



Assessment of hygiene status of poultry slaughtering facilities and meat handling practices of butchers by using a hygiene assessment tool

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ABSTRACT

In the present study, hygiene conditions and meat handling practices of poultry butchers are assessed by using a hygiene assessment tool. The study was conducted in the Hyderabad and Jamshoro districts of Pakistan from April 2019 to February 2020. A total of fifty slaughtering facilities were selected based on convenient sampling techniques and butchers from those shops were interviewed by using a hygienic assessment tool. Moreover, socio-demographic details of butchers were also recorded by questionnaire survey. The hygiene assessment tool comprises three domains, personal hygiene index (PHI), meat hygiene index (MHI) and slaughtering facility hygiene index (SFHI). Each of the indexes consists of certain observations and each of the positive observations was scored one, while negative observation was scored zero. It has been revealed from this study that more than 50% of butchers were without any education and none of the butchers had received any formal training in slaughtering and meat handling practices. Basic prerequisites of hygiene such as handwashing facilities and clean water were missing in all of the slaughtering facilities. More than 30 and 50 percent of butchers scored the least (between zero – one) in PHI MHI and SFHI. However, the total score of butchers with a higher level of education was greater ($p < 0.05$) than with a lower education level. To improve hygiene levels and reduce transmission of diseases due to the consumption of contaminated meat, regular surveillance of the poultry shops and formal training of butchers are necessary.

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1. Introduction

Foodborne illnesses are a global health issue, affecting thousands of millions of people in both developed and developing countries and are the major cause of morbidity and mortality (1).

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Access to safe, nourishing and good quality food is considered a basic right of humans, and foodborne illness has been a major concern for consumers (2). Broiler meat makes a significant contribution to the human diet (3). It has become a massive product of consumers all over the world: in every region, in countries with very different levels of development, and many different forms (4).



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A number of factors contribute to the attractiveness of this product, among which the sensory, economic, and dietary factors are playing the major role. This is because the poultry industry has developed extensively in the last 30-40 years, which in results made the chicken meat from a completely exclusive product, available only to a limited group of consumers, to become a popular, cheap, and useful meat in everyone's budget (5).

Animal products, especially meat, can cause infection or food poisoning in two different ways. The first is the consumption of infectious meat and as a result transmission of animal infection to humans, and the second, meat containing carcasses or foreign substances that can be either microbial, chemical, or physical origin. The most important causes of the appearance of these contaminates in meat are poor working or handling practices and poor work settings (6).

In 2002, about 76,000 cases of food-borne illness were recorded by the Centers for Disease Control (CDC) in the United States, the majority of them were of bacterial infections (7). The potentially pathogenic organisms most commonly associated with foods of animal origin and poultry, in particular, are *Salmonella*, *Listeria monocytogenes*, *Campylobacter*, *Escherichia coli*, and *Staphylococcus aureus* (5). One of the major risks of contamination of meat originates from the practices of meat handlers and food-borne pathogens present in or on the body of the meat handlers that can subsequently be transported to the consumers (8). Likewise, equipment and personnel working in slaughterhouses can be important sources of meat contamination (9).

The way the slaughtering process is carried out and carcasses are handled plays an important role in shelf life and quality of meat and meat products (10). The maintenance of proper hygiene and sanitation conditions in any slaughterhouse is also important because most of these facilities are located within the community and can affect the health of the residents easily (11).

The modified hygiene assessment tool is simple and efficient to assess hygiene and sanitation in any community setting (12) and is becoming a popular method for the assessment of hygiene behaviors (13). For observing hygiene indicators, the hygiene assessment tool could potentially be a rapid and efficient method for assessing hygiene at a small level. The composite indices can more accurately and consistently represent the actual state of hygiene in any community, which can be used in the assessment of hygiene promotion programs or the risk of disease transmission among individuals (12).

In Pakistan, the production rate of the poultry industry has been expanded from 20 to 25 percent per annum and is providing 0.652 million tons of meat that is equal to 23% of all meat production at national level (14). However, most of the poultry meat in Pakistan is provided by small scale, unauthorized poultry shops, with inadequate facilities, usually located on the sides of roads and streets. These slaughtering facilities may act as a source transmission of pathogens as they hardly follow any hygienic practices. Hence, the objective of this study is to assess the personal hygiene and meat handling practices of poultry butchers along with slaughtering facility hygiene by using a hygiene assessment tool with composite indices.

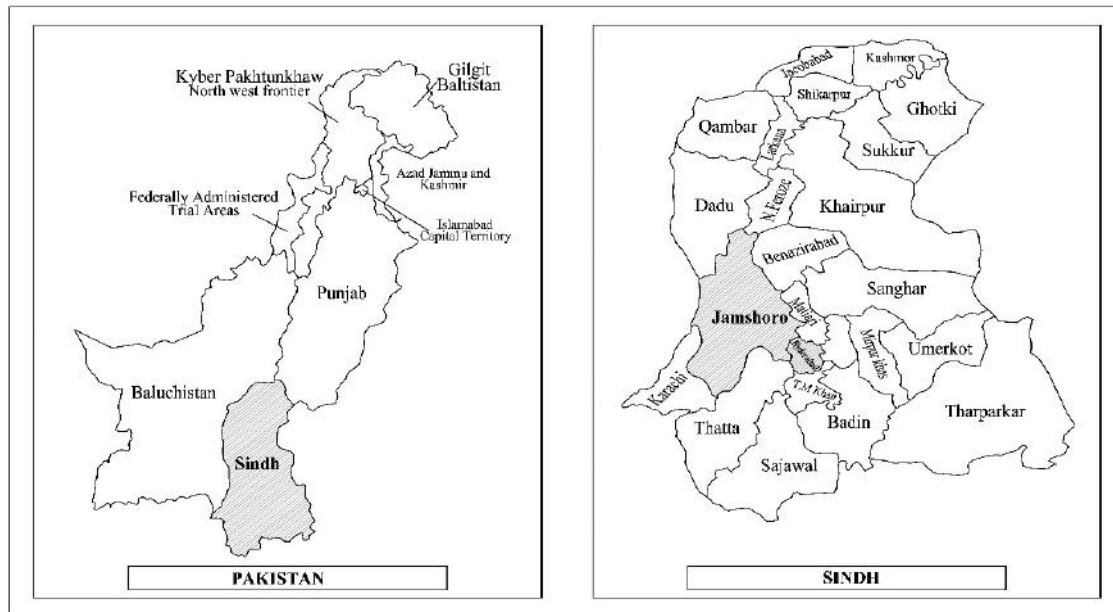


Figure 1. Study areas

2. Materials and Methods

2.1 Study area

The study was conducted in Hyderabad and Jamshoro district. Hyderabad (Figure 1), the second-largest city of Sindh and 5th largest in Pakistan is located at the East bank of river Indus at latitude and longitude of 25°22'45"N and 68°28'06"E. Its altitude is 40 m above sea level. While district Jamshoro is located on the west bank of Indus at a distance of 18 km from Hyderabad and at an elevation of 13 m from sea level. The total population of Hyderabad and Jamshoro is 1,732,693 and 993,142 as per the 2017 census respectively.

2.2 Development of hygiene assessment tool

In order to assess personal hygiene, meat hygiene, and slaughtering facility hygiene, a hygiene assessment tool was developed similarly to the one prepared by (12,13).

It consists of three domains, i.e. 1) personal hygiene index (PHI), 2) meat hygiene index (MHI), and 3) slaughtering facility hygiene index (SFHI). The entire tool included 23 observations, of which PHI comprised of six observations while MHI and SFHI comprised of 5 and 12 observations. All the observations were carried out by the same researcher (first author). Each positive observation was given a score of one while the negative one was given zero (Supplementary data 2). The sum of the items was used to calculate the indices. Table 1 shows the indices with observations.

Clothing of the butchers, wearing protective covering, wearing jewelry, nails of the butchers, and hand washing before and after meat handling that was elicited through a questionnaire survey, formed the PHI. Butcher's should follow hygienic practices while handling and cutting meat and should disinfect the slaughtering tools thoroughly. Nevertheless, the meat handler should not handle money or touch any dirty

object. Therefore, butchers' practices regarding meat handling such as meat cutting on slab/table, using rust-free knife, using clean slaughtering tools, and disinfecting slaughtering tools properly form the MHI. Observation on the presence of flies and stray animals, the unwanted smell in the shop, covered waste container, adequate lighting, and ventilation in the shop, clean floors, and walls, maintenance of birds' cages, and availability of major prerequisites of hygiene such as water, soap/hand wash, and detergents form the SFHI.

2.3 Targeted population

A total of 50 shops were selected at random for this study and butchers working in those slaughtering facilities were included in the study. Of these, 13 shops were selected from Jamshoro and 37 from Hyderabad from April 2019 to August 2019. In both cities, poultry slaughtering facilities were in an unorganized form, so it was not possible to estimate the actual number of existing slaughtering facilities.

Table 1. Indices for assessing the personal hygiene, meat hygiene, and slaughtering facility hygiene

Domains	Variables	Possible Score
Personal hygiene index (PHI)	1. Clothing of the butchers	6
	2. Wearing apron, gloves, and hair cover	
	3. Not wearing jewelry	
	4. Nails of the butchers	
	5. Washing hands before cutting meat with soap & water	
	6. Washing hands after cutting meat with soap & water	
Meat hygiene index (MHI)	1. Meat cutting on clean slab/table	5
	2. Using rust free knife	
	3. Using clean slaughtering tools	
	4. Disinfecting slaughtering tools with water and detergent	
	5. Money handling by cashier	
Slaughter facility hygiene index (SSHII)	1. Presence of flies in the shop	12
	2. Presence of stray animals	
	3. The unwanted smell in the shop	
	4. Waste container covered	
	5. Adequate ventilation in the shop	
	6. Adequate lighting in the shop	
	7. Clean floors	
	8. Clean walls	
	9. Clean cages for live birds	
	10. Availability of clean water in the shop	
	11. Availability of detergents/disinfecting materials in the shop	
	12. Separation of clean and waste material	

2.4. Questionnaire survey to assess personal hygiene, meat, and slaughtering facility hygiene

2.4.1 Preparation of questionnaire

The questionnaire is what the researcher used during the survey. It includes both positive and negative observations such as, yes/no, clean/dirty. It was prepared after a thorough review of previous literature (15-17) and guidelines of butcher shops by the veterinary regulation department. The study was conducted from May 2019 to February 2020. The questionnaire included 30 variables, which were in English but during the interview, the researcher explained them in the desired language of butchers, i.e. Sindhi and Urdu.

2.4.2. Data collection

After explaining the purpose of the study and obtaining verbal consent from the butcher for using the data for research, a personal interview of the butchers was conducted. It starts with the socio-demographic status of butchers. Some shops had more than one butcher. In that condition, apart from the senior one, others were left out. Demographic details include; age, gender education status of butchers, working experience, number of days butchers used to work, number of birds slaughtered per day, and involvement of butchers in any other business. After that, the meat handling practices of butchers were assessed by observing the butchers for few minutes and hygiene assessment was carried out according to the hygiene assessment tool, i.e. PHI, MHI, and SFHI. Photography, interviews, visual observations, questionnaires, and recordings were the main tools of data collection.

2.4.3. Statistical analyses:

The effect of the education status of butcher on their total hygiene score was tested by using Pearson's correlation on SPSS. Value of $p < 0.05$ was considered as statistically significant while $p > 0.05$ is considered as insignificant. The total score was calculated by adding the score of personal hygiene, meat hygiene, and slaughtering facility hygiene of butchers.

3. Results

3.1 Location and infrastructure details

The poultry slaughtering facilities selected for hygiene evaluation were located in the market area and the residential area at 92% and 8%. All the slaughter shops were categorized into 2 types i.e., Open facility and shop with physical infrastructure (roof, walls, and flooring). Shops with proper physical infrastructure are having a solid floor, the permanent roof made up of cement concrete and walls. It has been found out that only 38% of the shops were having proper physical infrastructure and the remaining 62% were located at footpaths, roads sideways, or under flyovers with either temporary shelter or open to the sky.

3.2. Details of Socio-demographic and occupational characteristics of poultry butchers

The section illustrates the details on educational status, age, sex, and working experience of butchers, as presented in Table 2. It was shown from survey results that all the studied butchers were male. Most of the butchers involved were of different age groups, from 10 to > 50 years and their experience has been observed from 0 to > 40 years.

In terms of educational level, more than fifty percent of the respondents were uneducated. A broad classification of education status is shown in Figure 2 (a). Among the educated butchers, the primary level was a leading educational level which had 44.4% of respondents, followed by secondary level which had 33.3% of respondents, whereas higher secondary level had less representation of 13.60% of respondents and only one person (5.55%) had a graduation degree. None of them has got any kind of formal training for butchering. The source of training for the majority of the butchers was either their brother (20%), father (30%), friend (25%), or other relatives (25%) (Figure 2b).

3.3 Assessment of personal hygiene, meat hygiene, and slaughtering facility hygiene

Assessment of personal hygiene of butchers is shown in Table 3. All the studied butchers were wearing dirty clothes with bloodstains all over the clothes that could bring dirt and bacteria into meat handling areas and can easily contaminate the meat. None of the butchers was having any kind of protective covering, i.e. apron, hair cover, gloves, or footwear. Only 3 out of 50 butchers were having clean and trimmed nails. Moreover, 20 out of 50 butchers were wearing jewelry, which can collect dirt and harmful bacteria and fall into the meat or transfer to the customer. The butchers were claiming to wash their hands every time before and after handling meat, but when the researcher asked those to show the soap/hand wash, none of them were having it.

The meat cutting practices of butchers were observed by the researcher for 5 min or until one bird is slaughtered and it includes; availability of meat cutting slab/table in the shop, cleanliness of meat cutting areas, use of rust-free knife, condition of meat cutting tools and method of disinfecting the slaughtering tools. From the visual inspection of the shops, it was observed that all of the shops were having dirty meat cutting areas. Only 6% of the butchers were using rust-free knives. Upon asking the participant what they used for cleaning the knife, wooden plank, and other slaughtering tools, 64% indicated that they used water, 32% indicated that they used to clean their equipment by smearing with a piece of cloth and only 2 participants were having both water and detergent to clean their tools. Forty-two out of fifty butchers handled the money while handling meat, (Table 4). These observations firmly indicate the need for awareness among the butchers in providing hygienic meat.

The variables on the hygiene of slaughtering facilities recorded among poultry shops are shown in Table 5. All of the studied butcheries were having ample levels of flies and 30% of the shops were having stray animals (dogs/cats) around the butchery setting which may be vectors for many dreadful infections. The chickens were sitting in the cramped cages and their cages were contaminated with their fecal waste, which was causing the dreadful smell in the shops. Inadequate ventilation (62%) and poor lighting (56%) was also been observed in many shops and are indicative of poor meat quality because the air might get trapped inside and can host the pathogens (18).

Table 2. Socio-demographic status of butchers

Demography	N (50)	%
Sex		
Male	50	100
Female	0	0
Age		
10-20	7	14
21-30	13	26
31-40	10	20
41-50	14	28
>50	6	12
Years of butchering experience		
<5	8	16
6-10	5	10
11-15	11	22
16-20	10	20
>20	16	32
Number of days butchers worked per week		
5 days	0	0
6 days	3	4
7 days	47	94
Butchers involved in any other business		
Yes	8	16
No	42	84
Formal training of butchering		
Yes	0	0
No	50	100
Education status		
Literate	22	44
Illiterate	28	56

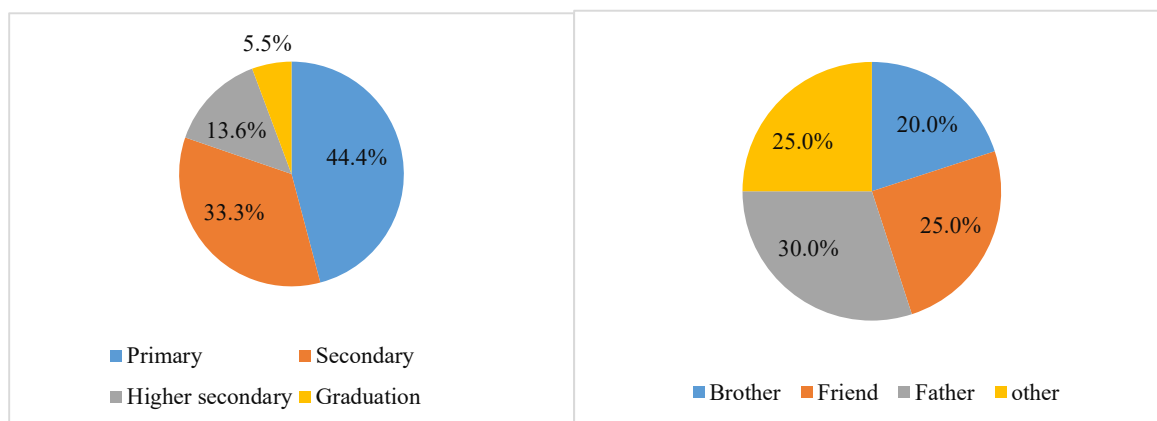
**Figure 2 (a).** Broad classification of the education status of butchers and **Figure 2 (b)** source of training for butchers

Table 3. Personal hygiene of butchers

Observation	N (50)	%
Clothing of the butchers		
Clean	0	0
Dirty	50	100
Wearing apron, gloves, and hair cover		
Yes	0	0
No	50	100
Wearing Jewelry		
Yes	20	40
No	30	60
Nails of the butchers		
Clean and well-trimmed	4	8
Dirty	46	92
Washing hands before cutting meat with soap & water		
Yes	0	0
No	50	100
Washing hands after cutting meat with soap & water		
Yes	0	0
No	50	100

Table 4. Meat hygiene assessment

Observation	N (50)	%
Cutting of meat		
On table/slab	39	78
On floor	11	22
Using rust free knife		
Yes	3	6
No	47	44
Condition of slaughtering tools		
Clean	0	0
Dirty	50	100
Disinfecting slaughtering tools with		
Water only	49	98
Water and detergent	1	2
Money handling by		
Main butcher	42	84
By Cashier	8	16

Table 5. Slaughter facilities hygiene assessment

Observation	N (50)	%
Presence of flies in the shop		
Yes	50	100
No	0	0
Presence of stray animals		
Yes	15	30
No	35	40
Unwanted smell in the shop		
Yes	50	100
No	0	0
Waste container		
Covered	0	0
Open	50	100
Ventilation in the shop		
Adequate	19	38
Poor	31	62
Lighting in the shop		
Adequate	22	44
Poor	28	56
Condition of Floor in the shop		
Clean	0	0
Dirty	50	100
Condition of walls		
Clean	0	0
Dirty	50	100
Birds storages		
Clean	0	0
Dirty	50	100
Clean water in the shop		
Available	0	0
Not available	50	100
Detergents/disinfecting materials in the shop		
Available	1	2
Not available	49	98

Hand wash, detergents, and clean water are major prerequisites of hygiene. Careful and frequent hand washing will do much to reduce contamination (8). Unfortunately, almost all of the studied slaughtering facilities were running without these basic hygiene facilities. No segregation between clean and waste material was found in most of the shops. All of the facilities were having garbage bins without cover with flies roaming over them.

The observations distribution regarding personal hygiene, meat hygiene, and slaughtering facility hygiene and their corresponding specific indices are shown in Figure 3. More than 30% of the butchers scored 0 out of 6 in PHI and none of the butchers scored greater than two. Fifty-six percent of the butchers got one out of six and only 6% have scored two out of six. This reflects the poor personal hygiene maintenance among poultry butchers. The MHI score also did not show more than three. Eighteen percent of the butchers scored a minimum score of zero out of five and more than sixty percent of the butchers scored one out of five. While only 20% of the butchers scored two. This reflects the unawareness of poultry butchers to handle meat adequately. As per the SFHL, 18% of slaughtering facilities got zero out of 12 and none of the slaughtering facilities scored more than three. Scores of one, two, and three were obtained by 30%, 32%, and 20% of the facilities.

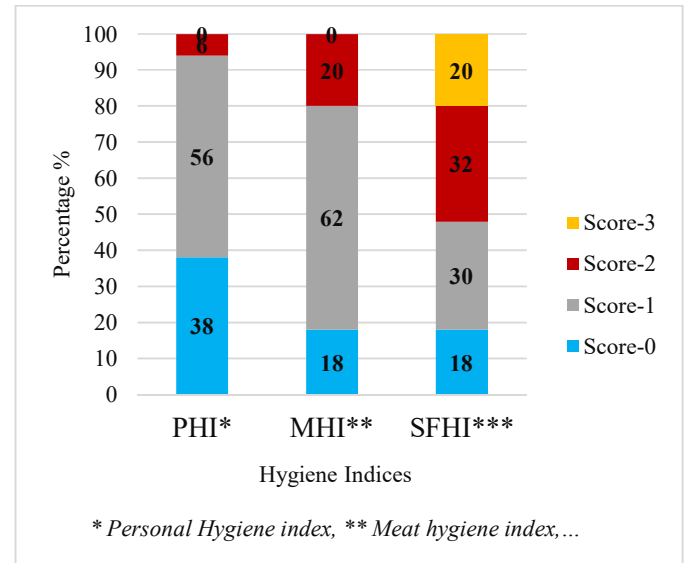


Figure 3. Specific hygiene indices distribution

3.4 Effect of education status of butchers on their hygiene score:

The Pearson's correlation test revealed that there is a significant difference ($p < 0.05$) between the educated and uneducated butchers. The butchers with a high level of education were comparatively better than those with no or less education.

4. Discussion

Management of proper hygiene and effective sanitation is an important element in the processing of poultry meat, as they significantly contribute to the prevention of contamination of the product by microorganisms, which cause diseases and deterioration in the origin of the food (19). The present study revealed that the majority of the meat handlers were illiterate (55%) and primary school dropouts (20%), contrasting results were obtained in Uganda, where more than 50% of butchers accomplished secondary level education (20). Likewise, Guru and Gebretinsae had reported that 58%

of butchers in Mekelle, Ethiopia, had taken butchering training to maintain personal hygiene while slaughtering (21), but in the current study, none of the butchers have got any sort of training. Even though numerous studies have indicated that food safety training is needed to improve food managers' knowledge, attitudes and safety practices (22).

Moreover, around one-fourth of the studied population had 11-15 years of Butchering experience but their hygienic practices towards meat handling were found to be very poor. Personal hygiene of those who come in direct or indirect contact with meat is a major requirement and an important part of meat hygiene. Butchers are required to maintain a high level of personal hygiene.

In this study, none of the butchers was wearing any sort of protective clothing, which is in agreement with the study conducted by Gurmuand Gebretinsae, where none of the studied meat handlers put on hair cover (21). Another study conducted in Nairobi Isiolo, also shown similar results that around 82% of the slaughtering workers did not wear protective clothing while slaughtering (23).

In addition, the guidelines of butcher shops by the veterinary regulation department suggest that meat handlers should frequently wash their hands with clean water and soap after touching anything liable to introduce contamination. In the current study, the results of the observational survey revealed that 42/50 butchers frequently handled paper money and coins while cutting birds and did not wash their hands. The same was noted by Chepkemoi et al in Isiolo and Nairobi were 87-90% of the butchers handled money and meat simultaneously (23). Overall slaughtering

facility hygiene in all 50 studied facilities was also found very poor.

Eleven out of fifty butchers were slaughtering on bare grounds and none of the shops were having clean slabs for cutting meat or clean meat cutting tools similar to the study conducted in the United Kingdom where chopping boards, food containers, equipment, and surfaces of food selling premises were dirty and bearing higher levels of pathogens (24). The butchers were so careless with the meat handling that the meat fell on the dirty floor and became infected. Added to the insufficiencies was the lack of adequate lighting.

Only one shop had detergent. However, including that shop, all the shops were lacking other prerequisites of hygiene such as dish wash, soap, etc. (Table 5). The U.S. Food and Drug Administration (FDA) classifies flies as contaminated and requires the elimination of flies and other pests from food and companies that make, package, or store food. Flies are also considered as an important vehicle for transmission of various diseases such as Salmonellosis, Shigellosis, and Cholera (25). All the studied slaughtering facilities in the present study had the problem of insects and flies in the shops, whereas, in a study conducted among street food sellers at Accra, Ghana, only 35% of shops had files inside shops (26). The presence of stray animals in the shops was also found in 30% of the slaughtering facilities. Stray animals may act as the source of many zoonotic diseases which makes the health of the public questionable (27).

Careful and frequent hand washing will do much to reduce contamination (8). Therefore, hand-washing facilities must be available in meat cutting areas and workers should be aware of washing their hands before

and after meat handling. Washbasin or any other handwashing facility was also lacking in all the shops and butchers were washing their hands either washing their hands with contaminated water from their buckets or wiping with the dirty cloth. Wiping hands with a common cloth during work is a hazardous practice, as revealed by a study conducted in the year 1986 that wiping cloths were heavily contaminated with pathogens (28). The use of birds' feathers for wiping hands was also found a common practice in the present study.

Clean and potable water is essential for the proper functioning of any slaughterhouse and must be easily accessible during slaughter, to clean and wash slaughtering equipment and workers' hands with adequate disinfection (7). In the present study all, the studied shops were running without it. It is necessary to provide trainings to workers who process meat to reduce microbial contamination. In these training courses, they should be informed of all precautions to be taken when cutting and processing meat.

5. Conclusion

Slaughterhouses are a part of the food industry and have to comply with common hygiene standards. The present investigation concluded in fifty poultry slaughtering facilities revealed the neglect of hygienic practices by meat handlers. The meat handling practices were not according to the recommended standards. To overcome these issues regular monitoring of these poultry butcher shops is needed.

Formal education to the butchers can be one of the important factors to improve the quality of poultry meat. Moreover, Strong policies should be suggested for establishing guidelines for disposal of slaughtered waste, and management, regular hygiene monitoring in various poultry shops of district Hyderabad as well as Jamshoro. Fines should be made on the butchereries so that they cannot violate hygiene while slaughtering. In addition, Individuals should be educated to improve food hygiene in their homes and vicinity.

Conflict of interest

The author declared no conflicts of interest.

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