



## Assessment of Food Hygiene Compliance of Wet Market Processors in Accra, Ghana

### ABSTRACT

Hygiene of processing facilities and process operations at wet markets, popularly known in Ghana as live bird markets, plays an important role in the safety of dressed poultry products. Compliance with good hygienic practices (GHPs) or good manufacturing practices is fundamental to improving and maintaining the safety and quality of poultry meat. This study assessed the level of compliance of live bird processing and retailing operations in wet markets in Ghana against GHPs. A total of 11 study sites in Accra were selected using cluster sampling. An audit checklist was designed based on the Codex Alimentarius Commission's Code of Hygienic Practice for Meat (poultry) (CAC/RCP 58-2005) and the recommended international code of practice—general principles of food hygiene. Facilities that scored 90% to 100% were categorized as fully compliant, 70% to 89.9% indicated satisfactory, 50% to 69.9% indicated conditional satisfactory, and <50% indicated unsatisfactory. Results showed that none of the facilities audited were fully compliant; 9.1% were satisfactory, 63.6% were conditionally satisfactory, and

27% were unsatisfactory. The general performance shows a need for major to critical improvements in hygienic practices to meet GHP standards, which is the basic requirement for licensing food facilities in Ghana.

### INTRODUCTION

Globally, poultry meat is considered a significant exposure pathway for salmonellosis and campylobacteriosis (9). These diseases are caused by the zoonotic agents *Salmonella* and *Campylobacter*, respectively. These organisms may be inherent in live birds or present in their environment or feed, and they are shed through the fecal matter of birds. Controlling such foodborne disease agents associated with poultry and other animal source foods requires concerted food control efforts from farm to plate (5). The Codex Alimentarius Commission's Code of Hygienic Practice for Meat (poultry) (CAC/RCP 58-2005) recommends risk-based approaches to ensuring meat hygiene throughout the meat value chain, particularly strategies and control measures to curb microbiological hazards (4). One such strategy is the application of a hazard analysis critical control

\* Author for correspondence: Phone: + 233 27 271 5759; Email: aparry-hanson@ug.edu.gh

point (HACCP) system. HACCP is a proactive food safety management system that identifies specific hazards associated with a process or product and establishes controls for them. In many jurisdictions, HACCP is mandatory, and it is regulated by relevant government agencies.

In Ghana, poultry processing is largely small scale and unlicensed. Many consumers of fresh broiler or layer meat source their products from live bird markets (LBMs). The LBMs are wet markets that trade live birds and slaughter, dress, cut to convenient sizes, and sometimes roast poultry meat on demand (12). LBM operations generate vital supplementary income for a significant number of informal small- and medium-scale value-chain actors. These LBM operators have a customer base ranging from restaurants, canteens, and supermarkets to individual consumers who buy the dressed chicken for home preparation. They are located in traditional open markets spread throughout the country. Although their operations are small, they serve a niche market all year and are popular during religious festive seasons. HACCP is voluntary in Ghana; licensing of food manufacturing or preparation facilities is based on Good Manufacturing Practices (GMPs) or Good Hygienic Practices (GHPs). In the informal sector, licensing of food processing facilities by the Ghana Food and Drugs Authority (GFDA) is not required for business operation.

The Codex and the Office International des Epizooties recognize that animal slaughter and subsequent handling activities are critical to food safety (11). The Codex's code of hygienic practices for poultry meat provides live bird processors with guidelines for the provision of a safe and hygienic environment from primary production to the point of retail. These guidelines aim to reduce the rates of contamination and cross-contamination among birds during slaughter, dressing, and subsequent handling activities (4).

A recent study (12) identified significant gaps in food safety knowledge and hygiene conduct of live bird operators. The LBM operators interviewed in the study (12) lacked sufficient food safety knowledge about sources of contamination in poultry processing. The study also identified gaps in food safety practices such as infrequent hand washing before and during poultry processing, infrequent washing of processing tables between batch processing, and lack of washing and chilling after evisceration. Our study builds on the results in Ovai et al. (12) to determine the compliance of live bird processing facilities to the Codex's hygiene guidelines with the aim of highlighting areas for improvement for poultry processing hygiene. This study provides evidence as a good basis for regulators and relevant government agencies to develop implementable interventions for the poultry sector.

## **MATERIALS AND METHODS**

### **Study design and location selection**

Data on the numbers and locations of LBMs in Accra were obtained from the Ghana Veterinary Services Directorate

(GVSD) of the Ministry of Food and Agriculture, Ghana, and the Accra chapter of the National Poultry Association. According to the database, there are 33 LBMs in Accra. For the 33 LBMs, a cluster sampling method was used to select the study sites by dividing the LBMs into four clusters (north, south, east, and west). For each cluster, Random.org was used to randomize and select two LBMs and one cottage farm, making 12 study sites. However, one of the selected facilities opted out of the study; hence, 11 facilities participated in the study.

### **Audit checklist design**

The audit checklist was designed based on CAC/RCP 58-2005 and the recommended international code of practice—general principles of food hygiene (4). The checklist was structured into 10 hygiene principles: (i) regulatory (licensing and food handlers' certification); (ii) primary production (sourcing, health status of birds at point of purchase, and traceability systems); (iii) hygiene of slaughtered animals (health status at point of slaughter, contamination control measures, and regulatory compliance); (iv) hygiene of feed and feed ingredients (sourcing, regulatory compliance, feed components, and antibiotics administration); (v) hygiene of the primary production environment; (vi) presentation of animals for slaughter; (vii) establishment of the design, facilities, equipment, and personnel; (viii) design and construction of slaughter areas; (ix) water supply and temperature controls; and (x) process control (standard operating procedures [SOPs] and critical control point considerations). These processing facilities were graded on full compliance (meet all requirements of CAC/RCP 58-2005), minor noncompliance (failure to meet part of the requirements for a particular module that may not lead to a food safety violation), major noncompliance (failure to meet specific requirements of a module in CAC/RCP 58-2005 that could lead to a breach in food safety), and critical noncompliance (failure to implement any requirements of a module in CAC/RCP 58-2005 that will lead to a food safety breach). Full compliance was scored 30, minor noncompliance was scored 20, major noncompliance was scored 10 and critical noncompliance was scored zero for each item on the checklist. A hygiene assessment system (7) with some modification was used to compute and grade the facilities based on the 10 hygiene principles as follows: 90% to 100% represents excellent or full compliance, 70% to 89.9% represents satisfactory compliance with minor improvements required, 50% to 69.9% represents conditional satisfactory compliance implying major improvements required, and <50% represents unsatisfactory compliance or full noncompliance.

### **Pretesting**

A study site was selected at random for pretesting of the audit checklist. This exercise tested the checklist and helped

to determine the duration of the audit. The results obtained from the pretest were used in revising the checklist.

### Ethical clearance

Ethical clearance was obtained from the Institutional Review Board of the Ethics Committee for Basic and Applied Sciences, University of Ghana.

### Audit

The selected live bird processing and retail points were visited once during normal operational days of the week to allow the observation of their normal processes. Permissions were sought from the heads of the LBMs or cottage farms to carry out the audit. Each facility that participated in the study was visited once on a normal business day. In addition, the head of each facility confirmed that the observations made were typical of their operations. Face-to-face interviews and physical observations of their activities were carried out. Although the audit checklist was designed in English, it was administered in both English and Twi (the local language).

### Data analysis

Frequency of compliance in each grade category was determined. Associations between hygienic practices and compliance were analyzed using Pearson's chi-square test of significance at an alpha level of 0.05 using SPSS version 23.

## RESULTS AND DISCUSSION

The hygiene audit was an assessment of the establishment of hygiene systems by informal poultry processors to ensure food safety. Evidently, the general hygiene compliance of the visited facilities was poor, as shown in *Figure 1*, where most

facilities have a conditional rating or an unsatisfactory rating. About 9.1% of the respondent facilities had satisfactory compliance with the Codex's hygiene guidelines, whereas 90.9% of the LBMs required major revisions to achieve satisfactory or full compliance. Similarly, in a study by Ovai et al. (12), respondents exhibited poor food safety practices during their processing operations, which was largely influenced by insufficient food safety knowledge.

### Licensing and certification

Every food business in Ghana is required to obtain a GFDA license for the business facility and a food handler's certificate for their food processors. Certification and licensing from the GFDA ensures accountability on the part of the business operators, which in turn creates consumer confidence in the quality and safety of the product (3). No facilities audited in this study was licensed by the GFDA. Most cottage food operatives in Ghana do not meet the basic requirement to be licensed by regulatory agencies. Most of them operate with permits given by the Metropolitan, Municipal and District Assemblies to conduct small-scale businesses in the open markets. These permits do not have requirements for food quality and safety; instead, the permit covers monthly dues or daily tickets for business operation in the open market.

Only 1 of the 11 facilities had satisfactory compliance in this category. This is because they were halfway through the licensing process and most processors within the establishment had the food handler's certificate. However, in 90.9% of the LBMs audited, the operators were unaware of the need to acquire food handler certificates, so none of the operators in those facilities had one. In some cases,

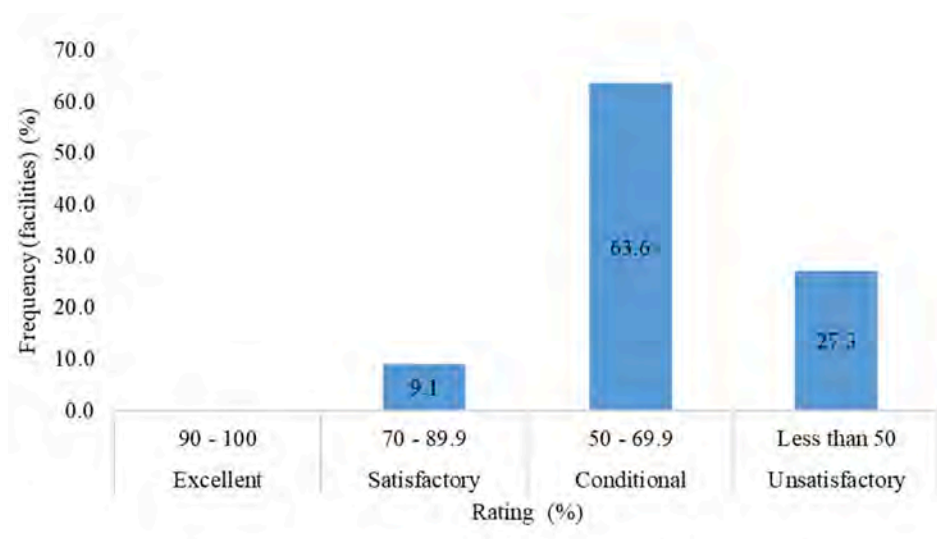


Figure 1. Overall performance of facilities in compliance with the Codex's code of hygienic practices.



only a few operators within the establishment had acquired the certificates. Although licensing is important, it cannot be used to predict compliance, because  $P = 0.730$  and Phi and Cramer's  $V = 0.239$  show a weak association between licensing and compliance.

### Primary production and traceability

Primary production includes the source of the birds, their health management, and transportation to the sale or processing point. The conditions of primary production are critical in determining the likelihood of introducing hazards to the meat; thus, the management of primary production reduces the likelihood of the transmission of zoonotic microorganisms to chicken meat to assure safety (1).

According to respondents, the birds were obtained from various poultry farms in regions across the country, especially from the eastern region, from the central region, and within the Greater Accra region. Bird sourcing was done based on the proximity, price, and availability of matured birds that they could readily process or sell. To keep up with high demand, the traders sourced birds from multiple farms. However, their documentation on source, health status, and identification of the birds was limited. The code of hygienic practices requires operators to have a good identification and traceability system, which will help in tracing the source of contamination if it occurs (4). Of the 11 audited facilities, only 2 facilities kept an up-to-date notebook in which the number of birds, dates, and places of purchase were recorded (Table 1). The other nine ranged from minor to major noncompliance, with some having nonupdated traceability records and others relying on individual recollection to identify the originating farm for the birds. On rare occasions, the birds were marked by their poultry farmer, making it easy to trace the source of a bird. Their system of identification and traceability was considered subjective and thus flawed. A simple record keeping system could be employed to reflect details such as the source, date and location, number of birds, type or breed, peculiar characteristics, and retail location if the live bird trader or processor has more than one operational site.

Compliance with primary production and traceability requirement data showed that the respondents did not have biosecurity control measures in place except at one facility. However, seven facilities (63.7%) had extra holding cages that they occasionally used to isolate and monitor sick birds (Table 1). During peak seasons, like Christmas and other festive seasons when poultry sales are highest, these cages would be occupied with birds, consequently taking up the space that should be set aside to isolate and monitor sick birds to mitigate the spread of potential infections. From the responses gathered, the processors rely heavily on experience in relation to health status monitoring of the birds. This practice allows variability among operators who conduct bird quarantine and health monitoring activities. Overall, only a third (27.3%) of the LBM had satisfactory compliance scoring above 70% on primary production and traceability (Table 2).

### Hygiene of slaughter

According to the code of hygienic practices (4), primary producers need to have up-to-date health records of their animals, including the health status of the animal and whether it is safe for slaughter. From the data gathered, there were limited records on health status of birds. At best, some traders and processors kept records of the birds that had died in transit or during holding for the purpose of revenue analysis. There were no systems in place to monitor quality and hygiene for 72.7% of the establishments audited. Their modus operandi is that the clients look through the flock in holding and choose the birds they want slaughtered and dressed. Clients typically choose birds based on size and weight. The processors and traders rely heavily on visual observations. The code of hygienic practices requires that a competent official, such as a veterinarian, administer monitoring and surveillance to control the spread of zoonotic infections and offer technical support where necessary (4). A few (27.3%) of the audited sites received regular visits from GVSD, whereas others rarely had visits from either GVSD or other regulatory agencies. Although some processors are trained to identify some symptoms of specific

**TABLE 1. Compliance of primary production and traceability (N = 11)**

Subcategories	n (%)			
	Compliant	Minor Deviation	Major Deviation	Noncompliant
License/inspection permit to transport	7 (63.7)		2 (18.2)	2 (18.2)
Health status monitoring	1 (9.1)	6 (54.6)	4 (36.4)	
Biosecurity measures	1 (9.1)		7 (63.7)	3 (27.3)
Identification systems	2 (18.2)	4 (36.4)	4 (36.4)	1 (9.1)

**TABLE 2. Association between hygienic practices and compliance with the code of hygienic practices among selected processors in Accra (N = 11)**

Score Allocation	n (%)				P-Value	Phi-Cramer
	Excellent	Satisfactory	Conditional	Unsatisfactory		
License/certification to operate		1 (9.1)		10 (90.9)	0.730	0.239
Primary production and traceability	1 (9.1)	2 (18.2)	5 (45.5)	3 (27.3)	0.026*	0.807
Hygiene of slaughter animal		1 (9.1)	2 (18.2)	8 (72.7)	0.016*	0.744
Hygiene of feed for slaughter animal		1 (9.1)	5 (45.5)	5 (45.5)	0.110	0.586
Hygiene of primary production environment	1 (9.1)	9 (81.8)		1 (9.1)	0.008*	0.793
Presentation of animal for slaughter			5 (45.5)	6 (54.5)	0.073	0.690
Establishment design, facilities, and equipment		1 (9.1)	4 (36.4)	6 (54.5)	0.015*	0.751
Design and construction of slaughter area	1 (9.1)	2 (18.2)	2 (18.2)	6 (54.5)	0.028*	0.728
Water supply and hygiene		1 (9.1)	5 (45.5)	5 (45.5)	0.021*	0.724
Process control			1 (9.1)	10 (90.9)	0.004*	1.000

\*Significant at  $\alpha < 0.05$ .

**TABLE 3. Compliance of the hygiene of slaughter requirement (N = 11)**

Basis for Score Allocation	n (%)			
	Compliant	Minor Deviation	Major Deviation	Noncompliant
Records on health status	1 (9.1)	2 (18.2)	3 (27.3)	5 (45.5)
Quality or hygiene assessment before slaughter	1 (9.1)	3 (27.3)	6 (54.6)	1 (9.1)
Monitoring by GVSD onsite	3 (27.3)	1 (9.1)	3 (27.3)	4 (36.4)
Control of contamination/cross-contamination	1 (9.1)	4 (36.4)	5 (45.5)	1 (9.1)

infections, a proper assessment by an expert onsite is ideal and encouraged.

Most (72.7%) informal live bird traders and processors scored below 50% in terms of hygiene of slaughter (Table 2), with noncompliance spanning from major to critical noncompliance across health status monitoring, hygiene assessment before slaughter, and record keeping (Table 3). However, 18.2% of the respondents separated only the birds with obvious signs of illness from the flock but were not fully compliant, because the records kept were outdated and scanty. Although efforts such as having some spare cages for isolation, isolating visibly ill birds, and cleaning out litter relatively often were being made, there is the risk of cross-contamination, because most operators did not frequently inspect their birds to isolate the sick ones before

they ended up spreading diseases or cross-infecting the rest of the flock. Based on responses from previous studies (12), most (91.7%) did not know that caging visibly sick birds with healthy birds can cause cross-infections. Only 9.1% of the auditees had satisfactory compliance with the hygiene of slaughter requirements. The chi-square analysis ( $P = 0.016$  and  $\phi = 0.744$ ) also showed good association between the hygiene of slaughter and general compliance with the code of hygienic practices. This emphasizes that the hygiene of slaughter is critical to the overall hygiene of the dressed meat.

#### Hygiene of feed

According to the live bird traders and processors, feed for their birds is obtained from retail shops in the market and at farm gates, because some poultry processors have feed mills.

**TABLE 4. Compliance of the hygiene of the primary production environment requirement (N = 11)**

Basis for Score Allocation	n (%)			
	Compliant	Minor Deviation	Major Deviation	Noncompliant
Hygiene of establishment location	3 (27.2)	6 (54.6)	1 (9.1)	1 (9.1)
Storage position of chemicals or cleaning reagents	10 (90.9)	1 (9.1)		
Structure (control of cross-contamination)		9 (81.9)	1 (9.1)	1 (9.1)
Structure (coop-to-bird ratio)	4 (32.4)	7 (63.7)		
Source of water	11 (100)			
Disposal of process waste (offal, etc.)	8 (72.8)	3 (27.2)		
Frequency of cleaning	2 (18.2)	6 (54.6)	1 (9.1)	2 (18.2)

It was encouraging to know that most feed found on the market was branded, was mostly produced by local industrial- and cottage-level feed producers, and thus could be traced back to the producers. Although the feed did not come with a certificate of analysis or usage instructions, processors and retailers said they preferred specific brands because of their product quality and consistency. Nevertheless, there were no measured indicators of feed quality and safety and no records to indicate inspection of feed and poor storage conditions of feed that can promote mold growth. About half (45.5%) of the auditees were rated unsatisfactory in this category. Another 45.5% were rated as having major noncompliance issues. The auditees did not know the content of the feed they were giving to the birds, including the basic ingredient and chemical additives and their possible effects on the birds. At best, visual inspection was done by some traders to ensure the feed did not contain foreign materials that could be injurious to the birds.

According to code of hygienic practices (4), there should be a good partnership between all stakeholders in production and the users of the feed to ensure the farmer and traders get the requisite training on use of the feed, its benefits, the risks, and feedback from the users to the producers. Some live bird traders had antibiotics that they formulate into the birds' drinking water. According to them, it helps the birds grow bigger. According to Hughes and Heritage (8), antibiotics are meant to fight off bacterial infections. However, in livestock farming, antibiotics are also used as growth promoters. They are administered in low, subtherapeutic doses, which is one of the major factors responsible for emerging antimicrobial resistance issues.

#### Hygiene of the primary production environment

CAC/RCP 58-2005 forbids undertaking primary production under unhygienic conditions that could lead to unacceptable levels of foodborne hazards. The auditees

showed a positive attitude and practice in this regard. The hygienic conditions of 90.9% were satisfactory, because they had a relatively clean working environment, whereas the hygienic conditions of work were poor for 9.1% (Table 2).

Chemicals and cleaning reagents were stored away from the birds such that potential contact with feed is unlikely. The live bird traders also understood the need to avoid overcrowding in holding cages. On average, a cage of about 5 × 5 m<sup>2</sup> housed about 250 to 350 birds (Table 4). Overcrowding may result in the accumulation of heat, which may compromise the welfare of the birds. They stand at higher risk of spreading diseases and infections, cannibalism, and ultimately death (13).

In addition, all processors used potable water in the dressing of the bird and all other activities. Using clean water for processing reduces risk of contamination. Again, the means of waste disposal was largely reassuring. Offal of processed carcasses and feathers are kept separately in plastic bags and collected by either registered waste collectors or informal waste collectors who take it to the main dump sites closest to the markets. In some instances, the offal is collected by dog owners to be processed as feed.

Frequency and thoroughness of cleaning were inadequate. The processors were observed to mostly wipe contact surfaces such as tables with a sponge or polyurethane foam soaked with water. Consequently, the accumulation of microbiological hazards and the subsequent formation of biofilm on these surfaces are significant risk factors for the cross-contamination of meat.

#### Presentation of the animal for slaughter

Another category in which the auditees performed poorly was the presentation of the animal for slaughter. It was observed that 6 of the 11 facilities audited were unsatisfactory, whereas the remaining 5 facilities needed major improvements in their practices (Table 2). In relation

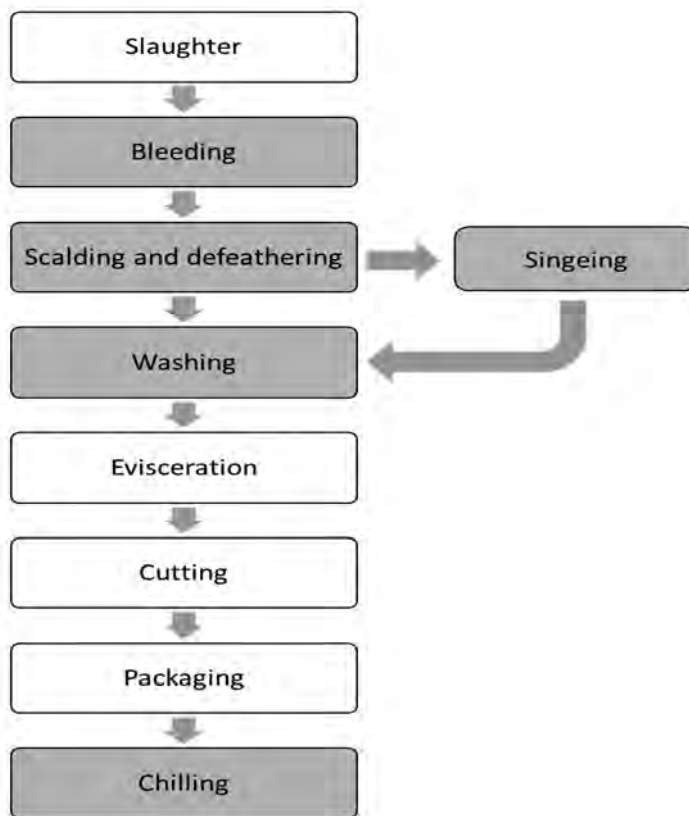


Figure 2. A flow diagram of poultry meat processing at the live bird markets and cottage farms. Variable processing steps are indicated in gray.

to the presentation of the animal for slaughter, it was observed that the birds were not cleaned before slaughter as required by the code of hygienic practices, which states that animals presented for slaughter should undergo adequate cleaning so as not compromise hygienic slaughter. According to the processors, it is assumed that changing the litter regularly is sufficient to produce clean birds. Moreover, because of their mode of operation, the time from the client's choice of birds, to slaughter, and to dressing should be minimal; therefore, important steps such as removing litter from the feet and feathers of birds and assessment of health status of the birds are skipped. In addition, processors believe that the scalding step (Figure 2) will kill microbes that may be present on feathers, feet, and skin of birds.

It was also observed that most auditees allowed feeding of the bird until slaughter, which according to Mead (10), increases the risk of contamination because of the risk of spillage of the guts matter, which may not have enough time to clear from the gastrointestinal tract before slaughter.

#### Establishment design and construction of slaughter

Facility design and equipment design largely define the flow of activities and product and process efficiency

and safety. In the case of the LBMs visited, almost all live bird processors and traders were found in a section of the traditional open market allocated by the government. This arrangement had its pro and cons. Separation from other commodities within the market helps reduce the risk of cross-contamination. Nevertheless, because the space allocated for them is often insufficient to accommodate the staff numbers, their activities tend to be space restricted, which leads to poor segregation of low-risk and high-risk operations.

Most live bird processing sites did not have washrooms or changing rooms of their own. They generally had to use the public washrooms provided for the market. In addition, some had a tiny designated area of their establishment as changing room. According to some respondents, they change early in the morning when they arrive and again at the close of day. The hygienic conditions of these public washrooms differed from market to market with respect to appropriate hygienic facilities. In terms of the hygienic conditions of the washrooms, only 18.2% complied fully with good hygiene (Table 5). There were hand washing sinks to enable and encourage hand washing after using the washroom. Although the washroom facilities were within the market, they were at a safe distance from the point of sale

**TABLE 5. Compliance of the establishment design and construction of slaughter requirement**

Basis for Score Allocation	n (%)			
	Compliant	Minor Deviation	Major Deviation	Noncompliant
Safety of location	5 (45.5)	5 (45.5)	1 (9.1)	
Hygienic conditions of washroom	2 (18.2)	3 (27.3)	5 (45.5)	1 (9.1)
Hygiene friendliness of washroom		5 (45.5)	6 (54.5)	
Stunning/bleeding and dressing area separation	8 (72.8)	3 (27.3)		
Scalding/defeathering and dressing area separation	5 (45.5)			6 (54.6)
Durability and cleanable nature of slabs for dressing	1 (9.1)	1 (9.1)	6 (54.6)	3 (27.3)
Special disposable system for offal and other animal parts			10 (90.9)	1 (9.1)

N = 11

to preclude cross-contamination. However, most of these washrooms needed minor to major improvement where in some locations there were no hand washing stations inside the facility. Of the washrooms, 45.5% could be managed with minor improvement, yet the other 54.5% required major improvement. Again, because of poor sanitation, most washroom facilities had a strong stench emanating from the facility. Although the facilities did not meet required standards, the processors understood the need to practice good personal hygiene. This is in line with observations made by Ovai et al. (12) among LBM operators.

Of the 11 sites audited, 6 (54%) had wooden platforms covered with plastic sheets for defeathering and dressing of birds (Figures 3 and 4), which was a major noncompliance. This is because tiny plastic pieces could contaminate the chicken. Of the three sites graded noncompliant, two of them had wooden slabs without plastic covers or covers of any material. The wood was difficult to clean and thus likely to accumulate microbiological hazards easily. The last used plastic bowls that were not adequately cleaned, increasing the chances of hazard accumulation in the bowl and thus meriting a critical noncompliance. In most industrial processing plants, stainless steel or ceramic tiles are used in making the work surfaces for the processing of the meat, because they are easy to clean and durable. A wooden slab with plastic covering could be considered a less expensive option, except that during dressing, the knife may make incisions in the plastic cover. These openings in the plastic will give water access to surfaces beneath the plastic sheet, which would eventually support microbial growth and serve as harborage. The plastic itself could be considered a food safety and health risk, considering that pieces of it could end up in the meat as a physical hazard, which can result in an adverse effect on consumers' health (Figures 3 and 4).

#### Water hygiene and temperature control

Although processors used potable water in their operations, some processing steps involving the use of water require critical attention and corrective action. The most vulnerable steps in poultry meat processing that are likely to result in cross-contamination include scalding, defeathering, and evisceration (6), all of which include the use of water. It was observed that the water in the scalding tank was reused for multiple birds, and these were often heavily soiled. This was because the scalding water was not frequently changed in most (81.9%) of the audited facilities. In some places (9.1%), the same water was used throughout the day; others changed it when it was dirty (Table 6). "Dirty" is a subjective indicator and thus difficult to measure. Such practices expose the meat to a high risk of cross-contamination even though the water may be hot. Only one operator changed scalding tank water relatively frequently.

The temperature of the scalding water varied greatly across all facilities. Even within the same facility, there were variations among processors. Some of them allowed the water to be very hot, some even at boiling temperatures, whereas other did the scalding at just-warm temperatures between 50°C to 70°C. This was because the temperature of the scalding water had not been standardized with regard to the breed of chicken produced in Ghana and thus was less likely to be monitored. Some processors relied on their experience in monitoring the temperature of the scalding water in the tank, which despite varying greatly continued to be the practice.

#### Process control

In relation to SOPs, most (91.9%) LBM operators did not have their SOPs documented. As a result, activities such as bleeding methods, scalding temperatures and duration, singeing, washing, and packaging differed from one processor





Figure 3. Types of processing surfaces used at live bird markets and cottage farms. (A) Tiled concrete slab. (B) Wooden table.



Figure 4. An example of a processing setup in one of the live bird markets.

to the other. Their processing skills were mostly acquired through apprenticeship, which is not documented; therefore, methods of slaughtering and dressing may differ from processor to processor in one LBM. In addition, most of their activities were not monitored, making it difficult to control and correct noncompliant practices.

#### Adherence to basic GHPs and GPPs

Table 7 describes the level of compliance with regards to some key GHPs and good processing practices. From the audit, it was observed that all informal live bird processors were noncompliant when it came to the use of personal protective equipment (PPE). According to the Codex's code of hygienic practices, processors are supposed to possess and

use PPE such as gloves, a hairnet, work clothes (often clothes they would normally not wear anywhere except work), aprons, and appropriate footwear depending on the design of the establishment (4). In most cases, processors only had working gear on; others had aprons. Even then, the aprons were mostly made of cloth, which is not the best for such activities. A rubber apron is usually recommended; that way, it is easily cleanable to avoid accumulation of hazards. Only one location had all their members wearing appropriate PPE.

#### Training programs

A lot of training programs are organized by the various agencies involved in poultry activities, such as the Ghana Veterinary Service Department, Ghana Standards Authority,

**TABLE 6. Compliance of the water hygiene and temperature control requirement**

Basis for Score Allocation	N (%) = 11 (100%)			
Subcategories	Compliant	Minor Deviation	Major Deviation	Noncompliant
Frequency in changing of water in scalding		1 (9.1)	9 (81.9)	1 (9.1)
Water temperature control			10 (90.9)	1 (9.1)

**TABLE 7. Level of deviation of selected GHPs and GPPs<sup>a</sup>**

Basic GPPs and GHPs	Level of Deviation, N (%)			
	Full Compliance	Minor	Major	Critical
PPE usage		1 (9.1)	10 (90.9)	
Disinfection of facility and equipment		2 (18.2)	9 (81.8)	
Attendance at training programs	3 (27.3)	2 (18.2)	2 (18.2)	4 (36.4)

<sup>a</sup>GPPs, good processing practices; GHPs, good hygienic practices.

GFDA, and Ghana Poultry Project (2). This was confirmed by respondents. However, from the observations made, little of what is taught or discussed in such training programs is put to use. Results in *Table 7* show that many live bird traders and processors do not attend the training sessions regularly or never attend, so they are not able to gain the required skills to improve on what they do. *Table 2* shows a breakdown of their performance under each category of the audit and the degree to which predictors affected the overall compliance of the code of hygienic practices.

To conclude, the performance of live bird processors on compliance with the Codex's code of hygienic practices was generally poor, although they exhibited some commitment to ensuring food safety. Primarily, they lack the necessary technical support system to help transition these processors from their old ways to what is expected of them. Enforcement of the standards is key to the sustenance of food safety and

comes in many forms. The institution of a reward system, distribution of critical equipment such as temperature monitoring devices, access to the standards and their interpretation, and continuous education would help increase implementation of the standards. Therefore, regulatory agencies and other stake holders need to start monitoring their activities to ensure compliance with the basic requirements and gradually help them to put in place the required systems to ensure food safety.

#### ACKNOWLEDGMENTS

This study was supported by the International Foundation for Science, grant numbers E/5890-1 and I-3-E-5890-2. The authors appreciate Dr. Akunzule and Ghana Poultry Association members for their cooperation and Benjamin Ovai for field assistance.

#### REFERENCES

- Banach, J. L., E. D. van Asselt, R. Hoogenboom, L. Razenberg, P. E. Boon, P. van Horne, M. J. B. Mengelers, and H. J. van der Fels-Klerkx. 2017. Chemical and physical hazards in the Dutch poultry meat chain. RIKILT Wageningen University & Research, Wageningen, the Netherlands.
- Boschloo, R. 2020. Analysis poultry sector Ghana 2019: An update on the opportunities and challenges. Netherlands Enterprise Agency, Assen, the Netherlands.
- Carpenter, D., J. Grimmer, and E. Lomazoff. 2010. Approval regulation and endogenous consumer confidence: Theory and analogies to licensing, safety, and financial regulation. *Reg. Gov.* 4:383–407.
- Codex Alimentarius Commission. 2005. Code of hygienic practice for meat. CAC/RCP 58-2005. Codex Alimentarius Commission, Rome, Italy.
- Conrad, C. C., K. Stanford, C. Narvaez-Bravo, T. Callaway, and T. McAllister. 2017. Farm fairs and petting zoos: A review of animal contact as a source of zoonotic enteric disease. *Foodborne Pathog. Dis.* 14:59–73.

6. Food Safety Authority of Ireland. 2016. Guidelines for the interpretation of results of microbiological testing of ready-to-eat foods placed on the market (revision 2). *Guid. Note* 3:48.
7. Garcia Pinillos, R., and D. J. Jukes. 2008. Hygiene assessment system (HAS) scores—An analysis of the available data from English slaughterhouses. *Food Control* 19:806–816.
8. Hughes, P., and J. Heritage. 2010. Antibiotic growth-promoters in food animals. *Pharma Times* 42:17–21.
9. Jorgensen, F., R. Bailey, S. Williams, P. Henderson, D. R. A. Wareing, F. J. Bolton, L. Ward, and T. J. Humphrey. 2002. Prevalence and numbers of *Salmonella* and *Campylobacter* spp. on raw, whole chickens in relation to sampling methods. *Int. J. Food Microbiol.* 76:151–164.
10. Mead, G. C. 2004. Microbiological quality of poultry meat: A review. *Rev. Bras. Ciência Avícola* 6:135–142.
11. Office International des Epizooties. 2008. Animal production food safety. *Off. Int. des Epizoot. Bull.* 1:4–6.
12. Ovai, B., A. Akunzule, and A. P.-H. Kunadu. 2019. Assessment of the subjective food safety knowledge, attitudes and practices of informal live bird traders in Accra, Ghana. *Food Prot. Trends* 39:62–73.
13. Steinfeld, H., T. Wassenaar, and S. Jutzi. 2017. Promoting health and reducing disparities in populations. *Diabetes Care* 40:S6–S10.

SUPPLEMENTARY TABLE 1: Audit checklist based on Codex Code of Hygienic Practice for Meat (CAC/RCP 58-2005)							
Main GHP topics	Checklist	Comply	Minor	Major	Critical	NA	Comment/Evidence
		30	20	10	0	NA	
1. Regulatory	Are you licensed to operate a food business?						
	Do you have a food handlers certificate?						
2. Primary production	Where do you source your live birds.						
	Does your supplier have a quality system in place? E.g. Does your supplier have information such as age, health status, breed, etc. of birds?						
	Do you receive a license/inspection report from VSD prior to transporting the birds to their facility?						
	How do you monitor health status of the birds?						
	What biosecurity measures do you have in place?						
	What identification system do you have for your birds? (System should allow for traceability and history of the animal.)						
3. Hygiene of slaughter animals	What records do you have on the health status of the animals?						
	What quality/hygiene indicators they use in assessing animal suitability for slaughter?						
	Is there any monitoring of your operations by local authority or monitoring agency? (Local government, VSD, FDA, GSA, etc.)						
	How do you control contamination/ cross-contamination of germs in preparation of animals for slaughter?						
4. Hygiene of feed and feed ingredients	Are your feed suppliers licensed?						
	Is the feed inspected prior to purchase?						
	What are the constituents of the feed given to the birds? Do you administer antibiotics to their water?						
	Have you or do you receive any training from the local authority or monitoring agency such FDA, GSA, VSD etc on the handling of the feed?						
	How do you ensure the safety of the feed you give to your chicken?						
	Do you know of other chemical component that could be present in the feed? That are of human health concerns?						

**SUPPLEMENTARY TABLE 1: Audit checklist based on Codex Code of Hygienic Practice for Meat (CAC/RCP 58-2005) (cont.)**

Main GHP topics	Checklist	Comply	Minor	Major	Critical	NA	Comment/ Evidence
		30	20	10	0	NA	
5. Hygiene of the primary production environment	Is the establishments located at an area where environmental pollutant and infestations of pests could compromise the suitability of meat for human consumption?						
	Does the storage position of chemicals or cleaning reagent pose any food safety concerns?						
	What is the source of the water used in the processing of the meat?						
	How many birds is your coop structure designed to house? Whether or no it is overcrowded.						
	How does your structure aid in controlling cross-contamination when there is an infection.						
	Is there is holding/quarantine area for birds which are likely to be sick and need to be under observation?						
	How do you dispose off dead animals or waste animal parts such as the offal and feathers?						
	How often is cleaning done in the establishment? To ensure hazards do not accumulate.						
6. Presentation of animal for slaughter	How frequent are the birds cleaned?						
	Are the birds cleaned sufficiently prior to slaughter?						
	What is the condition of the holding area? Is it prone to possible foodborne pathogen contaminations?						
	During slaughtering, do you check for any signs of disease or defects?						
	What sign do you look out for to pass a bird for slaughtering or consider it defected thus unfit for slaughtering?						
	Are the birds fed prior to slaughter? How many times are the birds fed prior to slaughter?						
7. Establishment: Design, facilities, equipments and personal	Is the location of the establishment safe for meet production and processing.						
	Are there changing rooms/shower rooms/ washrooms present on site?						
	How hygienic is the washroom?						
	Does the processors in this establishment posses any protective gears?						
	Is the washroom/ changing room facility designed to encourage good personal hygiene? (i.e.. Flush toilets, liquid soaps and sanitizers.)						
	What is the nature of the slabs or table surfaces being used in the processing? Whether or not it is covered.						
	Is portable water used in the dressing of the bird?						
	Do you disinfect your facility and food contact equipments?						
	How often do you disinfect your facility and equipments?						



SUPPLEMENTARY TABLE 1: Audit checklist based on Codex Code of Hygienic Practice for Meat (CAC/RCP 58-2005) (cont.)							
Main GHP topics	Checklist	Comply	Minor	Major	Critical	NA	Comment/Evidence
		30	20	10	0	NA	
8. Design and construction of slaughter areas	Does the stunning and bleeding area differ from the dressing area?						
	Does the scalding and defeathering area differ from the dressing area?						
	Do you slaughter injured or suspected sick birds on the same platform as the rest?						
	How often is the slaughter area cleaned?						
	Are your dress tables made of durable and cleanable material?						
	Do you have a special disposal system for the offal and waste parts?						
9. Water supply and temperature control	Do you have a reliable constant supply of water to this establishment?						
	Do you monitor the temperature of water used for scalding and defeathering?						
	What is the temperature range used in scalding?						
10. Process Control	Do you have any quality control systems in place? What do you do to prevent contamination and ensure good quality birds and meat?						
	Do you have a standardized method of operation that everyone use in sale and processing of live birds?						
	How do you ensure that you meet statutory regulations pertaining to you operation?						
	Describe your process of operations in as much detail as you can. (Document on the next page.)						
	What steps of your dressing operations do you consider important to control microbial contamination/proliferation? (CCP)						
	What control do you apply to these steps?						
	How often do you change water in scalding tanks?						
	What controls do you have in place to prevent spillage or discharge from the gut or from gall bladder and urinary bladder (spillage should be prevented.)						
Training Programs	Do processors receive any training from the monitoring agencies (i.e., VSD) on GMPs or GPPs, GHPs, Biosafety						
<b>Total Score</b>		<b>30</b>	<b>20</b>	<b>10</b>	<b>0</b>		<b>60</b>

Audit Score in percentage

All 30      1680

NA      Needs Improvement

Score legend	
0	Totally unacceptable
10	Far below requirements. Critical deviation(s) from requirements with direct serious impact on product safety or quality
20	Below requirements. Requirements partly met, but major aspects need improvement
30	Requirements fully met or only single minor aspects need improvement

Rating Scale:	Score	Rating
Excellent	90 – 100	A
Satisfactory	70 – 89.9	B
Conditional	50 – 69.9	C
Unsatisfactory	Less than 50	D



IAFP’s Business Meeting will be held Tuesday, August 2, at IAFP 2022. As required by the Association’s Constitution and Bylaws, **we are notifying IAFP Members that amendments to the Constitution and Bylaws will be presented for a vote at this year’s Business Meeting.** Visit the IAFP website to view the proposed changes. Look under the “About” dropdown, click on “Governance” and scroll down. For questions, contact David Tharp, IAFP Executive Director.