SPONGE VS EXCISION TECHNIQUE FOR CARCASS SAMPLING OF BEEF, LAMB AND PIG - INFLUENCE ON PROCESS HYGIENE CRITERIA AND MONITORING

B. Minvielle[1,2*], A. Le Roux[1], M.A. Fleury[2], V. Hardit[2] and J-C. Augustin[3]

[1]Department of Meat Quality and Safety, IFIP-Institut du Porc, La Motte au Vicomte, Le Rheu, France;

[2]Department of Meat Quality and Safety, IDELE-Institut de l'Elevage, Route d'Epinay sur Odon,Villers-Bocage, France;

[3]Ecole Nationale Vétérinaire d'Alfort, 7 avenue du Général de Gaulle, Maisons-Alfort, France.

*Corresponding author email: brice.minvielle@idele.fr

Abstract – European process hygiene criteria specify limits for the enumeration of Aerobic colony count and Enterobacteriaceae by the destructive sampling method on meat carcass surfaces. Prior to a potential use of sponge sampling method in French slaughterhouses for bacterial enumeration, its influence on the process hygiene counts, and on the hygiene monitoring of slaughtering process need to be investigated.
The present study was conducted in nine French slaughterhouses, with two types of sponge tested in comparison to excision (3 slaughterhouses/species, 3 sampling operators, 3 series of 5 carcasses). Animal species and sponge types significantly influence the difference between destructive and non-destructive methods, which are approximately 1 log lower than excision. The consequences on slaughter hygiene criteria and monitoring is discussed.

Key Words – destructive method, microbiological analysis, slaughterhouse.

I. INTRODUCTION

Several studies have been published on the comparison of destructive (excision) and non-destructive methods (swabbing-based) for the microbiological analysis of carcasses, in particular in Europe in the last decades. Excision is generally considered to be the most effective sampling method because it recovers significantly more bacteria than swabbing [1, 2, 3], but sponges has been considered a suitable method for the sampling of carcass surfaces [1, 2].
According to EU Regulation [4], meat operators must comply with process hygiene criteria specified for cattle, sheep and pig carcasses in terms of daily mean log cfu/cm² of Aerobic colony count (ACC) and Enterobacteriaceae (ENT). Whereas the regulatory limits shall apply only to carcass sampled by excision, other sampling method may be used if it can be demonstrated to the satisfaction of the competent authority that it provides at least equivalent guarantees.
In France, excision has been the reference sampling method to assess hygiene of carcasses and meat cuts for more than 20 years, and to monitor process (e.g. control charts) [5]. However, as the other process hygiene criterion Salmonella require sponge use [4], application of two different sampling methods on carcasses is laborious and time consuming.
The present study was undertaken to evaluate for beef, lamb and pork carcasses (i) the effectiveness of two type of sponge swabbing for the enumeration of ACC and ENT in comparison to excision sampling, (ii) the consequences on the calculation of process hygiene counts and the determination of alternative microbial limits, and (iii) the impact of the change of method on the hygiene monitoring of the slaughtering process.

II. MATERIALS AND METHODS

The present study was conducted in 3 French commercial slaughterhouses for each species (beef, lamb and pork), with sampling series of 5 carcasses performed by 3 abattoir operators, on 3 different days for each operator, in strict accordance to EU Regulation, recommendations of the French Directorate General for Food, and professional guidelines.
On each half of the tested carcass, triangular incisions of 12.5 cm² were excised from the surface of the 4 sampled sites, before chilling. The sponge swabbing method was then applied on each sampled site on an adjoining surface of 100 cm², two types of cellulose sponge (standard or attached to a stick) being alternatively tested on each half-carcass.
The initial microbial preparation was realized with 50 ml of diluent, before further homogenization, dilutions and plating. Enumeration of ACC and ENT were respectively performed according to ISO 4833 and ISO 21528-2 methods. Results were expressed as colony forming units (cfu) per square centimeter (cm²), and log10 transformed for interpretation. Enumeration thresholds were respectively 0 and -0.9 log cfu/cm² for excision and sponge swabbing. Data below these quantification limits were not included in the statistical analysis, and regulatory mean log of 5 carcasses (daily mean log) were not calculated if more than 2 carcass values were below the thresholds.

The effects of slaughterhouse, sampling method, and sampling operator were tested for ACC and ENT on individual (data not presented) and mean log results. The results expressed in terms of differences between the excision method and the sponge methods were analyzed for slaughterhouse and sampling operator effects, then for animal species, sponge types and bacterial indicators. Linear correlations with excision were calculated to assess the bias of sponge methods.

III. RESULTS AND DISCUSSION

Table 1 Average daily mean log of bacterial indicator, according to animal species and sampling method

Bacterial indicator	ACC*			ENT*		
Species \Sampling	Excision	Sponge	Stick Sponge	Excision	Sponge	Stick Sponge
Beef	(27) 2.79 [0.48]	(27) 1.61 [0.33]	(27) 1.89 [0.26]	(8) 0.72 [0.48]	(4) -0.71 [0.08]	(8) -0.50 [0.30]
Sheep	(27) 3.42 [0.38]	(27) 2.34 [0.42]	(27) 2.64 [0.45]	(15) 0.52 [0.22]	(15) -0.04 [0.53]	(14) -0.26 [0.36]
Pig	(27) 3.64 [0.30]	(27) 2.29 [0.32]	(27) 2.65 [0.36]	(27) 1.48 [0.48]	(26) 0.03 [0.49]	(26) 0.42 [0.66]

* (number of daily mean log) average daily mean log cfu/cm² [standard deviation]

As expected [1, 2, 3], for all species the daily mean log of ACC and ENT (Table 1) were significantly lower for sponge methods than for excision ($p<0.001$). The ranges of excision values were in accordance with data observed in France.
The differences of daily mean log between excision and sponging methods for both microbial indicators were not influenced by sampling operator despite practical difficulties for the standardization of non-destructive methods. When analyzed globally, animal species ($p<0.001$) and sponge type ($p<0.001$) had a significant effect on the differences of daily mean log, which have been previously reported [1, 3]. Differences of daily mean log were not significantly affected by bacterial indicator ($p=0.69$), contrary to that could be suggested by the values in Table 1 or published studies [1, 2].
Linear correlation coefficients between excision and sponge methods were respectively of 0.89 and 0.95 for standard sponge and stick sponge. The slopes of the regression lines for the sponges were close to 1, the bias due to non-destructive methods was thus considered for all species constant on the range of values of 0 to 5 log ufc/cm².
The average difference of regulatory mean log of 5 carcasses between the excision and the sponge swabbing methods was -1.07 log ufc/cm², with a standard deviation of 0.47 (n=249). This difference between excision and acetate sponges for surface carcass sampling was slightly higher than previously reported results, calculated on individual data [1, 2, 3].

IV. CONCLUSION

This extensive field study on the influence of sponge swabbing technique on the process hygiene criteria of beef, lamb, and pig carcass, in comparison to the traditional excision sampling, was conducted on a total of 405 carcasses sampled in 9 French slaughterhouses. The results confirmed that non-destructive method reduces the bacterial counts of approximately 1 log, with limited but significant influence of animal species and sponge type. Differences of means due to sponge swabbing were not affected by bacterial indicator, and appeared constant on the range of enumeration values. Implications for the determination of alternative ACC and ENT limits for carcasses are currently in discussion with the French Directorate General for Food. No significant impact is expected on the hygiene slaughtering process monitoring.

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