

# GROWTH POTENTIAL OF *LISTERIA MONOCYTOGENES* IN READY-TO-EAT MINCED MEAT SAMPLES ENRICHED WITH PLANT POWDERS



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## INTRODUCTION

**Listeriosis**, which is one of the most severe foodborne illnesses, ranks as the fifth most commonly reported zoonosis among humans in the European Union. To ensure the safety of ready-to-eat (RTE) foods, Regulation (EC) No 2073/2005 has established microbiological criteria for *Listeria monocytogenes*. If a food business operator intends to use the numeric criterion of 100 cfu/g for RTE food, a **challenge test** must be conducted in compliance with the technical guidance document issued by the EU Reference Laboratory for *L. monocytogenes* (EURL *Lm*).

Numerous plants have been shown to be effective in inhibiting microbial growth in food. The use of plant powders with antimicrobial properties in food manufacturing requires compliance with consumer demands for microbiological safety, nutritional value, and sensory properties.

The **aim** of this study was to assess the growth potential of *L. monocytogenes* in minced meat products enriched with plant powders.

## MATERIALS AND METHODS

In order to assess the growth potential ( $\delta$ ) of *L. monocytogenes* in cooked minced samples, challenge testing was carried out following the guidelines provided in version 4 of the **Technical Guidance Document** by the EURL *Lm*. The procedure involved intentionally contaminating three batches of samples per analysis day with a microbial suspension of *L. monocytogenes* strains using a syringe. The mixture, the amount of which did not exceed 1% of the total mass of the product and which contained ~100 cfu/g, was injected at three different points within the sample. The inoculated samples were individually packed into sterile cups and stored in an incubator at a temperature of  $7 \pm 1$  °C until the analysis. Apart from enumerating *L. monocytogenes*, the total microbial count, pH, and water activity ( $a_w$ ) were also determined in duplicate on each analysis day. The growth potential of the pathogen was evaluated based on the enumeration of *L. monocytogenes*.

The composition of the meat products is listed below:

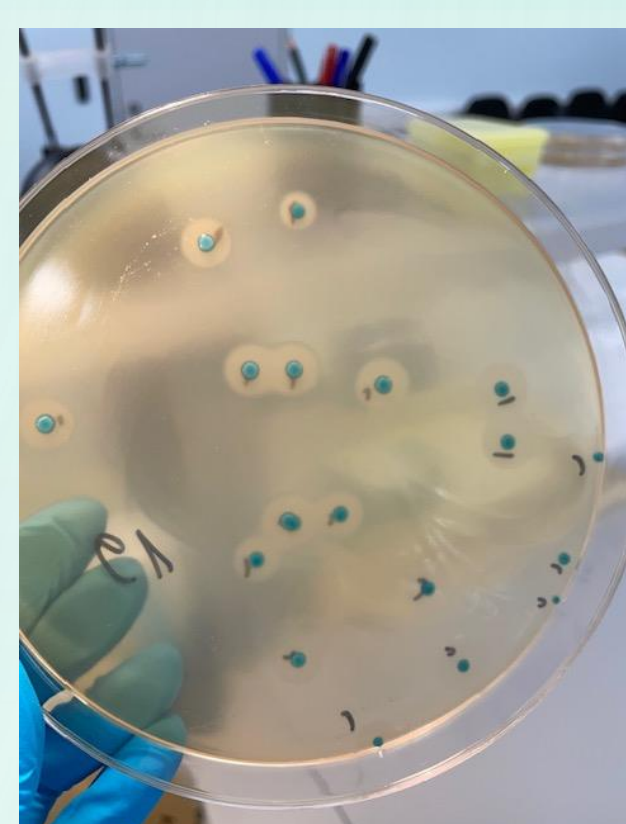
- (1) minced meat without additives (control); (2) minced meat + 3% apple + 1% onion + 2% blackcurrant; (3) minced meat + 3% apple + 1% garlic + 2% tomato; (4) minced meat + 3% apple + 2% tomato + 1% rhubarb petioles; (5) minced meat + 2% garlic; (6) minced meat + 2% onion and (7) minced meat + 2% rhubarb petioles.

## RESULTS AND CONCLUSIONS

**Table 1.** Physico-chemical and microbiological indicators of RTE minced meat products with different plant composition (Koskar *et al.*, 2022)

Samples	Storage Day	pH *	Water Activity * $a_w$	Total Count (cfu/g)	$\delta$ (log cfu/g) **
Meat ***	0	6.35 ± 0.048	0.986 ± 0.003	<1.0 × 10 <sup>2</sup>	7.30
	6	6.30 ± 0.021	0.987 ± 0.003	4.3 × 10 <sup>2</sup>	
	12	6.35 ± 0.001	0.992 ± 0.005	2.5 × 10 <sup>2</sup>	
Apple+On+BCber	0	5.75 ± 0.071	0.987 ± 0.002	<1.0 × 10 <sup>2</sup>	3.63
	6	5.70 ± 0.016	0.985 ± 0.001	<1.0 × 10 <sup>2</sup>	
	12	5.72 ± 0.005	0.984 ± 0.004	1.0 × 10 <sup>2</sup>	
Apple+Ga+Tom	0	5.93 ± 0.066	0.986 ± 0.001	<1.0 × 10 <sup>2</sup>	5.35
	6	5.87 ± 0.021	0.990 ± 0.001	1.0 × 10 <sup>2</sup>	
	12	5.95 ± 0.010	0.979 ± 0.001	2.0 × 10 <sup>2</sup>	
Apple+Tom+Rhub	0	5.51 ± 0.011	0.988 ± 0.002	<1.0 × 10 <sup>2</sup>	3.74
	6	5.42 ± 0.013	0.987 ± 0.001	<1.0 × 10 <sup>2</sup>	
	12	5.48 ± 0.012	0.977 ± 0.001	1.5 × 10 <sup>2</sup>	
Garlic	0	6.68 ± 0.015	0.986 ± 0.002	1.5 × 10 <sup>1</sup>	7.85
	6	6.73 ± 0.001	0.990 ± 0.003	5.5 × 10 <sup>1</sup>	
	12	6.72 ± 0.003	0.987 ± 0.002	2.0 × 10 <sup>1</sup>	
Onion	0	6.48 ± 0.011	0.964 ± 0.005	2.0 × 10 <sup>1</sup>	7.92
	6	6.58 ± 0.008	0.984 ± 0.001	3.6 × 10 <sup>1</sup>	
	12	6.60 ± 0.017	0.979 ± 0.001	3.0 × 10 <sup>1</sup>	
Rhub	0	5.24 ± 0.001	0.980 ± 0.001	1.0 × 10 <sup>1</sup>	2.74
	6	5.31 ± 0.013	0.987 ± 0.001	3.5 × 10 <sup>1</sup>	
	12	5.41 ± 0.059	0.979 ± 0.001	3.0 × 10 <sup>1</sup>	

\* Values are mean (obtained from analyses in duplicate) ± SD (standard deviation). SD values are not shown when zero. \*\* Growth potential ( $\delta$ ) more than 0.5 log cfu/g indicates the samples which support the growth of *L. monocytogenes*. \*\*\* Purchased from a retail outlet (fat content 27%). Abbreviations: On, onion; BCber, blackcurrant berries; Ga, garlic; Tom, tomato; Rhub, rhubarb petioles.



**Challenge testing** revealed that the growth potential of *L. monocytogenes* exceeded 0.5 log<sub>10</sub> cfu/g in all food samples. The growth potential of *L. monocytogenes* varied significantly within the samples. The highest growth potential of *L. monocytogenes* ( $\delta = 7.30$  log cfu/g) was determined in the control sample and samples with single plant additive (onion or garlic), while the sample containing 2% rhubarb petiole powder had the lowest growth potential ( $\delta = 2.74$  log cfu/g). In comparison to the control sample, the growth potential of *L. monocytogenes* was also lower in the following samples: minced meat + 3% apple + 1% onion + 2% black currant ( $\delta = 3.63$  log cfu/g) and minced meat + 3% apple + 2% tomato + 1% rhubarb petiole ( $\delta = 3.74$  log cfu/g).

**In conclusion**, achieving complete inhibition of *L. monocytogenes* growth requires the application of certain additional internal, external, or implicit factors.

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**References:** Koskar, J.; Meremäe, K.; Püssa, T.; Anton, D.; Elias, T.; Rätsep, R.; Mäesaar, M.; Kapp, K.; Roasto, M. 2022. Microbial Growth Dynamics in Minced Meat Enriched with Plant Powders. Applied Sciences, 12 (21), 11292.