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ASSESSMENT OF THE CURRENT SITUATION OF HACCP PREREQUISITES PROGRAMMES ADOPTED IN PORTIONING POULTRY OPERATIONS IN KHARTOUM STATE, SUDAN

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ABSTRACT

Study was carried out in poultry meat portioning operations (POs) in Khartoum State from February 2018 to August 2020. The study aimed to assess the current situation of HACCP prerequisites programmes (PRPs) adopted in these operations. Twelve operations were selected out of 33 (36.4%) of poultry portioning meat. A number of 6 POswere chosen randomly from the traditional and 6 from modern systems to cover the three localities of Khartoum State. The data was collected through a standardized observational checklist. The results indicated that there was significant difference(p=.049) between the two systems regarding the location of the operations. In terms of good hygiene practice and good manufacturing practice, mostly there were no significant differences between the two types though several minor differences were found in favor of modern sector. However, a significant difference was found in terms of separation between clean and dirty areas (p=.010). The findings also showed no significant differences between the two types of operations regarding sufficient number of facilities for cleaning, disinfecting hands and for cleaning tools near workstations (p=.599), facilities for cleaning and disinfecting hands provided at every wash basin (p=.599), foot dip stations adequate in number and location (p=.290), and toilet facilities adequate in number and location and are adequately stocked (p=.549). It could be concluded that the assessment of the current implementation level of HACCP PRPs adopted in portioning poultry operations in traditional system was not complying with the international standards.

KEYWORDS: *Poultry meat portioning; Slaughterhouses; HACCP prerequisites programmes.*

I. INTRODUCTION

Poultry production has grown rapidly during the last years in KhartoumState. Now there are 23 poultry slaughterhouses distributed in the threelocalities of the State designed to produce more than 31,400 bird/ hr. Fromthese, 10 modern companies have additional halls for cutting chicken, tallying or classifying to wings, breast, drumstick, legs and fillet thenpacking and freezing. Compared to the traditional operations, the halls inthese modern operations, so far, comply with the regulations in terms ofcleanliness and hygiene.[1]

General source of contamination of microorganisms on foods are soil, water, plants, fodder, fertilizer, animals, humans, canalizations and tools and equipment used during processing, additives, product to product and package materials.[2]

Pathogenic bacteria such as *Salmonella* sp., *Staphylococcus aureus*, *Listeria monocytogens*, *Campylobacter* sp. and *Escherichia coli* 0157:H7, have been implicated in a number of food borne illnesses.[3]

These bacteria arise from contamination in the slaughter house during processing of live animals into meat where the routine veterinary inspection procedures cannot detect the presence of these bacteria on meat.[3]

To produce safe poultry meat for human consumption, quality assurance systems should be applied in production and processing premises. One of these systems is hazard analysis and critical control point (HACCP).

HACCP is a preventive system which has been used to ensure the production of safe food.[4] The system is based on Pre-requisites programs (PRPs) which are good manufacturing practices (GMPs) and good hygiene practices (GHPs).

PRPs may include but not limited to: training, premises and equipment, storage, maintenance, cleaning/sanitation, residue control program, services (water and pest control), waste management and product recall/withdrawal and traceability. These programs need to be effectively monitored and verified before implementing the HACCP.[5]

II. MATERIAL AND METHODS

- **Study area and population**

This study was conducted in poultry meat POs in Khartoum State. In this study 12 poultry meat POs were targeted, 6 from the traditional and 6 from modern sectors in the three localities of Khartoum State (Khartoum, Omdurman and Bahri).

- **Study design**

This cross-sectional research study was conducted using standardized Checklist.

- **Standardized Checklist**

A standardized observational checklist was designed to assess HACCP prerequisites programs (PRPs). It included location, building, environment, equipment, water supply, hygienefacilities, waste disposal, insect control, rodent control, raw materials, identification of product, recall system, good hygiene practices, personal workpractices, water quality, finished product, refrigeration and storage, production rooms, monitoring and control, production storage and source of chicken portioning.

- **Statistical Analysis**

The collected data was analyzed using SPSS version 20.0. Chi-squared was used to find association between variables; paired sample t-test to determine significance in each parameter between traditional and modern portioning ($P< 0.05$).

III. RESULTS

The results indicated that there was significant difference (p=.049) between the two systems regarding the premise location. However, a significant difference was found in terms of separation between clean and dirty areas (p=.010) (Table 1).

Table 1: Comparison of location and Buildings in traditional and modernportioning operations.

Location and Buildings	Type of portioning	Sig.
Is the premise located in an area which is appropriate for a food factory, and which does not pose a risk of contaminating the food?	Traditional	**.049****
	Modern	
Is the buildings and surrounds designed, constructed and maintained in a manner which promotes easy cleaning and sanitation	Traditional	**.341**
	Modern	
Ensure appropriate product and personnel flows?	Traditional	**.341**

	Modern	
Separation between clean and dirty areas?	Traditional	**.010****
	Modern	

**P-value considered significant at less than 0.05 levels

While the results revealed no significant difference between the two systems with regards to preventative maintenance programmes (p=.0920) and maintenance tools storage (p=.092),a significant difference was found in terms of equipment calibration procedures (p=.049) (**Table 2).**

Table 2: Comparison of equipment in traditional and modernportioning operations.

Equipment	**Type of portioning**	**Sig.**
Are there adequate standards maintained to safeguard the product?	Traditional	**Not computed**
	Modern	
Are there preventative maintenance programmes?	Traditional	**.092**
	Modern	
Is there maintenance tools storage?	Traditional	**.092**
	Modern	
Are there equipment calibration procedures (or calibration by special modern)?	Traditional	**.049****
	Modern	
Is there adequate supply of electricity?	Traditional	**Not computed**
	Modern	
Is there suitable arrangements made for the possibility of power cuts or breakdowns?	Traditional	**.049****
	Modern	
Is there an adequate supply of refrigeration?	Traditional	**.341**
	Modern	
Is all production, storage areas are maintained within measurements? (measuring devices e.g. thermometers)	Traditional	**.341**
	Modern	
Is there system for draining off water or condensation?	Traditional	**Not computed**
	Modern	
Is there an adequate supply of potable water?	Traditional	**.11**
	Modern	
Are there supplies for both hot and cold water?	Traditional	**.11**
	Modern	
Is water storage tank covered?	Traditional	**.549**
	Modern	
Is there an inspection hatch and is it lockable?	Traditional	**.145**
	Modern	

**P-value considered significant at less than 0.05 levels

The findings of this study showed no significant differences between the two systems regarding hygiene facilities (Table 3).

Table 3: Comparison of hygiene facility in traditional and modern portioning operations.

Hygienefacility	Type of portioning	
Are there a sufficient number of facilities for cleaning, disinfecting hands and for cleaning tools (near workstations,)?	Traditional	**.599**
	Modern	
Are facilities for cleaning and disinfecting hands provided at every wash basin?	Traditional	**.599**
	Modern	
Are foot dip stations adequate in number and location?	Traditional	**.290**
	Modern	
Are there suitable dispensers and containers for used towels and disposable gloves?	Traditional	**.11**
	Modern	
Are toilet facilities adequate in number and location and are they adequately stocked (e.g. toilet paper, soap, disposable towels, trash cans, etc.)?	Traditional	**.549**
	Modern	
Are there adequate changing rooms?	Traditional	**.11**
	Modern	

**P-value considered significant at less than 0.05 levels

Comparison of pest control in the two systems revealed no significant differences (p=.290) (**Table 4).**

Table 4: Comparison of pest control in traditional and modernportioning operations.

Insect control and Rodent control	Type of portioning	Sig.
Are there pest control programme?	Traditional	**.290**
	Modern	
Are all external openings equipped with insect control devices?	Traditional	**.260**
	Modern	
Are there catch trays and are they emptied?	Traditional	**.11**
	Modern	
Are there rodent control programme?	Traditional	**.599**
	Modern	
Is the buildings rodent proof?	Traditional	**.11**
	Modern	
Are all drains leading to the exterior have rodent traps?	Traditional	**.11**
	Modern	

**P-value considered significant at less than 0.05 levels

The results also showed no significant differences between the two systems regarding the recall procedure, calibration, maintenance and checks and audits **(Table 5).**

Table 5: Comparison of recall system and documentation in traditional and modern portioning operations.

Recall system and Documentation	Type of portioning	Sig.
Are there written recall procedure?	Traditional	.145
	Modern	
Documentation pertaining to the product coding system?	Traditional	.341
	Modern	
Finished product distribution records?	Traditional	.11
	Modern	
Product complaint file?	Traditional	.11
	Modern	
A recall coordinator?	Traditional	.145
	Modern	
Sanitation programme?	Traditional	.11
	Modern	
Calibration?	Traditional	.145
	Modern	
Maintenance?	Traditional	.599
Are all documents controlled and an amendment register maintained; Checks and audits?	Traditional	.11
	Modern	

***P-value considered significant at less than 0.05 levels*

The results of the good hygiene practices in the two systems investigated in this study showed no significant differences in several parameters, while there was only a significant difference in relation to documented training programme (p=.049) (table 6).

Table 6: Comparison of good hygiene practice in traditional and modernportioning operations.

Good hygiene practice and Personal work practices	Type of portioning	Sig.
Are all staff certified by a medical practitioner that there is no impediment to them working on or with meat?	Traditional	.341
	Modern	
Are there documented training programme?	Traditional	.049**
	Modern	
Is there process for washing hands policy, including the use of sanitizer and/or gloves?	Traditional	.260
	Modern	
Wear their protective clothing, footwear, hair covering, gloves etc. in the appropriate manner?	Traditional	.599
	Modern	
Keep their own personal equipment such as aprons, knives and steels clean and tidy?	Traditional	.11
	Modern	
Are there hygiene and policies and procedures?	Traditional	.11
	Modern	
Are all employees wearing outer garments	Traditional	.11

suitable for the operation?	Modern	
Is there a designated area for employees to leave protective outer garments?	Traditional	.549
	Modern	
Are employees washing their hands before entering procedures area and after using the toilet?	Traditional	.341
	Modern	
Watches, jewelry - including earrings, bracelets and rings?	Traditional	.290
	Modern	
Smoking and eating and drinking?	Traditional	.145
	Modern	
Supervision of laundry operations?	Traditional	.549
	Modern	
All operators wash their hands and other personal equipment	Traditional	.599
	Modern	

**P-value considered significant at less than 0.05 levels

The sanitation programme was also investigated in the two systems. There was significant difference regarding a written sanitation programme for the plant (p= .049) and the microbiological swabbing to determine the effectiveness of sanitizers used (p=.010). (Table 7).

Table 7: Comparison of fitness to work in traditional and modernportioning operations.

Sanitation programme	Type of portioning	Sig.
Is there a written sanitation programme for the plant?	Traditional	.049**
	Modern	
Are all areas of the plant and equipment visually examined before production to ensure the cleaning procedures have been effective?	Traditional	.341
	Modern	
Is there a use for microbiological swabbing to determine the effectiveness of sanitizers used?	Traditional	.010**
	Modern	

**P-value considered significant at less than 0.05 levels

No association between the two systems was found regarding date of production (Table 8).

Table 8: Cross tabulation between type of partitioning and date of production.

			What is the date of production?			Total	χ2	P-value
			Fresh (1-7 days)	Semi fresh (7-15 days)	Non fresh (15-30 days)			
Type of portioning	Traditional	No.	3	2	1	6	4.0	.135
		%	33.3%	100.0%	100.0%	50.0%		
	Modern	No.	6	0	0	6		
		%	66.7%	.0%	.0%	50.0%		
Total		No.	9	2	1	12		
		%	100.0%	100.0%	100.0%	100.0%		

**P-value considered significant at less than 0.05 levels

IV. DISCUSSION

This study was conducted to assess the current implementation level of HACCP PRPs adopted in portioning poultry operations in Khartoum State, Sudan.

The findings of this study indicated that there was significant difference (p=.049) between traditional and modern portioning operations regarding the premise location which did not pose a risk of contaminating the food. This may be because the possibility of risk posed from traditional portioning is greater compared to modern portioning operations. However, a significant difference was found in terms of separation between clean and dirty areas (p=.010). This difference may be due to better hygiene practices applied in modern portioning compared to traditional portioning operations. This result is in line with[6] who stated that the design and construction of food facilities must permit easy cleaning and sanitation, control the entry and harboring of pests, and control the entry of environmental contaminants such as smoke and dust.

On the other hand, the study showed that there was no significant difference found between traditional portioning and modern portioning operations (p=.092) concerning preventive maintenance programme. This finding is supported by Schmidt and Erickson[6] who stated that keeping the area uncluttered and free of refuse will discourage insects and other vermin from taking up residence.

The current study showed that significant difference was found between the two systems in terms of equipment calibration procedures. However, at a minimum, the traceable reference standard should be recertified annually**.**

Also the study revealed no significant difference found between the two systems in relation to an adequate supply of potable water. This may be because water supplies can become polluted with human sewage or agricultural waste containing fecal contamination from animals, therefore all sectors used to consider this practice.

No significant differences were found between the two systems regarding sufficient number of facilities for cleaning. This may be because there were routine monitoring and supervision from the authorized bodies in the Ministry of Agriculture, Animal Wealth and Irrigation in Khartoum State for the sectors working in poultry industry.

The study illustrated that there were no significant differences found between the two systems regarding pest control programme. The good hygiene practice is that food premises must be kept clean to minimize the likelihood of food becoming contaminated and to discourage pests.

Also, the comparisons of rodents control in this study showed significant differences. It may be because of modern portioning operations being located in far areas that were easily spread by rodents. The reason may also be due to the fact that good hygiene practice is meant to storefood items in an area that is sealed from insects and rodents, for example a foodstorage area.[7]

Also the study showed that there was significant difference between the two systems in relation to documented training programme. This difference may be due to well documented training programme in modern sector.

Non-systematic review suggesting that wearing rings may make using gloves more difficult as well as having the potential to breach glove integrity.[8] The finding indicated good hygiene practice of workers in both sectors; this may be returned to high proportion of education level.

The study showed that no significant difference between the two systems concerning staff certified by a medical practitioner. This step is very crucial to guarantee all workers were free from infected diseases to protect transmission diseases.

Furthermore, the study showed significant between the two systems regarding written sanitation programmed. This difference may be returned to the commitment of modern sector, finished products suitable in every way for human consumption and they were causing adverse health effects to the final consumer when they are prepared and eaten in accordance with its intended use.

Temperature of all refrigerated storage and production areas in this study monitored to ensure that they remain within the adequate limits (p=.11). Temperature is one of the major factors affecting microbiological growth. This was consistent with the James[9] who stated that microorganism has a maximum growth temperature above which growth no longer occurs.

In the present study there was no significant difference found regarding all products clearly labeled or marked in a manner which identifies the date of production and batch or lot details. Poultry products are required to include a date of packing, either as a calendar date or a code.[10]

V. CONCLUSION AND RECOMMENDATIONS

The assessment of the current implementation level of HACCP PRPs adopted in portioning poultry operations in traditional system was not complying with the international standards. It is recommended that all food operations apply HACCP PRPs.

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Competing interests

The authors declared that they have no competing interests.

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