A PROPOSAL ON SETTING PERFORMANCE OBJECTIVES FOR CAMPYLOBACTER AND EHEC IN MEAT INDUSTRY

Rahkio, M. and Kärkkäinen, T.
Finnish Meat Research Institute, P.O. Box 56, FIN 13101 Hämeenlinna, Finland

Background

Food Safety Objective (FSO) is the maximum level of a hazard, which still provides an appropriate level of protection in a food at the time of consumption. Governmental risk managers should evaluate the need for an FSO for a certain hazard and food combination. However, risk managers in food industry usually encounter the challenging task to implement these FSOs to HACCP (Hazard Analysis, Critical Control Points) - and GHP (Good Hygiene Practice)-plans so that FSOs are really met. A practical tool in this work, Performance Objective (PO) is the maximum level of a hazard in any specified food at a specified time of production before the consumption in order to ensure the achievement of an FSO. In the Proposed Draft by Codex Alimentarius (2004) on Microbiological risk management it is suggested that PO could be less stringent than the FSO for those food items, which are supposed to be cooked by the consumer. Nevertheless, if these food items can be a source of cross-contamination the PO and FSO could be the very same according to the Codex Alimentarius proposal (2004).

In year 2002 the National Public Health Institute in Finland reported 3738 cases of campylobacteriosis and 17 cases of EHEC infections (Enterohaemorrhagic E.coli O 157:H7) (KTL 2003). In most of these cases the connection with the causative food item was missing. According to Finnish strategy for zoonosis (MMM 2004) the progress of risk assessment for both Campylobacter and EHEC are among the national priorities in Finland. The parameters used are the number of reported human cases for Campylobacter and EHEC as well as the number of EHEC –isolates in cattle and the prevalence of Campylobacter in poultry. The aim is to lower the number of reported human cases and to decrease Campylobacter among poultry and to keep the existing low number of EHEC isolates in cattle.

There is a great seasonal variation of Campylobacter in Finnish poultry. About 10% of the herds are infected with Campylobacteria during summer months. From November to May infected herds are uncommon. According to Lahti et al. (2001) EHEC was isolated from 1,3 % of the 1448 bovine faeces samples taken at Finnish slaughterhouses in year 1997. In 2003 EHEC was isolated from 0,4% of the samples (EELA 2004).

Objectives

The purpose of this paper is to propose a model that could be used in establishing performance objectives for meat industry.

Materials and methods

There is a simple mathematical model, which illustrates the relationship between maximum level of a microbiological hazard in food, (Food Safety Objective, FSO), the initial level of the hazard in food (H_0), the reduction of hazard during process ($\sum R$) and the total increase in the level of hazard during distribution and the shelf-life ($\sum I$). In this model; $H_0 - \sum R + \sum I \leq FSO$, $H_0 \leq FSO + \sum R - \sum I$ the parameters are expressed in $\log_{10}$ units. (Stewart et al. 2003).

The model is practical for food items, which are ready-to eat and the reduction of hazard during process ($\sum R$) means the effect of heating or cooking. However campylobacter and EHEC are hazards in non-heated meat products, which are expected to be cooked at home.

Results and discussion

Campylobacter and poultry

The setting of Performance objective, PO is accomplished in two steps by estimating the initial safety level and by comparing this estimate to known initial levels of Campylobacter in food.

I Estimation of the safety level by identified tolerable intake

The Food Safety Objectives should be based on real risk assessment. Since there are no official Microbiological Food Safety Objectives for Campylobacter in poultry, the safety level of Campylobacter in poultry is estimated according to the identification on minimum infective dose.

The amount of Campylobacteria in a portion of cooked poultry should not exceed its tolerable intake. When the known infective dose is 500 cfu (NFA 2003) and it is considered as the tolerable intake, a 100 g portion of cooked poultry should not contain more than 500 campylobacterial cells. Thus the level of hazard should not exceed 5 cfu/g (0,7 $\log_{10}$). However, the safety level is estimated to be one thousandth of the tolerable intake, that is 0,005 cfu/g (-2,3 $\log_{10}$).

The model $H_0 - \Sigma R + \Sigma I \leq FSO$ is used for the situation at home kitchen. Supposing the temperature has been below 32°C during transportation and storage and no growth has taken place neither during the transportation nor during the storage at home kitchen, thus the H_0 for the home kitchen is the performance objective, PO for the industry. The reduction of hazard during home cooking is estimated to be as low as 3,5D, ($\Sigma R = 3{,}5$). The estimate of the safety level –2,3 $\log_{10}$ is used in this model instead of the FSO. ΣI is zero.

$H_0 \leq FSO + \Sigma R - \Sigma I$, when FSO = safety level = -2,3; ΣR =3,5: ΣI =0; H_0 = PO

$PO \leq \text{safety level} + \Sigma R - \Sigma I$

⇔

$PO \leq -2{,}3 + 3{,}5 - 0$

⇔

$PO \leq 1{,}2$

The performance objective of 1,2 $\log_{10}$ means that the level of Campylobacteria in 1 g of raw poultry could be 15 cfu/g before cooking at home. This level of hazard is the initial level of hazard before cooking and it is also the level of hazard, which is not supposed to be exceeded at the end of the industrial processing of raw poultry.

II Comparing the performance objective to the identified levels of Campylobacteria in poultry.

According to the Finnish National Food Agency (2003) in 1999 Campylobacter was found in 4,1% of the analysed poultry samples and the levels of Campylobacter were less than 90 MPN/kg, excluding two samples, which had levels of 200 MPN and 10500MPN/kg. If these results obtained by most probable number method are considered comparable to figures of cfu/g, it can be concluded that the highest levels of Campylobacter in poultry are 0,2cfu/g (-0,7 $\log_{10}$) and 10,5 cfu/g (1,02 $\log_{10}$). According to this published information on levels of Campylobacter, the PO of 1,2 $\log_{10}$ is not exceeded in the industry.

The levels of Campylobacter in poultry vary from country to country and between establishments as well. When comparing results, the analysing method used must be paid attention to. According to Stern and Robach (2003) the level of Campylobacter in broiler carcasses was 3.03 $\log_{10}$ (2,10-4.59) per postchilled carcass. Studies were made by rinsing method.

EHEC and food

When setting the Performance objective, PO is accomplished in two steps by estimating the safety initial level and by comparing this estimation to known initial levels of EHEC in food.

I Estimation of the safety level by identified tolerable intake

The Food Safety Objectives should be based on real risk assessment. Since there are no official Microbiological Food Safety Objectives for EHEC, the safety level of EHEC is estimated according to the knowledge on minimum infective dose.

The amount of EHEC in a portion of food like beef should not exceed the tolerable intake. According to the National Food Agency, the known infective dose is only a few cells. If the figure of 5 cfu is considered as the tolerable intake, dose of 100 g should not contain more EHEC cells than 5. Thus the level of hazard should not exceed 0,05 cfu/g (-1,3 $\log_{10}$). However, the safety level is estimated to be one thousandth of the tolerable intake, that is 0,00005 cfu/g (-4,3 $\log_{10}$).

The model $H_0 - \sum R + \sum I \leq FSO$ is used for the situation at home kitchen. The growth of EHEC is dependent on the temperature and is characteristic for the food. Supposing the temperature during transportation from industry to the retail shop has been less than 10 degree C, no growth has taken place. The growth during transportation from retail shop and during home storage can be estimated by predictive modelling programme (USDA PMP6). Supposing the transportation temperature is 18 degree C, the time is 2 h, the pH of the food is 6,9 and water activity 0,997, the growth during transportation that can be estimated is 0,13 $\log_{10}$. The growth during storage can be estimated by the same way. If this storage time is of 3 days at 10 degree C, the growth during storage is 1,11 $\log_{10}$ and $\sum I_0$ is 1,24 $\log_{10}$.

The initial level H_0 for the home kitchen is the performance objective PO and the $\sum I_0$.

$H_0 \leq MFSO + \Sigma R - \Sigma I$, when FSO = safety level = -4,3; ΣR =3,5: ΣI = 0; $H_0 = PO + \sum I_0$

$PO + \sum I_0 \leq \text{safety level} + \Sigma R - \Sigma I$

$\Leftrightarrow$

$PO + 1,24 \leq -4,3 + 3,5$

$\Leftrightarrow$

$PO \leq -4,3 + 3,5 - 1,24$

$\Leftrightarrow$

$PO \leq -2,04$

The performance objective of –2,04 $\log_{10}$ means that 1 g of food could have EHEC level of 0,0092 cfu/g at the end of the processing in the industry level. The in proper storage of food at 10 º C for 3 days at home is included in the estimation.

II Comparing the performance objective to known levels of EHEC

It's very rare to know the number of EHEC-bacteria in a food. Therefore reliable comparisons between estimated PO and real levels are not possible.

The estimated performance objectives are linked to the effect of home cooking. If the reduction effect of cooking at home is not taken into consideration at all, ΣR is zero and the performance objectives according the model would be much more stringent.

Conclusions

According to the model used in this paper, the estimated performance objective of 1,2 $\log_{10}$ for the Campylobacteria in poultry is not exceeded in the industry. If poultry meat is heated and cross-contamination is avoided at home kitchen, poultry should not be a risk and a source of Campylobacter infections.

However, a lot of research is needed before more exact estimations can be given. More information on the actual levels of Campylobacteria in poultry is needed and quantitative methods should be favoured instead of qualitative analysis. Instead of estimation of safety level used in this paper, proper national Food Safety Objective, FSO should be assessed for Campylobacteria in poultry.

The performance objective of –2,04 $\log_{10}$ for EHEC in food is estimated in this paper. However the quantitative information of EHEC levels does not exit and the practical achievement of this theoretical performance objective is not evaluated.

Both estimated performance objectives are dependent on the effect of cooking at home.

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