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Occupational Health and Safety in a Meat Processing Industry

Almas Hamid, Syeda Amber Fatima and Zirwa Khalid

Kinnaird College for Women, Lahore, Pakistan

Abstract: The meat processing industries pose a high risk to workers due to accidents and minor injuries during work operation. The environment is also deteriorated due to waste water discharge and improper solid waste disposal. In order to study these conditions, environmental monitoring of different parameters was carried out during three different months in a year that included noise, particulate matter, light intensity, humidity and drinking water and waste water quality parameters. A questionnaire survey was conducted in the meat processing to have the views of employers and workers about environmental health and safety conditions. A checklist was made according to occupational safety and health act in order to ensure occupational safety. Hazard identification and risk evaluation was also done to highlight occupational conditions at the meat industry. The results of environmental monitoring showed that noise level in washing hall slightly exceeded in March and September that was 85.9 dB and 85.5 dB respectively from occupational safety and health act standard value. The level of particulate matter was higher when compared to world health organization (WHO) standard while according to national environmental quality standards; particulate matter in packing and production hall exceeded the standard value during study period. In Production hall it was 648 $\mu g/m^3$ while in packing hall it was 662 $\mu g/m^3$ and 595$\mu g/m^3$ in March and September respectively. Over all, light intensity was good. Humidity level was within the range except in washing hall where the value exceeded 61.5 % when compared to standard range. The drinking water quality parameters were in compliance with WHO. The results of waste water quality showed that it had high chemical oxygen demand and biological oxygen demand which suggest that there must be a water treatment technology at the meat industry. Chemical oxygen demand of water sample taken from finished goods section was 670 mg/l while water sample taken from cleaning of raw material section was extremely high. Biological oxygen demand of raw material and finished goods water sample was 167.4 mg/l and 169.2 mg/l respectively. The results revealed that safety and health committee is not present in the meat industry. The meat industry showed that it had high risk of infection in cleaning of raw material. Initiation of proper waste disposal mechanism, waste water treatment and good cleaning practices can lead to sustainable operation in the meat processing industry.

Key words: Occupational Safety · Health

INTRODUCTION

To meet the demands of the growing population for high quality and nutritious food, the meat processing industries play an important role. There are many industries in Pakistan which are focusing on meat processing.

Meat is considered as high in nutrient but the improper industrial processing leads to environmental, health and safety hazards. These hazards, if not encountered, lead to deleterious effects not only on humans but also on the environment [1].

All the activities associated with meat processing have a greater risk of accidents, injuries and diseases due to continuous movement of labourers in the work place in managing animal body and other meat products. Although technological advancement has led to a decrease in injuries but still the rate is high in meat processing industries because the mitigation measures are not properly implemented and the workers especially in developing countries are not aware of the working operations. As a result they do not place a pressure on the management for proper implementation of standard working procedures [2].

Corresponding Author: Amber Fatima, Kinnaird College for Women, Lahore, Pakistan.

Many chemicals such as nitric acid, hydrochloric acid, acetic acid and phosphoric acid are used in the meat industry. Animal cleansing is done through acetic acid. Although meat by products are converted into processed foods but still the waste water and waste generated effect the environment adversely. The waste generated is categorized into solid, liquid and gaseous waste. Gaseous waste includes release of ammonia from cooling system. Liquid waste include blood, waste water from washing processes while solid waste includes hair, bone, packing material such as plastic or card board, organic matter, casings process and suspended solids in washing[3].

The study area chosen was a natural casing industrytransforms the animal (Sheep/ goat) intestine into an edible food item. It is located at Raiwind Ijtema road, adjacent to Sundar industrial state, gate no# 3. The objectives of the study were to:

- Monitor environmental air and water quality of industry.
- Identify and evaluate health and safety conditions in the meat processing industry.
- Conduct a gap analysis of health and safety conditions in the meat processing industry.

MATERIALS AND METHODS

Data Collection: Primary data was collected through questionnaire survey, general observations and monitoring with different instruments.

Secondary data was collected from articles, books, journals, website and related organizations and from industry.

Meetings and discussions were held with the key officials of the study area team. This activity was aimed to achieve a common ground of understanding of the various issues of the study area.

Questionnaire Survey: A questionnaire survey was carried out. 50 workers participated in the survey. The questions included both the views of workers as well as employers. The questionnaire was knowledge and health based including open ended, close ended, multiple choice and scaled response questions.

Survey for Gap Analysis: A check list was also made to evaluate the environmental health and safety conditions in the meat industry and to conduct a gap analysis in comparison to OSHA's (Occupational Safety and Health Administration) standards.

Environmental Monitoring

Air Monitoring: In air monitoring, CEL-712 Micro dust Pro was used for measuring the dust level (Particulate matter) at the selected site. Monitoring was carried out at production hall, washing hall and packing hall.

Analysis of Drinking Water and Waste Water Quality Parameters: Different parameters of drinking water were determined. The water samples were taken from filter and bore water. The pH was monitored through pH meter. Total Dissolved Solid and Total Suspended Solids were measured through TDS and TSS meter. Hardness in water was measured through titration method. The pH and dissolved oxygen (DO) was determined immediately after collecting samples as with the passage of time their values would change.COD and BOD meter was used to measure COD and BOD respectively. The waste water sample was collected from cleaning of raw material section and finished goods section.

Determination of Temperature and pH: The tap was cleaned using a sterilizer and the bottle was handled carefully using gloves. Thermometer was used to measure the temperature of water sample. Thermometer was washed with distilled water and dipped in the beaker containing water sample. After 30 seconds the reading was recorded as the mercury stabilized to a constant value. In order to monitor pH, pH electrode was rinsed with distilled water. It was dipped in the beaker containing 30 ml of water sample in such a way that it should not touch the sides and bottom of beaker. After 30 seconds the reading was recorded.

Determination of Total Suspended Solids and Total Dissolved Solids: 30 ml of water sample was taken in a beaker to determine TSS level in the water sample. Filter paper was pre-weighed and marked as initial weight of filter paper then it was folded in a cone shape and placed in funnel. Water sample was filtered, air dried and placed in oven at 105°C for 1 hour. It was cooled down after 1 hour, reweighed and marked as final weight of filter paper. The difference between the weights gave the value of TSS. For TDS china dish was used. It was pre-weighed and marked as initial weight of china dish. Filtrate was added in china dish and placed on tripod stand. The filtrate was completely evaporated using a burner, re-weighed and marked as final weight of china dish. The difference between the weights gave the value of TDS.

Determination of Dissolved Oxygen: Dissolved oxygen meter 970 DO_2 meter JENWAY was used to measure oxygen level in water samples. Its operating principle is simple. The probe wasdipped into the beaker having water sample with keeping in view that the probe didn't touch the sides and bottom of the beaker. The meter was switched on and the reading wasnoted after 30 seconds. It also gives the temperature of the water sample.

Determination of Hardness: Hardness was analysed in environmental lab after collection from the source. Initially, 20 ml of water sample was taken from the collected water sample in a conical flask. 2 ml of buffer solution was added in the conical flask together with a pinch of eriochrome black T as an indicator, the solution turned into wine red colour. 0.02M of EDTA was taken in burette and its initial volume was noted. Titration was done against EDTA until the solution turned into blue colour. This was the end point; its final volume was noted. The difference between volumes showed harness in water samples.

Determination of Biological Oxygen Demand: In order to measure BOD, 5 ml of water sample was taken from the collected water sample in a bottle. Then 300 ml of distilled water was added. Its dissolved oxygen was measured using dissolved oxygen meter and marked as initial value of dissolved oxygen. Then it was placed in incubator at 20°C for 5 days. After 5 days the sample was taken out and dissolved oxygen was measured. It was marked as final dissolved oxygen. The difference between the values was multiplied by 300 and divided by the volume of water sample taken, this showed biological oxygen demand of water sample.

Determination of Chemical Oxygen Demand: For measuring COD, 1 ml of water sample was taken. It was added in 2 ml of vial solution in a vial and kept in COD apparatus for 2 hours.

Solid Waste: The solid waste was analysed by observation. The generation of waste per day and physical composition was analysed. Management and disposal procedures were noticed.

Noise Monitoring: Sound meter 840029 (SPER SCIENTIFIC) was used for measuring noise level in the industry. The instrument was placed at a distance of 7.5 m from the center of source. It measured the noise level in decibel (dB).

Light Intensity Monitoring: Lux meter Testo 540 was used to monitor light intensity in the study area. Its procedure is simple by switching on the device, the reading can be noted. It would measure light intensity in lux.

Humidity: Hygrometer HTC-1 was used to monitor the humidity level at the meat industry. The device was simple to use. It was placed at the selected location and the device automatically displayed humidity level.

Hazard Identification and Risk Assessment: Hazards were identified at the meat industry and were categorized into physical, biological and ergonomic hazards. Risk evaluation was carried out using risk evaluation criteria in order to ensure the significance of hazards at the meat industry.

RESULTS AND DISCUSSION

Environmental monitoring was carried out which was related to environmental health and safety hazards at the study area. Monitoring was done three times during the study period in three months, March 2015, June 2015 and September 2015. Their average values were calculated and compared to OSHA, NEQs and WHO standards.

Table 1 and Fig. 1 show the noise level in production, washing and packing hall of the meat processing industry. The noise level of production and packing hall did not exceeded OSHA standard during three different months in a year while noise level in washing hall slightly exceeded the standard value 85 dB given by OSHA in March and September which was 85.9 dB and 85.5 dB respectively. The noise level was higher in March because generator was operating at that time which was located near washing hall while in September the management switch to another generator which was of smaller size that decreased the noise level but it was still slightly higher than the standard value. This slightly higher value which can be controlled by switching towards sustainable procedure otherwise this may pose a health hazard to the workers working in the washing hall [4].

Table 2 and figure 2 show the level of particulate matter in the meat processing industry. It was compared with NEQ and WHO standards. According to the WHO standard, level of particulate matter was exceeding the standard value during three different months in a year. According to NEQs, in March the concentration of particulate matter in packing hall was 662 µg/m3 which is

Table 1: Noise level at the studied industry area

Sr no#	Month	Production hall / dB	Washing hall / dB	Packing hall / dB	Standard value OSHA/dB
1	March	78.9	85.9	77.9	85
2	June	80.7	83.4	73.5	85
3	September	79.8	85.5	76.7	85
Average		79.8	84.9	76	85

Table 2: Particulate matter level at the studied industry area

Sr no#	Month	Production hall / µg/m3	Washing hall / µg/m3	Packing hall / µg/m3	Standard value NEQs / µg/m3	Standard value WHO / µg/m3
1	March	Max = 389	Max = 374	Max = 662	550	150
		Ave = 230	Ave = 207	Ave = 545		
2	June	Max = 648	Max = 615	Max = 528	550	150
		Ave = 489	Ave = 448	Ave = 411		
3	September	Max = 518	Max = 493	Max = 595	550	150
		Ave = 359	Ave = 326	Ave = 478		

Table 3: Light intensityat the studied industry area

Sr no#	Month	Production hall / Foot candles	Washing hall / Foot candles	Packing hall / Foot candles	Standard value OSHA/ Foot candles
1	March	2.9	3.6	24	5
2	June	10.9	6.4	32	5
3	September	7.9	5	28	5
Average		7.2	5	28	5

Table 4: Humidity level at the studied industry area

Sr no#	Month	Production hall / %	Washing hall / %	Packing hall / %	Standard value OSHA/%
1	March	49	56	35	20 – 60
2	June	61	67	47	20 – 60
3	September	55	61.5	41	20 – 60
Average		55	61.5	41	20 - 60

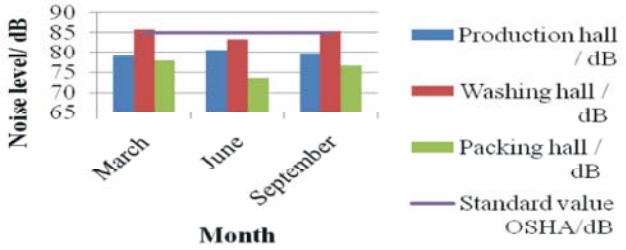

Fig. 1: Noise levelat the studied industry area

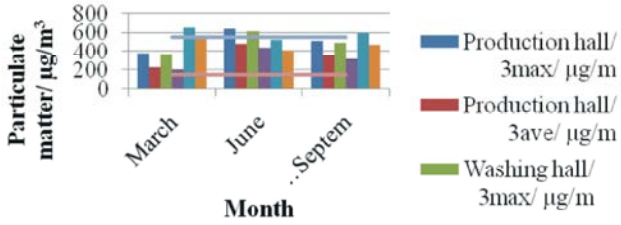

Fig. 2: Particulate matter level at the studied industry area

Fig. 3: Light intensityat the studied industry area

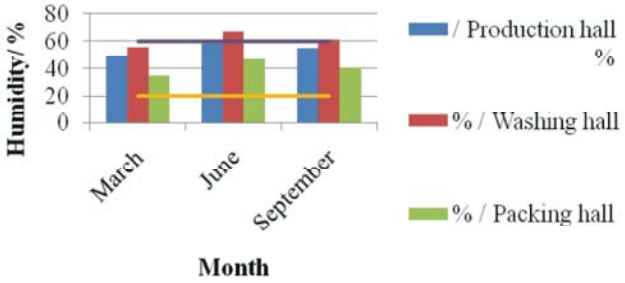

Fig. 4: Humidity levelat the studied industry area

higher than the limit. In June there was high level of particulate matter in Production hall and washing hall that was 648 µg/m3 and 615 µg/m3 respectively. While in September the level of particulate matter exceeded in packing hall that was 595 µg/m3. This was due to the use of salt for packing purpose. Fan was operating during the activity that resulted in increased particulate matter. Fan increased wind speed that caused the particulate matter to spread in air at work place [5].

Table 3 and figure 3 give the light intensity in the meat industry. The light intensity in the production and washing hall was less than the standard value 5 foot candles as suggested by OSHA which was 2.9 foot candles and 3.9 foot candles respectively, March. In March some of the light bulbs were not operating properly which resulted in less light intensity. But in June and September the light intensity was up to the standard value given by OSHA in production hall and washing hall. In June and September, light intensity in production hall was 10.9 foot candles and 7.9 foot candles while in washing hall it was 6.4 foot candles and 5 foot candles respectively. The light intensity in the packing hall exceeded OSHA standard during study period.

Table 4 and figure 4 represent humidity level in the three respective halls of meat industry that is production hall, washing hall and packing hall. In March the humidity level at the work place was within the OSHA standard range. While in June and September, humidity level in washing hall exceeded OSHA's upper limit. It was 67 and 61.5 respectively. This increased because the climate was hot in June and September. The humidity level at the work place during study period was not below OSHA's lower limit because of the use of fans and windows. Due to windows proper ventilation was provided and fans resulted in moisture control at the place [6].

Drinking Water Quality Parameters: Table 5 shows the drinking water quality parameters. The parameters of bore water and filtered water were compared with WHO standards [7]. The result of the drinking water quality parameters was also represented with the help of graphs. Fig. 5 shows that pH of filtered water and bore water was within the required standard of WHO that was 7.5 and 8.5 respectively. Dissolved oxygen (DO) was 5.46 mg/l in filtered water while in bore water it was 5.08 mg/l as represented in figure 6. The temperature was below 40°C both in filtered and bore water as shown in figure 7. According to figure 8, total suspended solids were present in negligible amounts in filtered water while 128 mg/l of total suspended solids were detected in bore water which was also not exceeding the standard value given by WHO. In figure 9, the concentration of total dissolved solid was represented. The total dissolved solids in filtered water were negligible while in bore water 760 mg/l of total dissolved solids were detected. According to figure 10, hardness in filtered water and bore water was 320 mg/l and 340 mg/l respectively which were not exceeding the standard value given by WHO.

Waste Water Quality Parameters: Table 6 shows waste water parameters. The pH of finished goods was 4.71 which are lower than NEQs [8]. This suggests that the waste water is acidic in nature [8]. The COD and BOD of waste water generated from cleaning of raw material and finished goods were 670 and 169.2 respectively. Exceeding the standard value [9]. COD in waste water generated from cleaning of raw material was very high. The results of the waste water parameters were also represented in figure 11 and 12 respectively.

Solid Waste: Solid waste was organic in nature. About 1 – 3 tons of solid waste was produced daily at casings industry. It included animal manure, mucosa and other contents apart from intestines. The organic matter was 99 % while 1 % was plastic material which was used during packaging.

Environment: Windows and exhaust was mostly used for ventilation. Only 20% people responded high roof also act as an efficient ventilation system in the meat industry that is shown in figure 13.

Table 5: Drinking water quality parametersat the studied industry area

Sr no#	Parameter	Filtered water	Bore water	WHO standards	Method Number
1	pH	7.5	8.5	6.5-8.5	ASTM D 1293 – 12
2	Dissolved oxygen/ DO	5.46 mg/l	5.08 mg/l	5 mg/l	ASTM D 888 – 12e1
3	Temperature	23.4°C	28°C	40°C	-
4	Total suspended solids/ TSS	Nil	128	1000 mg/l	D5907 - 13
5	Total dissolved solids/ TDS	Nil	760 mg/l	? 1000 mg/l	2540C (2012)
6	Hardness	320 mg/l	340 mg/l	500 mg/l	ASTM D 1126 – 12

Table 6: Waste Water Parametersat the studied industry area

Sr no #	Parameters	Unit of measure	Raw material	Finished goods	NEQs	Method number
1	pH		6.26	4.71	6 – 10	ASTM D1293 – 12
2	COD	mg/l	High	670	150	ASTM D1252 – 06 (2012) e 1
3	BOD	mg/l	167.4	169.2	80	ASTM D6283 – 98 (2011)

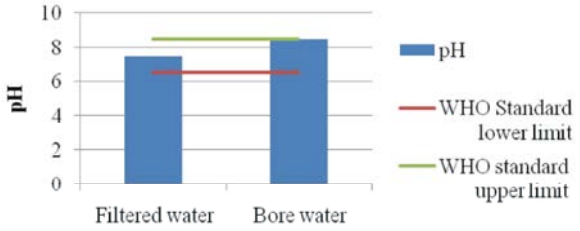

Fig. 5: pH of filtered water and bore waterat the studied industry area

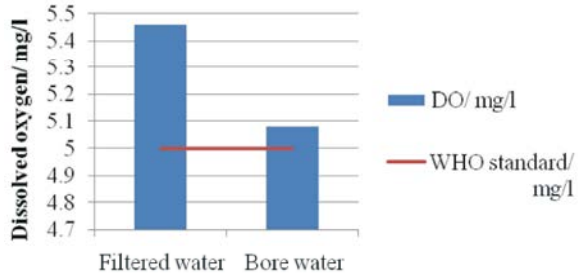

Fig. 6: DO of filtered water and bore water at the studied industry area

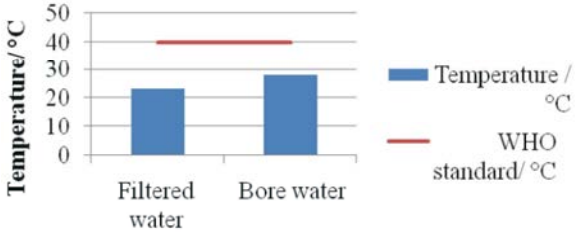

Fig. 7: Temperature of filtered water and bore waterat the studied industry area

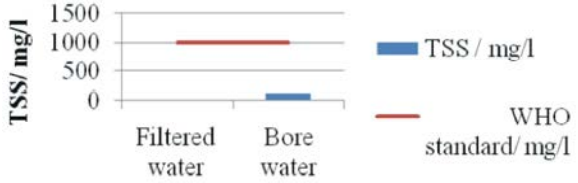

Fig. 8: TSS level in filtered water and bore waterat the studied industry area

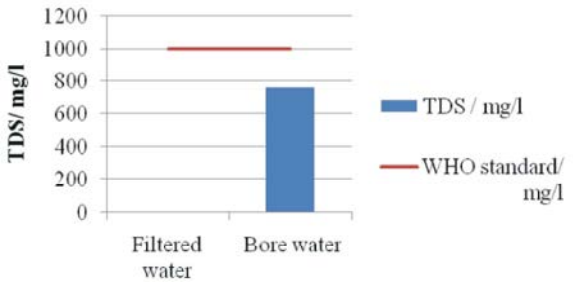

Fig. 9: TDS of filtered water and bore waterat the studied industry area

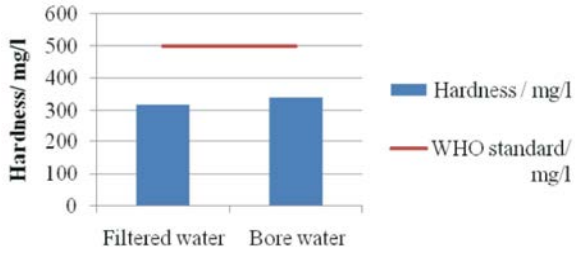

Fig. 10: Hardness of filtered water and bore waterat the studied industry area

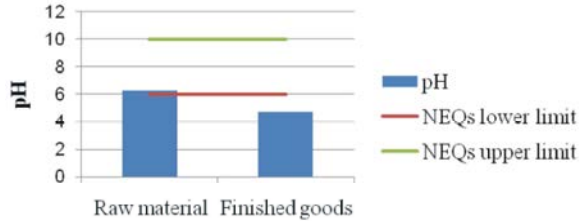

Fig. 11: pH of waste water sample at the studied industry area

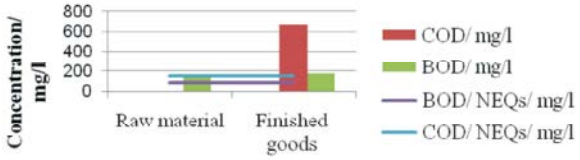

Fig. 12: COD and BOD of waste water sample at the studied industry area

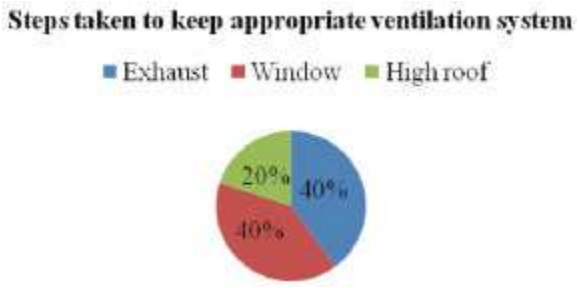

Fig. 13: Steps for ventilation system at the studied industry area

Infection Control: According to the employers appropriate steps were taken to control infections as shown in figure 14. Mostly anti- bacterial hand wash was used to prevent infections, some also responded to the usage of disinfectant for controlling infections which is shown in figure 15. According to figure 16, the hygienic practices were good overall only 30 % people responded that hygienic practices followed by workers were not appropriate to prevent infections because sometimes the workers skipped using hand wash and washed their hands just with water.

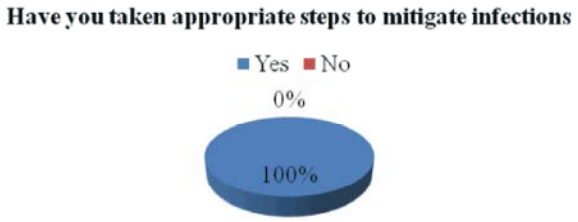

Fig. 14: Infection control at the studied industry area

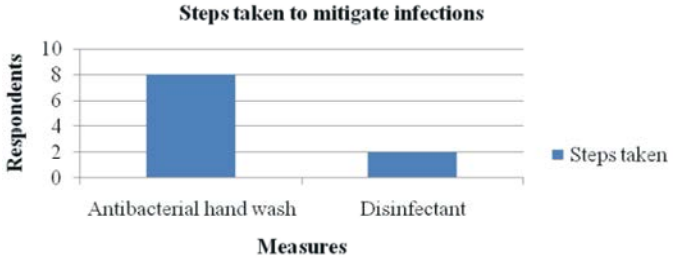

Fig. 15: Steps for infection control at the studied industry area

Fig. 16: Hygiene practiceat the studied industry area

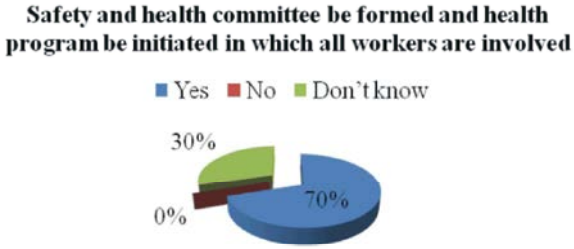

Fig. 17: Safety and health committee

Safety Committees: Safety and health committee deals with preventing injuries and illnesses at the work place. The people agreed largely that such committee should be established so that safe working environment for workers could be created, this is shown in figure 17. 30% people responded that they don't know about safety committee.

Questionnaire Survey: A questionnaire survey was carried out in order to demonstrate the views of the employers and employees about environment and health and safety conditions. The first section of the questionnaire results includes responses of managers while the second section includes the responses of workers.

Responses of Managers at Industry: Table 7 shows that there is no written health and safety program while 90% of employers agree that the workers are aware of the hazards related to their work activity. It shows that most people agreed that inspection records are beneficial in eliminating hazards, only 10 % disagreed that these are not helpful because they are ignored to some extent and everyone agreed that these are kept to identify unsafe conditions and practices carried out in the meat industry. Exit was made through an appropriate location that is through doors. Proper steps were taken to ensure that windows are not used as exits. The windows were covered with metal grill which cannot be used for exits. Fire extinguishers were installed at appropriate location.

Table 7: Opinions of managers about health and safetyat the studied industry area

Sr no.#	Questions related to knowledge and practices of managers for health and safety at the industry	Yes	No
1	Written health and safety program		100%
2	Workers awareness about health and safety hazards	90%	10%
3	Inspection records helpful in eliminating hazards	90%	10%
4	Carrying inspection records	100%	
5	Appropriate steps to make windows inaccessible	100%	
6	Installation of fire extinguishers at work place	100%	

Responses of Workers at Industry: The next section of questionnaire result includes responses of workers according to which in figure 4.18, 88% of the workers are familiar with the term occupational health and safety hazards.

Most of the people showed positive response regarding the accountability system, shown in figure 4.19. About 56% people agree that there should be an accountability system for managers and upper staff to carry out their health and safety supervision training and enforcement while 41% somewhat agrees with the statement. Only 3% disagree because they are not aware of the health and safety supervision. They agreed that accountability system should be established for managers and the upper staff to ensure that proper training is given to the employees and they perform their duties effectively.

Figure 4.20 shows that most of the incidents were reported about slips and cuts due to wet floors while 22 responded that they did not had any accident during their working activity.

Over all the relationship of employers with employees was good that is shown in Figure 4.21. Most of the people responded that they have good behaviour while no one responded to harsh behaviour.

Personal protective equipment such as aprons and boots were provided to the employees and these were kept in good and hygienic condition as shown in Figure 4.22 and Figure 4.23 respectively. The workers place their aprons in shelf and boots in shoe rack after their working activity. The shelf and shoe rack was located outside the working hall.

Injury and Illness Prevention: According to figure 24, mostly the people responded that managers are responsible for environment and occupational issues as they are the one to keep a check and balance on these issues while 16 people agreed that manager and employees both are responsible for these problems and only 7 responded that workers are accountable for these issues because the workers have to abide by the rules to ensure their safety.

Medical Services and First Aid: According to figure 25, more than 50% of the people agreed that inspection for the provision of medical services should be carried out when there is any emergency situation as they are unable to afford expensive medical treatment. They responded that this would help them cope with expensive medical charges and ultimately benefit their livelihood.

Safety Committees: Fig. 26 shows that mostly people wanted that inspection should be done on yearly basis. About 17 people responded that it should be done on monthly basis and only 1 said that it should be carried out on weekly basis in order to have thorough check.

Gap Analysis: A checklist survey was conducted that showed the environmental health and safety practices carried out at the meat processing industry. The result of the checklist was shown in Table 8. There was no safety and health program in print and there was no office or person for ensuring liability, regulations, risk reduction, conformity and review. No meetings or training sessions were carried out so that employees are encouraged to communicate about their issues regarding safety and health with employers. There were no periodic inspections regarding safety conditions and there was no incident and accident investigation program.

The hazardous conditions which were identified such as exposed wires were corrected immediately in order to prevent any accident.

According to table, the employees are familiar with the safety and health hazards associated with their work and when the workers are appointed, they are first trained for their work.

Whenever a new procedure, substance or any instrument is introduced in the working operation the employees are given training for it but the record is not kept for training each worker including the training dates and types of training. The manager has a labour-management safety and health committee.

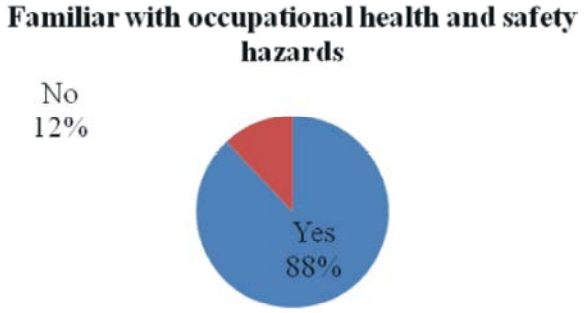

Fig. 18: Awareness of the term

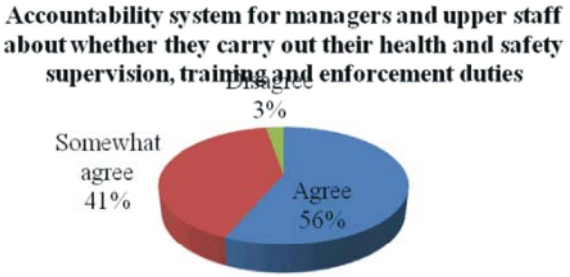

Fig. 19: Accountability system at the studied industry area

Fig. 20: Incidentsat the studied industry area

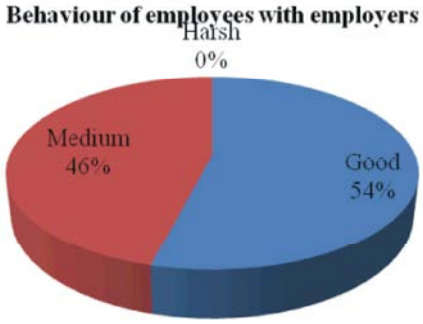

Fig. 21: Relationship with workers at the studied industry area

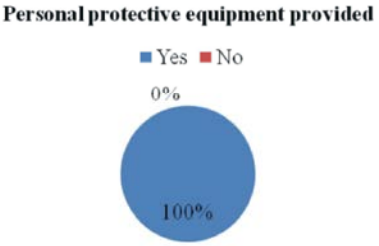

Fig. 22: Provision of personal protective equipment

Fig. 23: Condition of personal protective equipment

Fig. 24: Responsibility for environmental health and safety issues

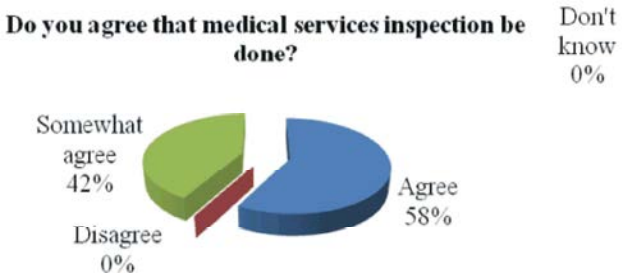

Fig. 25: Inspection of medical servicesat the studied industry area

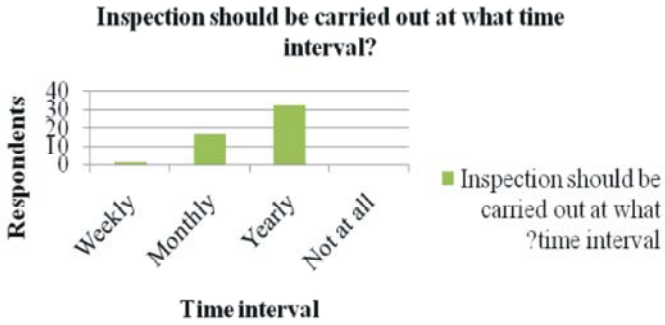

Fig. 26: Inspection and time interval

Steps for preventing environmental hazards are good overall. The hazardous substances which may result in any disease or illness are recognized. The ventilation system is adequate and is designed appropriately. The exhaust stacks are located at such a place that polluted air is not circulated back into the work place. Personal protective equipment are provided and used by the workers which include apron, boots and cap. The rest rooms and wash rooms are clean, dust bins are provided in order to throw litter. The water used for drinking, washing and cooking is safe except that all the work areas are not properly lighted and outlets of water which is un-adequate for drinking purposes are not recognized.

The exits are marked with a sign and lighted. They are adequate for escaping in an urgent situation. The exits are designed in a way that they do not cause any hindrance in the passage and all the windows which can be used as exits are covered with a grill.

Table 8: Gap analysis

General safety	YES	NO
Does the company have a comprehensive written safety and health program that addresses the following key elements:		
1. Management commitment;		
2. Employee involvement;		
3. Management and labor accountability;		
4. Incident and accident investigation policy and procedures;		
5. Safety training;		
6. Hazard identification and control; and		
7. Periodic program review.		No
Has responsibility for developing and monitoring the safety and health program been delegated to a person or office?		No
Has responsibility for carrying out the safety and health program been assigned to all levels of the line organization (Managers and supervisors) and employees?		No
Are managers and supervisors carrying out their safety and health supervision, training and enforcement responsibilities?		No
Is there an accountability system for ensuring managers and supervisors carry out their safety and health supervision, training and enforcement responsibilities?		No
Is there an accountability system for ensuring employees comply with safety and health rules and hazard/injury reporting responsibilities?		No
Is there a system that provides communication with affected employees on occupational safety and health matters (Meetings, training programs, posting, written communications, a system of hazard reporting, etc.)?		No
Does the communication system include provisions designed to encourage employees to inform the employer of hazards at the work site without fear of reprisal?		No
Is there a system for identifying and evaluating workplace hazards whenever new substances, processes, procedures or equipment are introduced into the workplace and whenever the employer receives notification of a new or previously unrecognized hazard?		No
Are periodic inspections for safety and health scheduled and carried out by managers and supervisors and the safety committee?		No
Is there an incident and accident investigation program?		No
Are unsafe and unhealthful conditions and work practices corrected immediately, with the most hazardous exposures corrected first?	Yes	
Do employees know the safety and health hazards specific to their job assignments?	Yes	
Is training provided to all employees when they are first hired and when they receive new job assignments?	Yes	
Are training needs of employees evaluated whenever new substances, processes, procedures, or equipment are introduced into the workplace and whenever the employer received notification of a new or previously unrecognized hazard?	Yes	
Are records kept documenting safety and health training for each employee by name or other identifier, training dates, types of training and training provider?		No
Does the employer have a labor-management safety and health committee?	Yes	
Environmental Controls		
Are hazardous substances identified which may cause harm by inhalation, ingestion, skin absorption, or contact?	Yes	
Are all local exhaust ventilation systems designed and operated properly (At the airflow and volume necessary) for the application?		
Are the ducts free of obstructions? Have you checked to ensure that the belts are not slipping?	Yes	
Are restrooms and washrooms kept clean and sanitary?	Yes	
Is all water (provided for drinking, washing and cooking) potable?	Yes	
Are all outlets for water (That is not suitable for drinking) clearly identified?		No
Are exhaust stacks and air intakes located so that contaminated air will not be recirculated within a building or other enclosed area?	Yes	
Exit or Egress		
Are all exits marked with an exit sign and illuminated by a reliable light source?	Yes	
Are there sufficient exits to permit prompt escape in case of emergency?	Yes	
Are doors which are required to serve as exits designed and constructed so that the way of exit travel is obvious and direct?	Yes	
Floor & Wall Openings		
Is the glass in windows, doors and glass walls (Which may be subject to human impact) of sufficient thickness and type for all conditions of use?	Yes	
Are grates or similar covers over floor openings, such as floor drains, of such design that foot traffic or rolling equipment will not be caught by the grate spacing?	Yes	
General Work Environment		
Are all work sites clean and orderly?	Yes	
Are work surfaces kept dry or appropriate means taken to assure the surfaces are slip-resistant?		No
Are all spilled materials or liquids cleaned up immediately?		No
Are the minimum number of toilets and washing facilities provided?	Yes	
Are all toilets and washing facilities clean and sanitary?	Yes	
Are all work areas adequately lighted?		No

Table 8: Continued

Hearing conservation		
Are there areas in the workplace where continuous noise levels exceed 85 dBA?	Yes	
Are noise levels being measured using a sound level meter or an octave band analyzer and records of these levels being kept?		No
Infection control		
Are employees potentially exposed to infectious agents in body fluids?	Yes	
Have occasions of potential occupational exposure been identified and documented?	Yes	
Has a training and information program been provided for employees exposed to or potentially exposed to blood or other body fluids?	Yes	
Have infection control procedures been instituted where appropriate, such as ventilation, universal precautions, workplace practices and personal protective equipment?	Yes	
Are employees aware of specific workplace practices to follow when appropriate (Hand washing, handling sharp instruments, handling laundry, disposing contaminated materials, reusable equipment, etc.)?	Yes	
Is the necessary equipment (Mouthpieces, resuscitation bags and other ventilation devices) provided for administering mouth-to-mouth resuscitation on potentially infected patients?		No
Are facilities/equipment to comply with workplace practices available, such as hand washing sinks, biohazard tags and labels, sharps containers and detergents/disinfectants to clean up spills?	Yes	
Are all equipment and environmental and working surfaces cleaned and disinfected after contact with blood or potentially infectious materials?	Yes	
Is infectious waste place in closable, leak-proof holders with proper labels?		No
Has medical surveillance including HBV evaluation, antibody testing and vaccination been made available to potentially exposed employees?		No
How often is training done and does it cover: universal precautions, personal protective equipment, workplace practices, needle stick exposure/management and Hepatitis B vaccination?		No
Injury and illness prevention program		
Is top management commitment evident?	Yes	
Is there a system in place to identify and control workplace hazards?		No
Are systems in place to ensure management and labor accountability?		No
Managers are generally accountable for safety supervision, training and enforcement of safety and health rules.	Yes	
Employees are generally accountable for complying with safety and health rules, reporting hazards and reporting injuries.	Yes	
Are procedures in place to investigate workplace accidents?		No
Is safety and health training provided for management and employees?		No
Are procedures in place to encourage and promote employee involvement in the safety and health program?	Yes	
Does management periodically evaluate the safety and health program?		No
Material handling		
Are materials stored in a manner to prevent sprain or strain injuries to employees when retrieving the materials?	Yes	
Is there safe clearance for equipment through aisles and doorways?	Yes	
Medical services and first aid		
Has an emergency medical plan been developed?	Yes	
Are emergency phone numbers posted?	Yes	
Are first aid kits easily accessible to each work area, with necessary supplies available, periodically inspected and replenished as needed?	Yes	
Personal protective equipment and clothing		
Are jobs or tasks assessed for hazards that require personal protective equipment?	Yes	
Are hazard assessments properly certified?	Yes	
Is training on the use, care and disposal of PPE conducted and documented?	Yes	
Are protective gloves, aprons, shields or other protection provided against cuts, corrosive liquids and chemicals?	Yes	
Posting		
Is the required OSHA safety poster(s) displayed?		No
Are emergency telephone numbers posted?	Yes	
Are signs regarding exits from buildings, room capacity, floor loading and exposure to x-ray, microwave, or other harmful radiation displayed?		No
Record keeping		
Are all occupational injuries and illnesses, being recorded on the OSHA Form 200?		No
Are copies of the OSHA Form 200 and First Report of Injury, Form 101, kept for five years?		No
Are employee safety and health training records maintained?	Yes	
Is documentation of safety inspections and corrections maintained?	Yes	

Table 8: Continued

Safety committees	
Is there an active safety committee in place?	No
Are records of safety and health training kept for employee by name, date, type and provider of training?	No
Does the committee meet at least once a month or as often by State OSHA rules?	No
Is a written record of safety committee meetings distributed to affected employees and maintained?	No
Does the safety committee conduct regular safety inspections or audits?	
Does the safety committee review the results of audits and offer recommendations?	No
Does the committee review accident and near-miss investigations and, give recommendations to mitigate future incidents?	No
Does the committee involve all workers in the safety and health program?	No
Has the safety committee developed safety programs, such as accident investigation procedures, according to State OSHA requirements?	No
Have safety committee members been trained and instructed in duties?	No

This shows that floor holes are covered with floor drains and the thickness of glass, windows and doors is of enough thickness to avoid any accident. The size of the floor drains is adequate that does not allow any equipment and foot traffic to be trapped.

The general work environment of the meat industry is moderately good. All the working areas are clean and organized. Sufficient and hygienic toilet facilities are provided but insufficient light is provided at some place. The floors are not dried and cleaned immediately in case of any spillage resulting in wet floors leading to the risk of slipping [5]. This is also shown in Figure 4.20 that the meat industry has high incidence of slipping.

The washing area has noise level which is slightly exceeding from 85 dB which is also represented in Table 1. There are no instruments such as sound level meter or octave band analyzer used to monitor the noise intensity at the industry.

The workers deal with infectious substances such as animal manure and mucosa. These are also recognized and documented. Training is provided to workers for this exposure and proper ventilation, personal protection equipment are provided and other universal precautionary steps are taken such as hand washing. The workers are conscious of the activities at their work place such as hand washing, use of sharp equipment and disposal of waste materials. The work place and all the instruments are cleaned with disinfectant but the provision of mouth pieces, resuscitation bags is not given to possible infected workers. The infectious waste such as animal manure, mucosa is not placed in labeled containers instead they are drained directly into the stream of effluent. There is no vaccination or evaluation done for any possible infection and no training is carried out for such purpose.

The management is committed to prevent injury and illness. The managers are liable for supervising, guiding and enforcing the safety and health regulations while the employees are liable to comply with these regulations and report management if there is any such case in the industry. The management encourages workers to participate in mitigation measures but lacks a system that can recognize hazards and liability. Health and safety training is not provided to the management and workers. The procedures are not established to examine the accidents and no intermittent evaluation is done regarding safety and health issues.

Material handling is good in the industry, the raw material is stored in plastic barrel and placed at appropriate location that does not cause back injuries in workers when they get the material out of it and the equipment used easily pass through the doors.

An emergency medical plan is developed by the industry. First aid kits are available at the time of an accident or injury. All the emergency phone numbers are listed and posted at an accessible location in the meat industry.

The hazardous work that requires personal protective equipment was examined. Aprons, caps and boots were provided to the workers to avoid any injury. The hazard assessment was authorized by HACCP. All the personal protective equipment were kept in a hygienic condition and are readily available. Training is given to the workers on usage and discarding of personal protective equipment.

The emergency phone numbers were posted at accessible location. There were no signs posted regarding exits, room capacity, floor loadings and OSHA poster is also not posted.

The record keeping at the meat industry was moderately good. Inspection and correction records are kept and the training provided to the workers regarding safety and health issues is recognized. The work related accidents and diseases are not recorded on OSHA form 200 and there are no copies of OSHA form 200 and form 101.

Table 9: Health and safety hazards at the industry

Physical hazards / Process		Biological hazards / process	Ergonomic hazards / process		
Falls	Maintenance	Infectious agents	Cleaning of raw material	Maintaining posture	Processing, contamination removing process
Noise	Cleaning of raw material	Flies and other pests	Cleaning of raw material	Repetitive movements	Cleaning of raw material, Packing
Electric shock	Washing, Maintenance			Work stress	All
Temperature extremes	Cold storage			Cramps, sprains in moving drums	Packing
Light intensity	Processing, contamination removing process				
Ventilation	Processing				

Table 10: Risk evaluation of health and safety conditions at the meat industry

			Risk assessment					Controls	
Work activity	Hazard category Health and safety	Identification of hazards	Severity	Frequency	Pobability	Significance	TrainingY /N	Y/N	Adequacy
Cleaning of raw material	Physical	Noise	2	1	-1	2	Y	N	No
	Biological	Infectious agents	4	3	+1	8	Y	Y	No
	Ergonomic	Repetitive movements	2	3	-1	4	Y	N	No
	Physical	Slips	2	3	+1	6	Y	Y	No
	Ergonomic	Work stress	2	2	+1	5	Y	N	No
Processing	Physical	Light intensity	2	2	-1	3	Y	Y	No
	Ergonomic	Maintaining posture	4	3	+1	8	Y	Y	No
	Ergonomic	Work stress	2	2	+1	5	Y	N	No
Contamination removing process	Phsical	Light intensity	2	3	0	5	Y	Y	No
	Ergonomic	Maitaining posture	4	2	+ 1	7	Y	N	No
	Ergonomic	Work stress	2	3	0	5	Y	Y	No
Packing	Physical	Noise	2	2	0	4	Y	Y	No
	Ergonomic	Repetitive movements	2	3	0	5	Y	N	No
	Ergonomic	Cramps, sprains in Moving drums	2	2	0	4	Y	N	No
Maintenance	Physical	Falls	4	1	-1	4	Y	Y	No
	Physical	Electric shock	4	3	+1	8	Y	Y	No

There is no safety committee that meets OSHA regulations regarding health and safety hazards. No records of instruction are maintained and no safety audits are conducted.

Hazard Identification and Risk Assessment: Hazards were identified and risk assessment was carried out at the casings industry as shown in Tables 9 and 10. The results showed that there is high significance of workers exposure to infectious agents. To control this they are using antibacterial hand wash and disinfectant but it further requires training as the workers experience skin diseases.

CONCLUSIONS

The meat sector has proven to be one of the prominent contributors of environmental health and safety hazards. The meat processing industries consume high amount of water for cleaning purposes and also consume energy for the refrigerator systems they use, leading to the generation of effluent which is discharge directly into the lake, river or sea. This disturbs the aquatic life thus disrupting the entire food chain. The workers are also at a high risk of injuries as they are in a constant motion and are not aware of good practices which are to be followed in the industry. The environmental conditions showed that there is no proper disposal mechanism in the meat industry and no waste water treatment technology. Without proper treatment technology water quality is being deteriorated and is a hazard not only for aquatic organisms but also for humans. The health and safety conditions at the meat industry suggestedthat it is lacking health and safety committee that can keep a check and balance on the safety, training and maintenance of these conditions. For fulfilling the requirement of sustainable operation, both the government and the industrial members have to work in coordination with each other so that cleaner operation is carried out.

Recommendations:

- Waste water treatment plant should be setup in industry premises because the results suggest that waste water has high amount of BOD and COD.

- Steps should be taken to keep the floor dry during working activity so that slipping could be avoided.
- A proper check on the use of personal protective equipment such as aprons, boots and cap should be taken.
- Hand creams should also be provided to workers in order to protect workers skin from excessive damage while working in water for long time.
- Signs related to room capacity, floor loadings and exits should be displayed.

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