both written procedures relating to meat safety and actual practices observed during the visits.

A score of zero (0%) was assigned when the factor posed a very high degree of the risk for meat safety, whereas full marks (100%) were given when there was no risk for meat safety.

- **Evaluation of the prerequisite programmes and adequacy**

The total score of each meat process was split into three categories depending on the risk of contamination and the possibility of cross-contamination according to the classification described by Youssif (2015): a) Satisfactory = covered assessment scores of 75% or more, b) Acceptable: covered assessment scores from 55% to 74%, where the HACCP plan, as well as the HACCP team is applicable, c) Unsatisfactory: covered assessment scores below 55%, where HACCP system is not applicable.

RESULTS

Table (1) summarizes the overall assessment of the prerequisite programs (GMPs & GHPs) and adequacy. The average of total score was found to be 69.1%, which was classified as '*Acceptable'*.

The results indicated that 6 of the PRPs were "*Satisfactory*" which equaled 46.1% of the total elements, 4 of them were "*Acceptable*" which equaled 30.8% and 3 of them were "*Unsatisfactory*" which equaled 23.1%.

The results showed that equipment design, pest management and document control & records scored '*Unsatisfactory'*.

- **Judgment:**

About 77% of the total elements were made up of both 'Satisfactory' and 'Acceptable' PRPs. Therefore, this result showed that the slaughterhouse had passed the PRPs and adequacy assessment, meaning that the HACCP system may be launched as long as the unsatisfactory parameters were changed to satisfactory.

Table 1: The HACCP Prerequisite Programs of the Investigated Slaughterhouse

No.	Element	Score %	Evaluation
A.	**Good Manufacturing Practices (GMPs)**		
1.	**Training & Competency** • All staff trained; training courses documented. • Had basic hygiene training; Know how to wear their protective clothing • appropriate use of wash-hand basins, boot washes, and other personal facilities • Job descriptions or procedures for all production personnel	75	Satisfactory
2.	**Building design and Construction** • Location • Lairage • Plant layout & structures (Easy cleaning and sanitation; Separation between clean and dirty areas; No production line criss-cross). • Maintenance • Temperature monitoring equipment calibrated • Environment • waterproof flooring; walls durable and impermeable • adequate ventilation and lighting	67.2	Acceptable
3.	**Equipment design** • adequate standards maintained to safeguard the product	30	Unsatisfactory
4.	**Equipment maintenance and calibration** • Availability of preventative maintenance programmes • Equipment calibrated • Equipment and food containers, used in production, constructed from non-toxic food grade materials	80	Satisfactory
5.	**Resources & facilities** • Adequate supply of electricity • Suitable arrangements made for the possibility of power cuts or breakdown • Adequate supply of refrigeration • Potable water supply for both hot and cold water • Sufficient number of facilities for cleaning, disinfecting hands and for cleaning tools • Toilets facilities adequate in number and location and do not open directly onto the production hall; provided with paper towels; bin(s) and toilet paper	68.9	Acceptable

	• Adequate changing rooms • Drainage**:** Trapped drains (i.e. can handle over-spills and be easily cleaned; floors sloped uniformly; drains flow in the reverse direction to product flow		
6.	**Waste management & disposal** • Garbage and waste bins available • Waste skips/containers covered (when not in use) and leak proof • Adequate facilities for animal waste material removal and handling	55	Acceptable
7.	**Pest management** • Pest control programme available • Rodent control programme available • all external openings equipped with insect control devices	53.3	Unsatisfactory
8.	**Supply chain management (approved supplier)** • A list of approved suppliers of raw materials available • Register of all incoming/outgoing raw materials maintained	100	Satisfactory
9.	**Document control & records** • A documentation system available • Checks and audits done • All documents controlled and an amendment register maintained	36.25	Unsatisfactory
10.	**Storage condition** • Temperature of storage and refrigerated rooms + 4ºC or colder within 24 hours of slaughter • Thermometers (independent of the thermostat probes) present in all coolers and freezers • All production areas monitored to ensure that they remain within the adequate limits • Permanent written record of temperatures retained together with the corrective action taken when temperatures are recorded outside these limits	90	Satisfactory
11.	**Identification and Traceability** • Identification and traceability system available	100	Satisfactory
B.	**Good Hygiene Practice (GHPs)**		
12.	**Personal hygiene** • Documented staff training programmes for washing hands policy, including the use of sanitizer and/or gloves; policy, and keep their own work environment clean and tidy at all times; Wear their protective clothing, footwear, hair covering, gloves etc. in the appropriate manner. • Health corticates available • Watches, rings, jewels prohibited in processing areas. Smoking prohibited	82.5	Satisfactory
13.	**Cleaning & Disinfection** • A written sanitation programme for the slaughter available • All areas of the plant and equipment visually examined before production to ensure the cleaning procedures have been effective. • There a use for microbiological swabbing to determine the effectiveness of sanitizers used. • Microbiological analysis carried out on samples of water	60	Acceptable
	Average of total score %	**69.1**	**Acceptable**

Satisfactory = (≥ 75%); Acceptable= (55-74%); Unsatisfactory= (< 55%).

DISCUSSION

This study aimed to assess the HACCP PRPs and adequacy at Al Seeb slaughterhouse in the Almabilah district of Al Seeb State, Muscat Governorate as a step towards HACCP implementation. In this study the slaughterhouse was investigated using a checklist for the assessment of HACCP PRPs and adequacy.

The assessment of this slaughterhouse disclosed that the average total score was 69.1% which resembled '*Acceptable'* score.

The current study the satisfactory score attained for staff training and competency may be due to the fact that training was a priority for slaughterhouse operators. This finding was consistent to that reported by WORSFOLD (2001) who claimed that training may improve hygiene practices and decrease the possibility of food contamination, Contrary to this, Govender and Genis (2010) evaluated the hygiene management system at red meat slaughterhouse in Gauteng, South Africa and found that training records were generally not available at slaughterhouses.

The findings of this study assessed building design and construction as 'Acceptable'. This result is supported by SKAARUP (1985) who recorded that slaughterhouse buildings should be designed, constructed and maintained in a manner that ensure appropriate product and personnel flow, and not permit production line crisscross; in addition, there should be separation between the dirty and the clean operations to forestall carcass contamination. Under the same element (building design and construction), this study assessed the slaughterhouse location, structure, maintenance, and environment, as 'Acceptable'.

This study assessed equipment design as 'Unsatisfactory' while it assessed equipment maintenance and calibration as 'Satisfactory'. The 'Unsatisfactory' assessment of equipment design may be due to the fact that the slaughterhouse was built long time ago. Yet, the design may act as a source of meat contamination and affect meat hygiene in the facility (Bryant et al., 2015).

The present study assessed resources and facilities such as power supply, potable water, adequate supply of refrigeration, hot and cold water etc. provided in this slaughterhouse as 'Acceptable'. This finding is similar to that reported by Ali et al. (2013) who evaluated the status of meat hygiene in four slaughterhouses in Khartoum State and concluded the same result. In the present study, sanitary facilities such as toilet facilities were found adequate in number and location and adequately stocked with toilet paper, soap, disposable towels, trash cans, and changing rooms, and that the drainage lines from toilets were separated from other drainage lines. The fact that restrooms were discovered to be open straight into the processing hall is the sole thing that is prohibited.

Different assessment for resources and facilities was reported by Fasanmi et al. (2018) who reported lack of water, no hand washing facilities, and no proper disinfection in most slaughterhouses under investigation, and therefore the majority of the slaughterhouse workers hardly observe these hygienic routines.

The assessment of waste management & disposal in this study scored 'Acceptable' which is in line to that obtained by Masaad and Mustafa (2020) who investigated the drainage system and waste disposal in an export slaughterhouse in Sudan. Contrary to this, the findings of Ali et al. (2013) and Salman et al. (2014) proved that the drainage system for the disposal of effluent and sewage was not smoothly designed in the investigated slaughterhouse.

Presence of rodents and other animals in and around the slaughterhouse will favour the transmission of slaughterhouse infectious or zoonotic diseases and can lead to persistence and spread of such diseases in the slaughterhouse environment (Fasanmi et al., 2018).
Pest management in the current study scored 'Unsatisfactory'. This result coincides that obtained by Masaad and Mustafa (2020) in an export slaughterhouse in Khartoum State. Similar findings also obtained by Fasanmi, et al (2018) who evaluated controlled rodent environment in slaghterhouse operations and hygiene in Oyo state, Nigeria as poor.

In this study personal hygiene practices such as wearing outer garments suitable for the operation, prohibition of wearing watches and jewelry, prohibition of smoking was found to be 'Satisfactory'. This can be the result of supervisors and managers at the slaughterhouse closely watching the workers. Contrary to this, Fasanmi, et al (2018) and Masaad and Mustafa (2020) reported Unsatisfactory' assessment.

In this study cleaning & disinfection scored 'Acceptable'. This will lead to hygienic environment for producing safe meat for consumers. Similar findings were obtained by Ahmed (2015) who evaluated the status of meat hygiene in four slaughterhouses in Khartoum State based on PRPs and concluded that meat hygiene status in these slaughterhouses was good. Contrary to this, Hong et al. (2012) investigated investigate latent problems of HACCP prerequisite programs in Korean slaughterhouses and found that the sanitary management scored 10.9% which was considered a non-compliance rate. Also, different assessment was found by Masaad and Mustafa (2020), Fasanmi et al. (2018) in the investigated slaughterhouses in Khartoum State.

CONCLUSTION AND RECOMMENDATIONS

Al Seeb slaughterhouse passed the PRPs and adequacy assessment, according to this result, which means that the HACCP system may be implemented if the unacceptable parameters are adjusted to satisfactory. It is recommended that the relevant authorities encourage this slaughterhouse to implement the HACCP system and ensure enforcement.

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Competing Interest
The authors declare that they have no competing interests.

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Authors' contributions
This work was carried out in collaboration between authors. Author (1) made initial contacts with those responsible for the Al Seeb slaughterhouse and prepared the required approvals, collected the research data, and prepared the results. Author (2) conceptualized the initial idea, performed supervision over the research, contributed to checklist preparation, drafting the initial manuscript and carried out correspondence duties. All authors read and approved the final manuscript.

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