A system for collection and analysis of HACCP data in a poultry processing plant. A working example

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Summary

HACCP as a preventive system requires large amounts of data to be collected, stored and analysed to be effective. Some companies seem to have problems with setting up appropriate procedures to ensure efficient monitoring of parameters in CCPs.

The Department of Food Quality Management undertook research to create a cost-effective computer system for the collection and analysis of HACCP data.

A concept of a versatile system utilizing “open source” software was created and cooperation with a medium-sized poultry processing plant was established. The company had already implemented the HACCP system, but found it problematic to efficiently analyse data obtained from CCP monitoring.

The computer system was implemented in the company using the existing hardware and “open-source” software. Workstations located by the production line make possible the input of monitoring data into the SQL database and analysis of the collected data. The system reminds the operator to undertake appropriate countermeasures anytime the monitored values reach warning limits. The system allows viewing of monitoring results in form of tables or graphs, where nonconforming values are clearly marked. More sophisticated statistical analysis may be done with external programmes utilizing the export feature.

The data collection and monitoring system proved to be easy and fast to implement and very cost-efficient. It has been recognised as a useful tool by the company management, local veterinary authority and external auditors.

HACCP is an efficient preventive system for health hazards management, which became obligatory in the EU in 1993 (1). Legislation regarding the HACCP system in Poland has changed several times. The Act of May 11th 2001 on sanitary conditions of food and nutrition introduced the obligation of HACCP implementation, but only for large food processors (over 250 employees or 40 million Euro annual turnover). After long discussions finally the system became obligatory for all food businesses operating within the food chain since May 1st 2004, with an amendment to the Act on sanitary conditions of food and nutrition published on October 30th 2003. The amendment forced small and medium sized companies (under 250 employees and 40 million Euro annual turnover) to start implementation of HACCP rules, but left them very little time to fulfil the requirement.

The HACCP system requires a large amount of data to be collected, stored and analysed. The practical effectiveness of the system relies to a large extent on the proper choice of monitoring methods and further processing of the collected data. Visits to food processing plants prove that many of them seem to have problems with setting up appropriate procedures to ensure efficient monitoring of parameters in critical control points (CCPs) and utilizing the collected data to improve the effectiveness of their control over health hazards.

Taking into consideration both the changing legal status of the HACCP system and practical problems related to HACCP implementation, the Department of Food Quality Management decided to undertake research in order to create a simple and cost-effective computer system for the collection and analysis of HACCP data, which would help processing plants to manage health hazards more effectively. As the Department has significant experience regarding poultry processing and contacts within the industry, the system was planned to suit the needs of poultry processing plants. It was decided that the planned system must fulfil several requirements:
• Processing power: it must be able to store and effectively process large quantities of numeric data, which will be collected on-line.
• Easy to use: the system must be as easy to use as possible, so that even first-line employees with little computer skills will be able to use it;
• Cost-effectiveness: the system must be affordable, in terms of initial investment, costs of modifications and costs of maintenance;
• High level of safety for stored data understood as protection against erasing the data for technical reasons, but also as protection against unauthorized access to data;
• Inability to misuse the monitoring results (for example to correct the data once input in the system in order to fulfil any requirements at a later time).

As a solution the concept of a versatile computer system was proposed. The concept assumed the following solutions to lower the costs of implementation:
• The system would utilize the company’s existing ICT network and infrastructure to the largest possible extent;
• Where possible “open source” type of software would be used, especially operating systems, database software and web server software;
• Users would have access to the system via a web browser, therefore no extensive training is necessary to became acquainted with the new tool and the system is as user-friendly as possible;

As a second step, cooperation with a poultry processing plant was established to test the concept. The cooperating company is a medium-size facility which slaughters chickens and sells chilled or frozen chicken elements. The company had already implemented the HACCP system, which utilized paper documentation and paper forms for monitoring the critical control points (CCPs). There are six critical control points in the system:

CCP1: Admittance of live birds.
The veterinary documents of the flock are checked before the birds are allowed on the plant premises.

CCP2: Mechanical evisceration.
The efficiency of the evisceration process is monitored. Every hour a sample of 25 carcasses is checked to verify that evisceration was carried out without faults.

CCP3: Air cooling of carcasses.
The efficiency of the cooling process is monitored. Every hour the temperature of 3 carcasses is checked.

CCP4: Final processing of chicken breast fillets.
Effectiveness of final processing is monitored. Every hour a 20 kg sample of the product is checked to verify that no physical hazards are presents (fragments of bone and gristle, foreign objects, etc.)

CCP5: Final processing of chicken thigh meat.
Effectiveness of final processing is monitored. Every hour a 20 kg sample of product is checked to verify that no physical hazards are presents (fragments of bone and gristle, foreign objects, etc.)

CCP6: Cooling of breast fillets and thigh meat.
Efficiency of product cooling is monitored. Every hour the temperature of breast fillets and thigh meat is checked.

The monitoring system was set up according to HACCP rules and it ensures the proper health hazards management. Documents regarding CCP monitoring were stored in a paper form, which was enough to prove control over any of the CCPs in any period of time. The Quality Control Department, however, found it problematic to efficiently analyse data obtained from CCP monitoring. The company therefore expressed interest in the implementation of the concept described above.

The computerised system for the monitoring and analysis of HACCP system data was implemented. The system became operational using only the company’s existing hardware: Microsoft® Networking local area network, an old server and workstations (PCs). It consisted of the following elements:
A dedicated server working under the control of the RedHat® Linux operational system (RedHat® 8.0 was used, at the time of implementation distributed as free software under the GNU General Public Licence);
MySQL™ database software (included in RedHat® Linux distribution);
A dedicated database prepared specifically to reflect monitoring of the company’s critical control points;
Apache™ web server software (included in RedHat® Linux distribution);
A php script which enables access to the MySQL™ database to input data from CCP monitoring or check
Workstations running Microsoft® Windows® 98 operating system with a Mozilla Firefox™ web browser installed (for the ease of use a self-extractable version of Mozilla Firefox™ 1.0+ was used).

The software which was used was either already existent in the company, or is distributed freely as “open-source” software. The server dedicated for the system was in fact a 3 year old outdated Windows® server, which means that the company didn’t have to spend any money in the phase of implementation.

The system for the collection and analysis of HACCP data is accessible from any workstation in the company for authorized personnel via a web browser. The user must log on to the system with their specific user ID and password. Every record of data input in the system is signed with an appropriate user’s ID and local IP address. The system is divided into 2 parts, one for monitoring (input of data) and one for the analysis of stored data. After choosing the monitoring section, the user must choose one of the six CCPs (Figure 1). Then a data entry screen appears, which reflects the specific way of monitoring of a given critical control point (Figure 2). Each CCP is described to provide the user with additional information on the monitoring procedure. Data input by the operator is automatically saved in the database located on the server. Each row of data (record) is accompanied by a unique ID, user ID, his or her local IP address, time and date. Information which was once saved in the database is impossible for the user to modify afterwards. The system reminds the operator to undertake appropriate countermeasures and fill in a nonconformity report anytime the monitored values reach warning levels.

The second section makes possible viewing of monitoring results. After selecting this section from the main menu, the user must specify the desired CCP, and then the period of time for analysis. The default value is “the last 7 days”, but the user may specify the period of time in days or months, or give a range of dates. Finally the required data are shown (Figure 3) in the form of a table. Nonconforming values are marked in yellow (values exceeding the warning limit) or red (values exceeding the critical limit). For each data range it is possible to generate a graph with a single button click. The graphs are fully scalable, may be zoomed in and out, printed with or without the table of data, saved or exported in a vector graphics format (Figure 4). The nonconforming values are clearly marked with an appropriate colour. The statistical analysis may be done with external programmes utilizing the export feature of the script. Any range of data may be easily exported to a spreadsheet software such as MS Excel. The system automatically sets the name of an exported file as “CCPname_startdate_enddate”, which makes it easy to store tables or graphs as periodical reports on monitoring results (Figure 5).

The data collection and monitoring system proved to be easy and fast to implement, easy to use after just a short training, and very cost-efficient. At the moment methods of statistical processing of collected data are being researched to verify the process capability and give HACCP feedback information. In a year after the implementation the system has been recognised as a useful tool by the company management, local veterinary authority and external auditors.

References
Figure 1  Choice of a CCP for data input.

Figure 2  Data input screen.
Figure 3  Viewing the stored data.

Figure 4  Graphical presentation of a monitored parameter.
Figure 5  Saving the data from CCP monitoring.