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DISTRIBUTION OF *LISTERIA* SPP. IN DUCK BREAST AND LIVER DURING GAVAGING, PLANT PROCESSING AND VACUUM-PACKING

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Summary

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The present research was carried out to investigate the prevalence of *Listeria* in 190 samples of duck breast and liver, obtained from three lots of ducks during gavaging (age of 79 days) and then, after slaughter processing and vacuum packing (age of 86 days). Seventeen feed samples were also studied. Data showed that contamination with *Listeria* spp. of gavaged ducks was 6.84% (13 specimens) and of feeds – 17.6% (3 samples). Positive swabs after slaughtering of ducks were 6 (4.3%) and those after vacuum-packing – 9 (6.4%). *L. monocytogenes* was found in 2.9% of all experimental specimens. The dominant serological group of *Listeria* spp. was II with 12 isolates followed by group I with 2 isolates.

Key words: duck breast and liver, food control, *Listeria* spp., *Listeria monocytogenes*

INTRODUCTION

According to data from The Community summary report and sources of zoonoses, zoonotic agents, microbial resistance and foodborne outbreaks, human listeriosis in the EU for 2006 was represented by 0.3 cases for every 100,000 people on average (Anonymous, 2007). One of the products that are observed for the presence of *L. monocytogenes* is the traditional French pâté, produced from duck liver (Lake *et al.*, 2002; Goulet *et al.*, 2006). The production of duck liver and breast fillet is traditional for some parts of Bulgaria, and a major part of the production is exported to Western Europe. Karakolev *et al.* (2003), performed a study to determine the presence of *L. monocytogenes* in frozen products (goose and duck liver/fillet), and proved that 4.76 % of the fillet and 4.92 % of the duck livers in the sample were contaminated by this human pathogen. Vitas *et al.* (2004) noted that it is necessary to not only prevent, but also to be aware of the presence of *L. monocytogenes* throughout the different stages of the production chain – from raw material to ready product. Escudero-Gilete *et al.* (2007) concluded that the presence of *L. monocytogenes* on the carcasses of slaughtered birds is caused mainly by cross contamination at the slaughter house, especially during categorization. According to Cruz *et al.* (2003), processing at a high pressure of 550 MPa

at 55 °C for 20 min, combined with two types of packing films (ethylene and vinyl-alcohol copolymer) leads to a longer storage period up to 90 days at 4 °C.

In some countries duck liver is traditionally served after minimal thermal processing, which is insufficient for the complete elimination of *L. monocytogenes*. This circumstance determined the goal of the current research – to establish the extent of contamination and determine the species variety of *Listeria* spp. during gavaging, slaughterhouse processing, and vacuum packing of duck liver and filet.

MATERIALS AND METHODS

The research included 190 samples (95 duck breasts and 95 livers) from 79-day-old ducks undergoing intensive feeding, with the aim of produce foie gras. The ducks were slaughtered at the farm, and individual samples of liver and of breast muscles were obtained in individual sterile bags.

To determine the presence of surface contamination after the regular slaughter and processing procedures (with separation of the liver and fillet) of 86-day-old ducks, 140 swab samples were taken from the liver and the breast muscles, right before vacuum packaging. To prove the presence of *Listeria* in the ready product, 70 liver and 70 muscle samples were collected from vacuum packs prepared for deep freezing. The material was obtained in sterile conditions and in-depth from the product.

Throughout the study, we also took 17 parallel samples of the feed used for gavaging. All samples were taken and stored in sterile bags, produced by Merck.

The microbiological study to prove the presence of *L. monocytogenes* and *Listeria* spp. was performed following the standards of BSS EN ISO 11290-1 (Anonymous, 1996). From each sample, 25 g were taken, cut into tiny pieces, and mixed with 225 mL Fraser Broth, containing ½ supplement concentration. The sample was then transferred to a thermostat for 24 hours, at 30 °C. Afterwards, the samples were enriched in Fraser Broth with a full concentration of supplement and put in thermostat under the same conditions. Inoculations were afterwards performed onto ALOA (Agar Listeria selon Ottaviani & Agosti) or Oxford/PALCAM agar. After incubation typical colonies were re-inoculated on trypticase soy agar with yeast extract (TSAYE agar) (Merck) and incubated for 24–48 hours at 30 °C. The identification of the species of *Listeria* was performed after Gram staining, measurement of motility at 20–25 °C, catalase and oxidase activity, and haemolytic activity. Species identification of the isolates was done through API *Listeria* test, produced by BioMériex. All proven *L. monocytogenes* isolates were serologically typified with O-Listeria sera (Bul-Bio, Sofia).

RESULTS

The tests of the 17 feed samples, fed to the lots of ducks included in the study, proved the presence of *L. monocytogenes* of serogroup II in 2 batches of food, and one sample contaminated with *L. innocua*.

The contamination with *Listeria* spp. during gavaging and within the ready vacuum-packed product ranged between 6.4–6.8% of all samples (Table 1). A lower percentage (4.3%) of *Listeria* was found in the swabs taken after processing and cutting of the birds. Table 1 shows that 6 out of 13 isolates in the samples taken during the gavaging process were

typed as *L. monocytogenes*, as well as 3 out of 9 samples of the ready product.

A complete predominance of *L. monocytogenes* was established in the swabs taken after the processing (5 out of 6 strains). The second most common strain was *L. innocua*, encountered in a total of 12 isolates, and *L. grayi* – in 2.

Among *L. monocytogenes* isolates, those from group II were predominant (12 cases). Two isolates from the feed samples were also from this serogroup. Only 2 isolates were typified as belonging to group I (Table 2).

DISCUSSION

Obtained values for *Listeria* spp. contamination during the gavaging and of vacuum-packed products are evidence for the connection between these two technological processes. The low percentage found in the washings was indicative for contamination on the surface, related mostly to post-contamination due to the different technological manipulations.

Presence of the human pathogen *L. monocytogenes* was noted in the studied samples and it could be explained by secondary contamination from the

Table 1. Data for presence of *Listeria* spp. in duck breast and liver during production chain

Products	n	Number (%) of positive samples				Total number (%) positive samples
		L. monocytogenes	*L. ivanovii*	*L. innocua*	*L. grayi*	
Listeria-positive samples from 79-day-old ducks in process of gavaging						
Duck breast	95	4 (4.20)	0	3 (3.15)	1 (1.05)	8 (8.40)
Duck liver	95	2 (2.10)	0	3 (3.15)	0	5 (5.25)
Total	190	6 (3.15)	0	6 (3.15)	1 (0.54)	13 (6.84)
Listeria-positive samples (swabs) from 86-day-old ducks after slaughtering						
Duck breast	70	2 (2.85)	0	1 (1.4)	0	3 (4.3)
Duck liver	70	3 (4.30)	0	0	0	3 (4.3)
Total	140	5 (3.60)	0	1 (0.7)	0	6 (4.3)
Listeria-positive samples from vacuum-packed duck products, ready for sale in retail stores						
Duck breast	70	2 (2.85)	0	4 (5.7)	0	6 (8.55)
Duck liver	70	1 (1.40)	0	1 (1.4)	1 (1.4)	3 (4.25)
Total	140	3 (2.15)	0	5 (3.6)	1 (0.7)	9 (6.40)

Table 2. Serological groups of *Listeria monocytogenes* isolates

Serological group	Isolates during gavaging		Isolates after slaughtering		Isolates from vacuum-packed products	
	breast	liver	breast	liver	breast	liver
Group I	1	0	0	1	0	0
Group II	3	2	2	2	2	1
Total	4	2	2	3	2	1

processing equipment and the performed manipulations.

Comparison of our data with the results of Karakolev *et al.* (2003) for the ready vacuum-packed products showed that in the current investigation, twice lower contamination values were encountered (2.85% of fillet samples and 1.4% of liver samples, with the results of the abovementioned authors being 4.76 % and 4.92 %, respectively). The same authors noted that all isolated strains belonged to O-serogroup I, while our isolates belonged mostly to group II. A large number of authors have determined *L. monocytogenes* serovar 4b of group II, as the main cause of listeriosis in humans, and considered the strains of this serovariant to be significant for control and prevention of the disease (Wagner & Allenberger, 2003; Lukinmaa *et al.*, 2004).

Regulation 2073/2005 (Anonymous, 2005) introduced mandatory *L. monocytogenes* contamination control for all ready-to-eat products. The complete elimination of this human pathogen is assured after in-depth thermal processing achieving 72 ^{o}C for 15–20 s. Specific national traditions in consuming minimally thermally processed food exist, as is the case with foie gras in France, Belgium, and other countries. According to Schuchat *et al.* (1992) the consumption of insufficiently heat-processed poultry products contaminated with *L. monocytogenes* could cause the occurrence of listeriosis in people with lower resistance. In these cases, the levels of contamination with *L. monocytogenes* of the raw, deep-frozen or cooled product plays a crucial role in provoking the occurrence of listeriosis.

In conclusion, *Listeria* spp. was detected in live ducks, during processing and commercial preparation of duck liver and filet. *L. monocytogenes* contamination was proven in 14 samples (2.9% of all samples), *L. innocua* in 12, and *L. grayi* – in 2 cases. *L. monocytogenes* isolates from serogroup II are predominant (12 cases in duck samples and 2 in feed samples), only two of the isolates belonged to group I. *Listeria* spp. was also found in the feed given to the examined ducks.

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