Knowledge of food safety and hygiene and personal hygiene practices among meat handlers operating in western Romania

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A B S T R A C T

The purpose of this study was to determine the knowledge of food safety and hygiene and personal hygiene practices among 168 meat handlers operating in 11 meat processing units in western Romania. For this purpose a self-administered, multiple-choice questionnaire was applied, distributed and completed in May–July 2012. The meat handlers interviewed demonstrated a good level of knowledge, with a mean score of 10.34 on a scale of zero to 16, together with excellent practices with a mean score of 9.51 on a scale of zero to 12. Identification of microbiological and chemical hazards and hand hygiene, respectively, are the main deficient knowledge among those surveyed. The knowledge of study participants was significantly different according to education levels (p < 0.001) and professional training (p = 0.043) as shown by univariate non-parametric testing. In a similar way, practices differ significantly with education (p = 0.033) and meat industry professional training (p = 0.013). However, when controlling for the effect of the other variable, in the General Linear Model (GLM) framework, education is significant (p = 0.001) only in the case of knowledge and training is significant (p = 0.038) only in the case of practices. The study shows a significant positive correlation between the level of knowledge and practices of meat handlers (r = 0.681, p < 0.001). Although the results show a good level of knowledge and practices among the meat handlers interviewed, some aspects like identification of risks to food safety and hand hygiene remain issues that need to be emphasized in training programs in the Romanian food sector.

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1. Introduction

Even in societies with highly developed food safety systems such as the European “farm-to-fork” and the American “farm-to-table” approaches, a “weak link” can cause significant morbidity and mortality from foodborne illness (Lazou, Georgiadis, Pentieva, McKevitt, & Iossifidou, 2012). The European Food Safety Authority (EFSA, 2013) in a report published in 2013 shows that a total of 5648 foodborne outbreaks were reported in the European Union in 2011, causing 69,553 human cases, 7125 hospitalizations and 93 deaths. The most important food sources of the outbreaks were eggs and egg products, mixed food, fish and fish products and meat and products thereof.

Because meat is a highly perishable food, the knowledge and level of training of meat handlers (MH) in the meat industry in hygiene and food safety are of particular importance in ensuring the health and safety of the consumer (Nel, Lues, Buys, & Venter, 2004). In these circumstances MH training represents one of the most effective strategies to maintain under control the risks that may affect food safety.

As of 01 January 2006 Regulation (CE) no. 852/2004 (OJL139/30.04.2004) came into force in the EU, requiring that food operators be supervised and trained in food hygiene depending on the activities they carry. Although the requirements of Regulation (CE) no. 852/2004 emphasize the importance of training food handlers (FH), nevertheless several studies have suggested that increasing the level of knowledge through training does not necessarily lead to changes in the attitude and behavior of FH (Angelillo, Viggiani, Greco, & Rito, 2001; Baş, Ersun, & Kivanc, 2006; Clayton, Griffith, Price, & Peters, 2002; Ehiri, Morris, & McEwen, 1997; Gomes-Neves, Araújo, Ramos, & Cardoso, 2007).
In Romania training FH in food hygiene is mandatory, "the evidence of training and acquisition of basic hygiene knowledge is represented by a certificate ... with a validity of two years, after which training must be repeated" (MO 276/16.06.1999) and is prohibited "the employment and/or maintaining ... of personnel without a certificate of professional training on acquiring basic hygiene knowledge" as per HG no. 857/2011 (MO 621/01.09.2011).

In the Romanian meat industry several professional training programs are currently available to qualify operators in this sector as butchers, meat cutters etc. In order to complete such a training program operators must also acquire theoretically and practically, in addition to skills specific to their qualification, competences related to working space and equipment hygiene, work safety, personal hygiene and food safety and HACCP.

In contrast to food hygiene training, attending professional training programs available in the meat industry is not mandatory under national legal requirements. The completion of such a program remains at the discretion of the operators and employer.

The goal of this study is to determine the knowledge of food safety and hygiene and personal hygiene practices among MH operating in western Romania, and identify opportunities to improve training programs in this sector. According to the data known to us to date, this is the most comprehensive study in this respect in the Romanian meat industry. Previous studies conducted in Portugal, Iran and South Africa (Ansari-Lari, Soodbakhsh, & Lakzadeh, 2010; Gomes-Neves, Cardoso, Araújo, & Correia da Costa, 2011; Nel et al. 2004) were also focused on the knowledge and practices of MH.

2. Materials and methods

2.1. Structuring of the questionnaire

To conduct this study a self-administered questionnaire was designed, modified and structured on the basis of previous studies (Angelillo et al. 2001; Ansari-Lari et al. 2010; Gomes-Neves et al. 2011; Jianu & Chiș, 2012; Osaili, Obeidat, Abu Jamous, & Bawadi, 2011). The questionnaire was divided into three distinct parts: demographic characteristics, knowledge of food safety and hygiene and personal hygiene practices of MH, respectively.

The demographic characteristics focused, in addition to information about the age, sex, education level, work experience of the participants, also on information about the position at work, professional training for qualification of MH. Knowledge in the field of food safety and hygiene was assessed through 16 questions with 5 response options including the option "I don't know", to reduce the possibility of selecting the correct answer. They were aimed at the level of knowledge about food poisoning, cross contamination, time and temperature control and personal hygiene. This knowledge score ranged between 0 and 16, scores below 8 were considered as deficient knowledge. Personal hygiene practices of MH were investigated by means of 12 questions using the five-point Likert-type scale (never, rarely, sometimes, often and always). The score varied between 0 and 12, scores below 6 were considered as poor practices.

The questionnaire was accompanied by simple completing instructions concerning the purpose of the study and the fact that participation is confidential.

2.2. Companies participating in the study and the method of submitting the questionnaire

16 meat processing units in western Romania (Timis and Arad counties) were invited to participate in the study, the authors having no legal right of entry into these food premises. 11 units (approx. 69%) confirmed their participation in this study that was conducted in May—July 2012.

207 questionnaires were distributed by post to the HACCP team leaders in the companies that agreed to participate in the study. The HACCP team leaders distributed the questionnaires to the MH, monitored the evaluation process and subsequently returned to the authors of the study by post the completed questionnaires for correction and analysis. 185 questionnaires were returned, of which 17 questionnaires were not included in the study due to insufficient filling, the remaining 168 questionnaires (approx. 81%) were processed.

The reliability of the questionnaire used was tested in a pilot study in which 20 questionnaires were used. Based on the comments collected, in order to improve clarity, several questions in the final questionnaire were modified. These questionnaires were not processed in the final study.

2.3. Statistical analysis

The statistical analysis of the data obtained from processing the questionnaires was performed using IBM SPSS (Version 21.0. Armonk, NY: IBM Corp). In order to verify the soundness of the basic hypothesis in parametric testing, the Levene test was used to check the homogenous variance assumption and the Shapiro–Wilks test to verify the normality assumption. The normality hypothesis was invalidated ($p < 0.001$) for both knowledge and practices. For one grouping variable, i.e. professional experience, the Levene test rejected the hypothesis of equal variances ($p = 0.007$) in the case of practices. By consequence the omnibus tests for group differences were realized using Kuskal-Wallis/Mann–Whitney non-parametric test. The data set being unbalanced, with the number of observations ($N^2$) as low as three for the age group of twenty and below (Table 1), the exact significance, based on Monte Carlo simulation (10,000 samples), was considered. Because the overall difference test was found significant for one grouping variable with ordered levels, i.e. education, the Jonckheere–Terpstra multiple comparisons procedure, with Bonferroni correction, was applied in this particular situation. Variables found significant in the preliminary univariate analysis were further investigated using the General Linear Model (GLM) on ranked data. The interaction effect was tested using the aligned rank method. Spearman rank correlation coefficient was used to see how well knowledge and practice are correlated. The statistical significance was set at the 0.05 level.

3. Results

3.1. Demographic characteristics of the participants

The demographic characteristics of the participants in the study are shown in Table 1.

3.2. Comparative analysis of the knowledge and practices of MH

The median, mean and standard deviation of score values, besides the average score rank by the levels of the following variables: sex, age, education, professional experience, job description and professional training, are shown in Table 1. The Spearman rank correlation coefficient between the two question groups is 0.681 ($p < 0.001$), showing a statistically significant positive correlation between the levels of knowledge and practice.

3.2.1. Gender

There are no statistically significant difference between males and females, according to the non-parametric Mann–Whitney test.
regarding the scores of knowledge \((p = 0.108)\) and practices \((p = 0.560)\).

### 3.2.2. Age

Even if respondents in the 41–50 age group obtained the highest scores and respondents below 21 years the lowest scores, no statistical significant difference could be detected either in knowledge \((p = 0.440)\) or in practices \((p = 0.231)\) according to the Kruskal–Wallis test.

### 3.2.3. Education level

The omnibus Kruskal–Wallis test shows significant differences in knowledge \((p < 0.001)\) and practice \((p = 0.033)\) between education levels. For both variables a monotonic increase of the scores can be seen along the education level. The multiple comparisons procedure based on the Jonckheere–Terpstra test with Bonferroni correction reveals significantly higher knowledge of high school \((p = 0.002)\) and university \((p = 0.012)\) educated respondents over elementary educated, and also of high school educated \((p = 0.028)\) over lower secondary educated respondents. For practices the knowledge score is significantly higher for secondary school \((p = 0.036)\) and high school \((p = 0.021)\) educated when compared with elementary school educated respondents.

### 3.2.4. Professional experience

A monotonic increase can be seen up to the third level of professional experience in practices and knowledge, but a drop is revealed for professional experience of more than ten years. However, scores between the levels of professional experience do not differ significantly according to the overall Kruskal–Wallis test, either for knowledge \((p = 0.241)\) or for practices \((p = 0.122)\).

### 3.2.5. Meat industry professional training

Regarding professional training, there are significant differences between trained and untrained respondents, both in knowledge \((p = 0.043)\) and practices \((p = 0.013)\), according to the Mann–Whitney test.

### 3.2.6. Job description

There are no statistically significant differences between job positions (manager, supervisor and operator) in knowledge \((p = 0.140)\) and practices \((p = 0.578)\).

### 3.2.7. Education and training. A General Linear Model (GLM) approach

Two factors, education and training, were revealed as potential candidates in explaining knowledge and practice according to univariate analysis. The association between the two factors is not significant according to Kendall’s tau coefficient \((p = 0.540)\), but a certain degree of confounding between these two factors clearly exists. The percentage of trained participants is rising along the education level (13.6% for elementary education, 28.9% for lower secondary education, 35.3% for high school and 37.5% for university education). In order to further investigate the effect of each factor while controlling the other effect, GLM was applied on the rank-transformed scores of knowledge and practices as dependent variables. According to the aligned rank procedure, the interaction effect is not significant for knowledge \((p = 0.111)\) and practices \((p = 0.228)\) and hence not kept in the final models. The results of the final main effect models show that education is significant \((p = 0.001)\) and training not significant \((p = 0.135)\) in the case of knowledge, and education is not significant \((p = 0.072)\) and training significant \((p = 0.038)\) in the case of practices.

### 3.3. Quantitative results of knowledge and practices of MH

#### 3.3.1. Knowledge of MH

The passing percentage for the 16 questions that focused on the knowledge of MH about food poisoning, cross contamination, temperature and time control and personal hygiene was 67.3%, the average score recorded in this case being 10.34 (the score can range between 0 and 16) (Table 2).

71.43% of MH does not recognize animal waste, minced meat and meat carcasses as potential sources of contamination with E. coli, while only 56.54% of the operators know that the evaluation

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N°</th>
<th>Question group</th>
<th>Knowledge</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Med.</td>
<td>Average rank</td>
</tr>
<tr>
<td>Gender&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
<td>Male</td>
<td>97</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female</td>
<td>71</td>
<td>10</td>
</tr>
<tr>
<td>Age interval&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
<td>≤20</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21–30</td>
<td>41</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>31–60</td>
<td>61</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41–50</td>
<td>47</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥51</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>Education level&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
<td>Elementary</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower sec.</td>
<td>45</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High school</td>
<td>85</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>University</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Professional experience&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
<td>&lt;1 year</td>
<td>36</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1–5 years</td>
<td>72</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5–10 years</td>
<td>36</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;10 years</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td>Professional training&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
<td>Trained</td>
<td>52</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Untrained</td>
<td>116</td>
<td>10</td>
</tr>
<tr>
<td>Job description&lt;sup&gt;**&lt;/sup&gt;</td>
<td></td>
<td>Manager</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supervisor</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operator</td>
<td>146</td>
<td>10</td>
</tr>
</tbody>
</table>
of microbiological contamination of meat carcasses cannot be made visually, olfactory or by taste checks. 62.5% of those surveyed knew that microorganisms are growing rapidly at a temperature of 37°C and 72.61% of the operators correctly indicated diarrhea, vomiting, abdominal pain and fever as the most common symptoms of food poisoning.

Chemical hazards to food safety such as food additives, allergens and sanitation agent’s residues were correctly identified by only 41.07% of the operators. Approximately 72% of MH responded that chemicals used in sanitation processes must be stored separately from food products to prevent cross contamination. Most of those interviewed (87.5%) indicated pests, poor personal hygiene and improperly sanitized utensils as potential sources of cross contamination. At the same time 73.21% of those questioned knew that cleaning and disinfecting the thermometer probe prevents cross contamination when they check the temperature of a meat carcass with the same thermometer.

76.19% and 75.59%, respectively, of those surveyed knew the recommended temperature for the freezing and refrigeration of meat, respectively. The frequency of temperature monitoring in a cold store (three times a day) is known by 58.92% of MH. 70.83% of the operators responded that in order to check the temperature of a frozen pork carcass they insert in depth, “to the bone”, the disinfected probe of a calibrated thermometer.

Approximately 81% of the operators knew the correct way of washing hands which includes wetting, use of soap and hot water, rubbing for approx. 20 s, rinsing and drying hands with a disposable paper towel. However, only 32.73% of the respondents knew that there is no substitute for hand washing. Among the respondents approx. 63% know that in case of disposable gloves breakage it is necessary to remove them, wash hands with soap and water for at least 20 s and replace the gloves. 86.31% of MH responded that in case of an accidental cut the wound must be covered with a colored water resistant patch, and the incident reported to the shift supervisor.

### Table 3

<table>
<thead>
<tr>
<th>Question</th>
<th>Never n (%)</th>
<th>Rarely n (%)</th>
<th>Sometimes n (%)</th>
<th>Often n (%)</th>
<th>Always n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you consume food or beverages (e.g., coffee) inside processing areas?</td>
<td>139 (82.73)</td>
<td>23 (13.69)</td>
<td>6 (3.57)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Do you smoke inside processing areas?</td>
<td>151 (89.88)</td>
<td>11 (6.54)</td>
<td>6 (3.57)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Do you wash your hands after handling waste/garbage?</td>
<td>1 (0.59)</td>
<td>2 (1.19)</td>
<td>16 (9.52)</td>
<td>164 (97.62)</td>
<td>148 (88.09)</td>
</tr>
<tr>
<td>Do you wash your hands before and after using gloves?</td>
<td>3 (1.78)</td>
<td>15 (8.92)</td>
<td>50 (29.76)</td>
<td>63 (37.5)</td>
<td>148 (88.09)</td>
</tr>
<tr>
<td>Do you wash your hands after using the toilet?</td>
<td>–</td>
<td>–</td>
<td>1 (0.59)</td>
<td>3 (1.78)</td>
<td>164 (97.62)</td>
</tr>
<tr>
<td>Do you wash your hands after smoking, sneezing or coughing?</td>
<td>2 (1.19)</td>
<td>21 (12.5)</td>
<td>43 (25.59)</td>
<td>34 (20.23)</td>
<td>40 (40.47)</td>
</tr>
<tr>
<td>Do you wear a hairnet or a cap while working?</td>
<td>–</td>
<td>–</td>
<td>1 (0.59)</td>
<td>17 (10.12)</td>
<td>89 (89.28)</td>
</tr>
<tr>
<td>Do you remove your work equipment when using the toilet?</td>
<td>–</td>
<td>–</td>
<td>5 (2.97)</td>
<td>22 (13.09)</td>
<td>141 (83.92)</td>
</tr>
<tr>
<td>Do you remove your personal effects (e.g., rings, necklaces, hairpins) when you process foodstuffs?</td>
<td>1 (1.19)</td>
<td>1 (0.59)</td>
<td>6 (3.57)</td>
<td>21 (12.5)</td>
<td>138 (82.14)</td>
</tr>
<tr>
<td>Do you handle/process foodstuffs when you have fever?</td>
<td>148 (88.09)</td>
<td>17 (10.12)</td>
<td>3 (1.78)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Do you handle/process foodstuffs when you have infected cuts?</td>
<td>142 (84.52)</td>
<td>22 (13.09)</td>
<td>4 (2.38)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Do you report to the manager when you experience symptoms of food poisoning?</td>
<td>–</td>
<td>5 (2.97)</td>
<td>4 (2.38)</td>
<td>14 (8.33)</td>
<td>145 (86.31)</td>
</tr>
</tbody>
</table>

| % Passing* | 84.5% |
| Overall score (mean score ± SD)* | 9.51 ± 2.60 |

Note: The correct answers appear in bold.

* The percentage of MH who answered correctly more than 50% of the questions.

* The score scale ranges from 0 to 12.
3.3.2. Practices of MH

The passing percentage for the questions that focused on the personal hygiene practices of MH was 84.5%, the average score recorded in this case being 9.51 (the score can range between 0 and 12) (Table 3).

82.73% of MH reported that they never consume food or beverages (e.g., coffee) inside processing areas. Regarding the hand washing practices, 88.09% of MH report that they always wash hands after handling waste and 97.62% after using the toilet, respectively. Only 37.5% of those questioned always wash their hands after using gloves and 40.47% after smoking, sneezing or coughing. On the other hand, 20.23% of MH declare that they often wash hands after smoking, sneezing or coughing, while 25.59% report that they perform this operation sometimes. Almost all MH (89.28%) reported that they always use a hairnet or a cap and remove their equipment when using the toilet (83.92%). The self-reported hygiene practices showed that operators never handle food when they have fever (88.09%) and always report to the manager when they are suffering from a disease (86.31%).

4. Discussion

The questionnaire applied in this study allowed the identification of quantitative differences between knowledge of food safety and hygiene and personal hygiene practices among MH operating in western Romania. Score statistics by demographic groups show different interesting patterns that add new information to the canon of knowledge and practice. In this study the scores of knowledge and practice increase along experience up to 5–10 years of professional experience. On the other hand lower scores for the MH with over 10 years of professional experience cannot be explained only by theory regarding this factor alone. Nevertheless, the lack of statistical significance precludes drawing any conclusions regarding the experience effect. Moreover, group differences for gender, age and job description are also not statistically significant according to the performed tests. Univariate analysis reveals education and professional training as significant factors for both knowledge and practices in the meat industry. Both scores are monotonically increasing along the education levels. Pairwise comparisons for ordered alternatives show that, in general, scores obtained at a certain education description are also not statistically significant according to the performed tests. Univariate analysis reveals education and professional training as significant factors for both knowledge and practices in the meat industry. Both scores are monotonically increasing along the education levels. Pairwise comparisons for ordered alternatives show that, in general, scores obtained at a certain education level are significantly higher if compared to inferior levels of education. Çakrogül and Uçar (2008), Jianu and Chiş (2012), Martins, Hogg, and Otero (2012) and Tan, Bakar, Abdul Karim, Lee, and Mahyudin (2013) also report that the highest level of knowledge belongs to operators with higher education, along with statistically significant differences between different levels of education. One exception is represented by university educated respondents which do not have significantly higher scores for practices than less educated respondents (Table 1). The GLM model adds more refinement, revealing education as significant (p = 0.001) only in the case of knowledge and professional training as significant (p = 0.038) only in the case of practices. McIntyre, Vallaster, Wilcott, Henderson, and Kosatsky (2013) and Rebellato, Cholewa, Chow, and Poon (2012) also report in the case of operators professionally trained in the FOODSAFE and PROTON programs, significantly better practices compared with the group of untrained operators. Even if statistical significance does not imply causation, this finding is a supplementary argument, besides theoretical reasoning, favoring the conclusion that the level of knowledge is improved mainly by education and the quality of practices mainly by professional training.

Although meat handlers present an acceptable level of knowledge, this study identifies a number of gaps in their knowledge on food safety. More than half (56.54%) of respondents believe they can appreciate the degree of microbiological contamination of beef carcasses by visual, olfactory or taste checks. Similar results have been reported in studies conducted by Gomes-Neves et al. (2011), Giritlioglu, Batman, and Tetik (2011), Martins et al. (2012) and Walker, Pritchard, and Forsythe (2003). Among those questioned, 62.5% know that bacteria grow rapidly at a temperature of 37 °C, comparatively higher levels of knowledge being reported in the studies of Gomes-Neves et al. (2011) and Walker, E. et al. (2003). Only 28.57% of respondents identify animal waste, minced meat and meat carcasses as potential sources of contamination with E. coli, while Osaili et al. (2011) reported that fewer than 18% of those surveyed can indicate sources of contamination with E. coli.

The study demonstrates that MH have a high level of knowledge regarding the correct temperature for storing meat by refrigeration and freezing, respectively, superior to those previously reported by Gomes-Neves et al. (2011) and Ansari-Lari et al. (2010). While only 58.92% of the operators know the temperature monitoring frequency of a cold store, this level of knowledge recorded is higher than that previously reported by Jianu and Chiş (2012).

The knowledge about cross contamination shows that about 80% of the MH polled know the correct storage of chemicals, the role of pests, poor personal hygiene and improperly sanitized utensils as potential sources of cross contamination. Abdul-Mutalib et al. (2012), Ansari-Lari et al. (2010) and Osaili et al. (2011) reported in their studies a similar level of knowledge in this respect.

Cross contamination together with unprocessed contaminated ingredients, storage time/temperature abuse, inadequate heat treatment and infected FH represent the main factors contributing to the generation of foodborne outbreaks (EFSA, 2013). For the reduction of cross contamination Sneed, Strobhn, Gilmore, and Mendonca (2004) suggest the correct application of hand washing steps, training and ongoing supervision of FH, and also the application of periodically checked standard cleaning procedures.

Our study reveals that the proper hand washing steps are known by the majority of the operators interviewed (80.95%), similar results being reported in studies conducted by Gomes-Neves et al. (2007), Nel et al. (2004), Soon and Baines (2012), while Osaili et al. (2011) report a lower level of knowledge (51%). In contrast to this knowledge, 32.73% of MH know that there is no substitute for hand washing. These gaps still remain difficult to explain given that all the operators questioned had been trained in food hygiene and maintain high the danger of food poisoning.

Personal hygiene practices of MH are essential in order to achieve safe food products. The results recorded in this study reveal that approx. 85% of meat handlers show good practices in personal hygiene. The majority of MH report that they never consume food or beverages (e.g., coffee) and do not smoke inside processing areas, respectively, in agreement with the results previously reported by Ansari-Lari et al. (2010), Abdul-Mutalib et al. (2012) and Nel et al. (2004). 97.62% of those questioned report that they always wash hands after using the toilet. For a similar question Giritlioglu et al. (2011), Jevisnik, Hiebec, and Raspor (2008) and Tan et al. (2013) recorded similar results (98.8%, 93.2% and 95.3%, respectively), while Baş et al. (2006) reported deficient practices (21.2%). Nevertheless, 37.5% of them report that they always wash hands before and after using gloves. Rebellato et al. (2012) notes that 70.3% of FH trained in food safety report that they always wash hands before and after using gloves, respectively. Baş et al. (2006) report deficient practices in their study, only 8.1% of operators washing hands before and 3.8% after using gloves, respectively.

This study shows a significant positive correlation between the level of knowledge and practices of MH (r = 0.681, p < 0.001). These results are in agreement with those reported by Abdul-Mutalib et al. (2012), Sani and Siow (2014) and Tan et al. (2013) and in contrast to Ansari-Lari et al. (2010), indicating a significant negative correlation between the knowledge and practices (r = −0.20, p = 0.04) of MH from Iran.
5. Conclusions

This study demonstrates a good level of knowledge on food safety and hygiene together with excellent personal hygiene practices among the meat handlers interviewed. The gaps identified highlight the necessity of emphasizing topics such as the identification of risks to food safety and hand hygiene in training programs in the Romanian food sector. The study underlines the link between the level of education and the knowledge on food safety and hygiene, and, on the other hand, professional training and personal hygiene practices of the MH questioned. The results suggest the effectiveness of professional training programs in providing qualified and competent personnel in the Romanian meat industry. It is appropriate to extend the professional training requirements for all MH working in this area. However, these results are related to self-reported practices and cannot be directly extended to real practices. The results are also limited to the geographical area considered (Timiș and Arad counties). More complex surveys are needed in order to extend these conclusions to all Romanian meat handlers.

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References


