

The personal and general hygiene practices in the deboning room of a high throughput red meat abattoir

S. Nel^a, J.F.R. Lues^{a,*}, E.M. Buys^b, P. Venter^a

^a School for Environmental development and Agriculture, Private Bag X20539, Technikon Free State, Bloemfontein 9300, South Africa

^b Department of Food Sciences, Faculty of Biological and Agricultural Sciences, University of Pretoria, Pretoria 0002, South Africa

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Abstract

Food handling facilities are under increased consumer and regulatory pressures to improve the micro-biological safety of perishable raw and ready-to-eat commodities. In this study workers from a deboning room of a high throughput abattoir were interviewed by means of a structured questionnaire to ascertain the knowledge, attitude, beliefs and practices regarding personal and general hygiene applied specifically in the deboning room. Basic hygiene practices were found to be in place and the workers adhered to the majority of these. The results, however, highlighted a need for improved communication between management and workers as well as a need for more training in personal and general hygiene. Although basic personal and hygiene practices such as the wearing of overalls and gumboots, as well as the cleaning and disinfection of equipment are adhered to, they need to be optimised in order to be effective. It is therefore advisable for all the requirements pertaining to personal and general hygiene to be re-evaluated, implemented and monitored by management to ensure that contamination of the final product by the workers inside the deboning room is minimized.

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1. Introduction

According to Gordon-Davis (1998) one of the major risks of food contamination originates from the working practices of food handlers and disease-causing micro-organisms present in or on the food handler's body are subsequently transported from the food handler to the food during the handling process. Frazier and Westhoff (1988) report that humans shed about 1×10^3 – 1×10^4 viable micro-organisms per minute. They add that a relationship exists between the numbers and types of such organisms and the working environment. Forsythe (2000) mentions that an estimated one in every 50 food handlers sheds around 10^9 pathogens per gram of faeces without showing any clinical manifestations of the related illness. Subsequently, poor personal hygiene practices such as negligence to wash hands after visiting the bathroom may result in up to 10^7 pathogens under

the fingernails of the food handler. Organisms originating from infected food handlers include *Salmonella* spp., *Shigella* spp., *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus* and faecal streptococci (Lawrie, 1998).

Because meat is such a highly perishable foodstuff and the abattoir, particularly the deboning room, is such a labour-intensive working environment, the knowledge and level of training of the food handlers regarding personal and general hygiene is of particular importance to ensure the health and safety of the consumer (Jay, 1996; Van Zyl, 1995). Furthermore Martínez-Tomé, Vera, and Murcia (2000) highlight the education of food handlers as a crucial line of defence in the prevention of most types of foodborne illnesses. To ensure that staff members conform to personal hygiene requirements two issues must be considered: (1) the environment within which the staff operates and the “quality” of the staff members. From a food hygiene point of view the quality of the working environment depends on the facilities or equipment provided, which include toilets and protective clothing. The quality of staff depends upon their health, their hygiene and their habits (Johns, 1991).

* Corresponding author. Tel.: +27-51-507-3134; fax: +27-51-507-3355.

E-mail address: rlues@tfs.ac.za (J.F.R. Lues).

According to Johns (1991) personal hygiene can be defined as follows: “as clean as is reasonably practical of hands, forearms, neck, hair and any clothing liable to come into contact with food.” Thus, the aim of the study was to assess the knowledge, attitudes, beliefs and practices of the food handlers regarding personal and general hygiene, to assess the level and quality of training, and finally ascertain the involvement of management in training, and in personal and general hygiene. The results from the study will be used in feedback to management, in order to effectively implement and maintain personal and general hygiene practices. Furthermore other meat processing plants to optimise their personal and general practices may use the results of this study.

2. Materials and methods

2.1. Questionnaire design

A questionnaire was compiled consisting of two sections designed to acquire the relevant information from the respondents. The structured interview was the method of choice because (1) the interviewer could follow a well-defined structure, preventing the respondent from own interpretation of the question, (2) it would allow more control over the interview process and people with no or low literacy levels could be interviewed, and (3) it would allow the interviewer to explain questions if unclear to the respondent (Czaja & Blair, 1996; Katzenellenbogen, Joubert, & Abdool Karim, 1997).

Both closed and open-ended questions were used in the questionnaire (Coggon, 1995; Sapsford & Jupp, 1996) and questions were put in a simple, concise and specific manner to prevent ambiguity (Katzenellenbogen et al., 1997). Care was also taken not to lead the respondents in answering the questions in a specific manner (Varkevisser, Pathmanathan, & Brownlee, 1995). A total of 37 questions were included in the questionnaire which was constructed in English, but during the interviews the interviewers translated the questions into the preferred language of the respondent, which included: English, Afrikaans, Zulu, Xhosa, South Sotho and Tswana.

2.2. During the interview

Prior to the interviews, arrangements were made with the management of the abattoir (one of only two Grade A red meat abattoirs in the Free State Province) and the deboning room (deboning between 25 and 40 tons of bovine meat daily) to obtain approval to interview employees, and also to utilise their facilities during the interviews (in South Africa, abattoirs are classified into

grades that are determined by the daily throughput of slaughter animals, with a grade A abattoir having the largest throughput of more than one hundred slaughtering units per day. Grade E abattoirs, on the other hand, have the smallest throughput of one to eight slaughtering units a day).

A hundred percent sample was selected (all the workers in the deboning area were included in the study) and the respondents were interviewed on a once-off basis during working hours with no prior notice of the interview. Before the interviewer commenced with the questions, he/she introduced him-/herself to the respondent and explained the purpose of the questionnaire and assured the respondent that the information would be handled confidentially. The interviewer also ensured that the respondent understood the objectives and importance of the study (Czaja & Blair, 1996).

2.3. Data analysis of completed questionnaires

The questionnaire were pre-coded and a code list drawn up. The questionnaires were analysed by hand using the code list and a data capturing sheet (Katzenellenbogen et al., 1997; Varkevisser et al., 1995). Finally, the data was presented in tables using frequencies and percentages.

3. Results and discussion

3.1. Employment status of the meat handlers

The respondents comprised of two groups, including permanent and temporary staff. “Permanent staff” refers to staff who are permanently employed at the abattoir, while “temporary staff” refers to those working on a contract basis. Twelve respondents (42.9%) were employed on a permanent basis whilst 16 respondents (57.14%) were temporary staff members.

3.2. Practices regarding the washing of hands

The human body is a reservoir for numerous microorganisms, with hands being the main agents for cross-contamination within a food handling establishment (Gordon-Davis, 1998). Jay (1996) reports that the hands of food handlers generally reflect the environment and also the habits of an individual.

In Table 1, all the respondents indicated that they always wash their hands before entering the deboning room. Legislation specifies that no person will be allowed to handle food if the hands of such a person are not washed (Republic of South Africa, 1999). In addition to the frequency, the procedure of hand-washing is also considered important. Upon asking the respondents what they used for hand-washing, 92.9% indicated that

Table 1
Practices of meat handlers regarding hand-washing during the deboning process

	Frequency (n) ^a	Percentage (%)
<i>Frequency</i>		
Always	28	100
<i>Means of hand-washing</i>		
Hot water and soap	26	92.9
Cold water and soap	2	7.1
<i>Availability of soap</i>		
Always	26	92.9
Most of the time	2	7.1
<i>Hand-drying</i>		
Disposable paper towels	28	100

^a The sub-categories were occasionally only answered by selected respondents and may not always include all 28 respondents.

they used hot water and soap, while 7.1% indicated that they used cold water and soap. Because hands are rarely free from micro-organisms (especially the bacteria *Staphylococcus aureus* that are present on the skin, nose and hair) it is of the utmost importance that soap (preferably in a dispenser) and hot running water are used for this purpose, thus aiming to reduce the micro-biological load on hands (Desmarchelier, Higgs, Mills, Sullivan, & Vanderlinde, 1999).

To ensure that the meat handlers wash their hands with hot water and soap, Van Zyl (1995) suggests that soap and hot water, at 45 °C, should always be available at the washing-basins. Regarding the availability of soap, 92.9% of the respondents indicated that soap was always available, while 7.1% reported that soap was available most of the time (Table 1). Desmarchelier et al. (1999) recommends that hand-washing alone has no effect on *S. aureus* counts on hands and continued that the reduction of bacteria on hands depends on the mechanical action, the duration and the type of soap and sanitizers being used.

The final step in hand-washing is drying. All the respondents indicated that they used disposable paper towels for this purpose. The usage of disposable paper towels is recommended due to its single use followed by disposal, which eliminates the possibility of cross-contamination (Hobbs & Roberts, 1993). It is stipulated in legislation that all wash-basins shall, at all times, be provided with an adequate supply of soap, together with disposable paper towels (Republic of South Africa, 2000).

3.3. Practices regarding protective clothing

Without exception workers reported that they wore overalls, hairnets, hardhats and gumboots. Van Zyl (1995) proposed that the overalls, hairnets (beardnets if

Table 2
Information on the wearing and cleanliness of protective clothing

	Frequency (n)	Percentage (%)
<i>Protective clothing</i>		
Overalls	28	100
Aprons	27	94.6
Hairnets	28	100
Beardnets	18	64.3
Hardhats	28	100
Gumboots	28	100
Stainless steel mesh gloves	24	85.7
Stainless steel apron	2	7.1
<i>Cleanliness of protective clothing</i>		
Washing of overalls		
Daily	27	96.4
Twice a week	1	3.6
Cleaning of gumboots		
Never	1	3.6
Always	27	96.4
<i>Stainless steel mesh gloves (sterilisation)</i>		
Not applicable (do not wear gloves)	4	14.3
After breaks	11	39.3
Daily	2	7.1
Visibly dirty or whenever there is a need	11	39.3

applicable), hardhats, gumboots and aprons (Table 2) should at all times be worn by meat handlers.

Because the purpose of wearing overalls is to protect both the food product and the meat handler from cross-contamination, overalls should be suitable to wear over other clothing (CFIA, 1990). The purpose of hairnets and beardnets is twofold: to prevent loose hairs and dandruff from falling into the food (primarily because hair is a probable source of *S. aureus*), and also to discourage the workers from running their fingers through their hair or scratching their scalps (Educational Foundation, 1992; Pelczar, Chan, & Krieg, 1993). All the respondents indicated that they wore hairnets, while 64.3% of the workers who had beards wore beardnets.

Although hardhats are also regarded as protective clothing, they fulfill a safety function (prevention of head injuries) rather than a hygiene function. All the respondents reported that they wore hardhats. In addition to protective clothing fulfilling a safety function, 85.7% wore stainless steel mesh gloves, while 7.1% wore stainless steel aprons underneath their clothing. The emphasis with regard to protective clothing should not only be on protection, but also on cleanliness. Twenty-seven of the respondents reported that they put on protective clothing on a daily basis. As indicated in Table 2, all the respondents indicated that they wore gumboots. Clean gumboots are just as important as clean overalls, because they may also be a source of contamination. Gumboots should therefore be washed at the facility provided (washing-basins supplied with

hot and cold water, liquid soap and a brush) before entering the deboning room (Van Zyl, 1995). Only one respondent (3.6%) indicated that he never washed his gumboots.

Stainless steel gloves also necessitate cleaning and sterilisation, but these gloves are difficult to clean, due to their woven construction (Van Zyl, 1998). Upon asking the respondents about the frequency of cleaning (water must be at 80 °C for sterilisation) 39.3% reported that they sterilised their gloves after breaks. Furthermore, a small percentage, 7.1%, sterilised their gloves on a daily basis while 39.3% sterilised their gloves whenever they were visibly dirty (usually full of fatty or bloody deposits). According to CFIA (1990) these gloves should be sterilised at regular intervals throughout the working shifts to prevent cross-contamination between the gloves and the meat. They should especially be sterilised when a source of contamination, such as an abscess, was cut open during the deboning process. Gill and McGinnis (2000) and Gill and Jones (1999) report that protective clothing such as the stainless steel mesh gloves harbour large persisting populations of bacteria. In a study done by Gill and Jones (1999), total aerobic counts circa a log mean of about 9.2 colony forming units (cfu) per stainless steel mesh glove were reported. Coliforms were recovered from about half of the stainless steel mesh gloves at log numbers of about 7.6 cfu per glove. *E. coli* however were only recovered from 2 out of the 25 stainless steel mesh gloves (Gill & Jones, 1999).

3.4. The practices and beliefs of the meat handlers regarding the reporting of illness

Because meat handlers are probable sources of contamination from micro-organisms, it is important that all possible measures be taken to reduce or eliminate such contamination (Mortimore & Wallace, 1994). One of the measures is to report illnesses to the supervisor or to management. In Table 3, 96.4% of the respondents indicated that they reported illness to management and only one respondent reported that he did not report illness to management. Trickett (1997) suggests that whenever a food handler experiences diarrhoea, sore throat, fever, cold or open skin lesions, he/she should be obliged to report the condition to the supervisor or to management. All the respondents who indicated that they had reported illness, also responded that whenever they reported an illness to management, they were sent for medical examination by the local on-site nurse. Hobbs and Roberts (1993) emphasise the importance and advantages of having on-site health services especially in large food handling establishments, with a large work force.

According to Jacob (1989) routine medical examinations of food handlers are of little value because they merely reveal the health status of the worker at a specific

Table 3
Practices regarding the reporting of illness

	Frequency (n)	Percentage (%)
<i>Report illness</i>		
Yes	27	96.4
Other	1	3.6
<i>Action of management</i>		
Medical examination	27	96.4
Other	1	3.6
<i>Medical examinations</i>		
Yes	8	28.6
No need	20	71.4
<i>Frequency of medical examinations (if yes) (n = 8)</i>		
Once a month	2	25
Annually	3	37.5
Before employment	3	37.5

point in time. The author further states that these medical examinations are unreliable and that carriers of pathogens are unlikely to transmit these organisms. In this study, a mere 28% of the respondents indicated that they went for routine medical examinations, while 71.4% indicated the opposite because they felt healthy and did not see the need to undergo medical examinations. Of the meat handlers who indicated that they underwent routine medical examinations, 25% underwent medical examinations once a month while 37.5% indicated that they underwent medical examinations either annually or on a once-off basis before employment (Table 3). Ziady, Small, and Louis (1997) explained that food handlers must undergo medical examinations before employment to assess the general health of the food handler. However, Jacob (1989) suggests that routine medical examinations are regarded as not being cost-effective and, in fact, unreliable.

3.5. The practices, attitudes and beliefs of the meat handlers regarding prohibited habits and actions inside the deboning room

In addition to the reporting of illness as a preventative measure of foodborne disease, regulations that prohibit smoking, eating and the wearing of jewellery are also regarded as preventative measures. All the respondents indicated that they did not eat or smoke inside the deboning room. Furthermore all the respondents indicated that they did not wear jewellery when they were handling the meat. Smoking inside the deboning room or whenever food is handled is prohibited, because whenever a cigarette is handled the fingers come into contact with the lips and saliva, together with micro-organisms, may consequently be transferred from the hands to the food (Burton, 1996). Smoking may furthermore cause coughing, thus transferring aerosols containing micro-organisms to the food (Gordon-Davis,

1998). Eating is also prohibited inside the deboning room and this activity should be confined to a designated room (CFIA, 1990). Jewellery is a potential source of micro-organisms, because the skin under the jewellery provides a favourable habitat for contaminating micro-organisms to proliferate (Trickett, 1997).

3.6. Information regarding the training of the meat handlers on personal hygiene practices

Table 4 represents information regarding the training of the food handlers on issues relating to personal hygiene. Fifty percent of the respondents indicated that they had received training in personal hygiene while the remaining 50% indicated that they had not received training. It was surprising that 57.1% of the respondents who indicated that they had not received training were permanent staff members, because it was expected that all permanent staff would have received training. The staff members who indicated that they had received training reported that 64.3% had received training from other meat handlers, whilst 14.3% had received training via video and slide courses, as well as from the supervisor. A further 7.1% had received training from the local nurse. 21.4% of the respondents reported that, although they had received training, the training was not effective, whilst 78.6% indicated that the training received had indeed been effective. The 21.4% of the respondents who indicated that the training was ineffective, suggested that more training was needed (Table 4).

Training and education of food handlers regarding the basic concepts and requirements of personal hygiene plays an integral part in ensuring a safe product to the consumer (Adams & Moss, 1997). To ensure this, there should be some form of induction training with regular updating and refresher courses for the food handlers. Meat handlers should furthermore understand the risks associated with contamination of food by micro-

biological agents, and should be trained to avoid the contamination of the meat. A formal employee training and assistance program (EAP) that describes all the training activities should be made attractive to the food handlers (CFIA, 1990). Ryser and Marth (1991) conclude that the training and education should be directed towards a thorough understanding of food hygiene, which includes aspects of sanitation.

3.7. Practices regarding the disinfection of equipment

The adequacy of a cleaning program is judged on the basis of the adherence to specified Standard Operating Procedures (SOPs) during the cleaning and disinfection process and the inspection of cleaned facilities and equipment (Gill, Badoni, & McGinnis, 1999). Gill et al. (1999) further reports that improperly cleaned equipment has been implicated in previous reported outbreaks of foodborne diseases and it is therefore apparent that cleaning and disinfecting processes should fully comply with regulations. Gill and McGinnis (2000) report that a primary source of *E. coli* deposited on meat during the deboning process appears to be the detritus in equipment which was not removed during daily cleaning. In addition Samelis and Metaxopoulos (1999) report that the processing environment are more implicated as a source of *Listeria monocytogenes* than live animals or carcasses and should therefore receive special attention during cleaning and disinfection. The absence of *L. monocytogenes* after cleaning and disinfection is indicative of an effective cleaning and disinfection program.

With regard to the frequency of cleaning and disinfection in this study, only one respondent indicated that he never disinfected his knife, whereas 42.8% indicated that they cleaned and disinfected their knives after breaks and during shifts (Table 5). Furthermore 25% of the respondents reported that they only disinfected their knives during shifts, while 10.7% indicated that they disinfected their knives only after breaks. The remaining 17.9% indicated that they disinfected their knives whenever they were excessively and visibly soiled with fat or blood.

The respondents were also questioned on the frequency of cleaning and disinfection of the working surfaces such as the tables and conveyor belt. A percentage of 78.6 reported that the surfaces were cleaned and disinfected before the commencement of work each day. Only 3.6% indicated that the surfaces were being cleaned and disinfected between shifts, while 14.2% indicated that the surfaces were being cleaned and disinfected during shifts.

The products and procedures applied to clean and disinfect the equipment are just as important as the frequency of cleaning and disinfection. Upon questioning the respondents regarding the procedures of cleaning

Table 4
Information on the training of the meat handlers

	Frequency (n)	Percentage (%)
<i>Receiving training</i>		
Yes	14	50
No	14	50
<i>Source (if yes) (n = 14)</i>		
Another staff member	9	64.3
Video's and slides	2	14.3
Clinic sister	1	7.1
Supervisor	2	14.3
<i>Effectiveness (n = 14)</i>		
Yes	11	78
No	3	21.4

Table 5
Cleaning and disinfection of equipment and surfaces

	Frequency (n)	Percentage (%)
<i>Frequency</i>		
<i>Knives and hooks</i>		
Never	1	3.6
Only after breaks	3	10.7
Only during shifts	7	25
During breaks and shifts	12	42.8
Excessively soiled	5	17.9
<i>Surfaces</i>		
Before commencing with work	22	78.6
Between shifts	1	3.6
During shifts	4	14.2
Weekly	1	3.6
<i>Means of disinfection</i>		
Hot running water	2	7.1
Hot running water and detergent	25	89.3
Cold water and detergent	1	3.6

and disinfection, a notably high percentage (89.3%) of respondents indicated that hot running water and detergent were used to clean and disinfect the surfaces. 3.6%, indicated that cold running water and detergent were being used to disinfect the surfaces. Two respondents (7.1%) reported, however, that only hot water was used to clean and disinfect the surfaces.

3.8. The level of contamination and effectiveness of the inspection procedure on the slaughtering floor

Table 6 shows the information obtained regarding the contamination of incoming carcasses that were ready to be deboned. Not all the respondents responded to these questions, which depended upon where they were working on the line inside the deboning room. 84% ($n = 25$) of respondents indicated that the carcasses were visibly clean whereas the remaining 16% indicated that the carcasses in general were not visibly clean when entering the deboning room, but contaminated with faecal material, hair, grease and even building material such as dry paint.

Table 6
Information regarding incoming carcasses ready to be deboned

	Frequency (n)	Percentage (%)
<i>Visible cleanliness (n = 25)</i>		
Yes	21	84
No	4	16
<i>Action upon encountering above (n = 23)</i>		
Notify management	12	52.2
Remove/trim	11	47.8

The respondents were also questioned on the frequency at which they encountered abscesses and Cysticercosis (measles). 21% reported that they encountered abscesses on a weekly basis, while 73.7% indicated that they encountered abscesses on a monthly basis. One respondent (5.3%) indicated that he encountered abscesses annually. Nine (42.9%) respondents indicated that they encountered measles on a weekly basis, while 57.1% encountered measles on a monthly basis. This indirectly gives an indication of the level of effectiveness of the inspection procedure during slaughtering.

The respondents were also questioned regarding the action they took whenever they encountered the abovementioned conditions. Twelve (52.2%) respondents indicated that they notified management, while 11 (47.8%) indicated that they removed or trimmed off the affected or contaminated areas. Aberle, Forrest, Gerrard, and Mills (2001) report that one of the major sources of carcass contamination is the live animal itself. According to Nottingham (1982) the hides, skins, faecal material and soil are the major sources of micro-organisms. In a study done by Hayes (1985), counts of 10^5 per cm^{-2} were found to be common on the hides of cattle. Therefore it is of the utmost importance that hygienic practices be employed in an abattoir during skinning and evisceration to ensure that bacterial counts be kept as low as possible (Lawrie, 1998).

Because hair and skin are possible sources of the organisms *B. cereus* and *S. aureus*, the presence of such material on the meat is an indication of lacking slaughtering and consequent inspection standards (Forsythe, 2000; Lawrie, 1998). Abscesses are furthermore known to contain very high numbers of various pathogenic organisms. Thus, whenever meat is found to contain abscesses it should be rejected (Church & Wood, 1992). Faecal material (a source of *E. coli* and *Salmonella* spp.) present on meat is a further indication of poor and inadequate slaughtering techniques. Therefore, according to the Committee on the Scientific Basis of the Nation's (1995), faecal contamination of meat during slaughtering is considered the single most important aspect to be kept in mind during sanitary slaughtering and dressing. It is therefore important to notify the supervisor whenever abovementioned conditions are encountered.

4. Conclusion

This study has attempted to cast light on the personal and general hygiene of the meat handlers of the deboning room of a selected South African high throughput red meat abattoir. The results indicated that there are some personal and general hygiene measures in place and that the workers adhere to the majority of them. However, the workers indicated that there is a

need for more effective training in both personal and general hygiene practices. This also served to indicate that the workers have a positive attitude towards personal and general hygiene. Some recommendations may be made on the basis of the information obtained from this survey.

Without exception only staff with the necessary credentials should be hired. These include qualifications or appropriate experience or alternatively the staff should undergo the necessary training to meet with the requirements prior to deployment. Management should strive to establish employee commitment regarding personal and general hygiene to ensure a safe product from the deboning room to the packaging area. Furthermore, continuous supervision over personal and general hygiene practices of the staff, by the supervisor or manager, is of the utmost importance in ensuring that staff conforms to the requirements and that healthy staff members are handling the meat throughout the deboning process.

Worker to worker training should be discouraged at all times and only a competent and educated person should be allowed to train the staff. Such a person should be responsible for training both new and established staff members in order to ensure uniformity in terms of training. Moreover, a cleaning schedule for the deboning room should be drawn up and its importance emphasised. Staff should furthermore be informed about the various responsibilities and the importance of adhering to the cleaning schedule at all times. Formal rules that ensure safe food handling practices and prohibit unsafe personal habits may additionally be drawn up. This will enable the supervisor to promptly address any deviations from these rules.

Finally, supervisors and managers should set an example by always conforming to the standards and rules regarding hygiene themselves, because if management is not taking personal and general hygiene seriously, then staff members will not do so either (Educational Foundation, 1992). High intention, sincere effort, intelligent direction and skilful execution should be part-and-parcel of the repertoire of both management and workers in order to function optimally to ensure a micro-biologically safe and wholesome product to the consumer.

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