foodproof® *Listeria* Genus Detection Kit

Revision A, December 2023

PCR system for the qualitative detection of *Listeria* Genus DNA using real-time PCR instruments.

Product No. KIT230047

Kit for 96 reactions for a maximum of 94 samples

Store at –15 to –25 °C

For food testing purposes.

FOR *IN VITRO* USE ONLY.

Table of Contents

1. What this Product Does

1.1 Number of Tests

The detection system is designed for 96 reactions with a final reaction volume of 25 µL each. Up to 94 samples (single sample preparation) plus positive and negative control reactions can be analyzed per run.

1.2 Storage and Stability

- Store the kit at –15 to –25 °C through the expiration date printed on the label.
- Once the kit is opened, store the components as described in the following Kit Contents table.

1.3 Kit Contents

Vial No./Cap Color	Label	Contents, Function, Storage
1 yellow cap	foodproof® *Listeria* Genus Master Mix	• 3 x 600 µL • Ready-to-use primer and hydrolysis probe mix specific for *Listeria* DNA and the *Listeria* Genus-specific Internal Control (IC). • Store at –15 to –25 °C. • **Avoid repeated freezing and thawing!** • **Protect from light!**
2 red cap	foodproof *Listeria* Genus Enzyme Solution	• 3 x 32 µL • Contains Taq DNA Polymerase and Uracil-DNA Glycosylase (heat labile) for prevention of carryover contamination. • Store at –15 to –25 °C.
3 white cap	foodproof *Listeria* Genus Internal Control	• 3 x 32 µL • Contains a stabilized solution of plasmid DNA and a yellow dye for better visualization. • For use as an internal amplification control. • Store at –15 to –25 °C. • After first thawing, store at 2 to 8 °C for up to one month.
4 purple cap	foodproof *Listeria* Genus Control Template	• 1 x 50 µL • Contains a stabilized solution of plasmid DNA. • For use as a PCR positive control. • Store at –15 to –25 °C. • After first thawing, store at 2 to 8 °C for up to one month.
5 colorless cap	H_2O, PCR-grade	• 1 x 1 mL • Nuclease-free, PCR-grade H_2O. • For use as a PCR negative control. • Store at –15 to –25 °C.

1.4 Additional Equipment and Reagents Required

- Real-time PCR instruments with FAM and VIC/HEX detection channels
- Real-time PCR compatible tubes, strips or plates with optical cap or foil applicable for the PCR cycler used
- Sample preparation kit options (choose one):
  - foodproof ShortPrep® II (Product No. KIT230171)
  - foodproof StarPrep Two Kit (Product No. KIT230177)
- Nuclease-free, aerosol-resistant pipette tips
- Pipettes
- Sterile reaction tubes for preparing PCR mixes and dilutions

1.5 Applicability Statement

The foodproof *Listeria* Genus Detection Kit is designed as a screening test for the occurrence of the six *Listeria* species in food samples (*L. grayi*, *L. innocua*, *L. ivanovii*, *L. monocytogenes*, *L. seeligeri*, *L. welshimeri*). The test allows the rapid detection of *Listeria* DNA isolated from enrichment cultures prepared with various methods inoculated with food samples that are potentially contaminated with *Listeria* spp.

The kit is based on the foodproof *Listeria* Genus Detection Kit - Hybridization Probes (LightCycler® 1.x, 2.0).

The detection kit must not be used in diagnostic procedures.

The kit described in this Instruction Manual has been developed for real-time PCR instruments with a FAM and a VIC/HEX detection channel. The performance of the kit was tested with the following real-time PCR instruments: LightCycler® 480 (Roche Diagnostics), ABI 7500 and StepOnePlus® (Applied Biosystems), Mx3000P® and Mx3005P® QPCR System (Stratagene), iQ5 Real-Time PCR Detection System (Bio-Rad), Rotor-Gene® 6000 (Qiagen) and Mastercycler® ep *realplex*^{4} (Eppendorf).

2. How to Use this Product

2.1 Before You Begin

2.1.1 Precautions

Detection of *Listeria* DNA using the foodproof *Listeria* Genus Detection Kit requires DNA amplification by PCR. The detection kit provides all the reagents required for the PCR. To achieve reliable results, the entire assay procedure must be performed under nuclease-free conditions. Follow the instructions below to avoid nuclease-, carryover- or cross-contamination:

- Prepare appropriate aliquots of the solutions and keep them separate from other reagents in the laboratory.
- Use nuclease-free labware (e.g., pipettes, pipette tips, reaction vials).
- Wear gloves when performing the assay.
- To avoid cross-contamination of samples and reagents, use fresh aerosol-preventive pipette tips.
- To avoid carryover contamination, transfer the required solutions for one experiment into a fresh tube, rather than directly pipetting from stock solutions.
- Physically separate the workplaces for DNA preparation, PCR setup and PCR to minimize the risk of carryover contamination. Use a PCR hood for all pipetting steps.

Keep the foodproof *Listeria* Genus Master Mix (vial 1, yellow cap) away from light.

2.1.2 Waste Disposal

Place any waste and biohazard material potentially contaminated with pathogenic bacteria in an appropriate contaminated waste bag. The bag should be treated and disposed of according to local regulations.

2.1.3 Sample Material

Use any sample material suitable for PCR in terms of purity, concentration and absence of inhibitors. For preparation of genomic DNA from raw material or from food enrichments, refer to the corresponding product package inserts of a suitable sample preparation kit (see Additional Equipment and Reagents Required).

2.1.4 Enrichment

Use pre-enrichment broth and temperature according to ISO 11290 or BAM (Chapter 10) or USDA for 24 – 48 hours. Other suitable, validated enrichment procedures can also be used.

2.1.5 DNA Extraction

Hygiena Diagnostics provides sample preparation kits suitable for all kinds of foods and raw materials (see Additional Equipment and Reagents Required). For more product information, visit www.hygiena.com.

2.1.6 Positive Control

Always run a positive control with the samples. To prepare a positive control, replace the template DNA with the provided control DNA [foodproof *Listeria* Genus Control Template (vial 4, purple cap)] or with a positive sample preparation control.

2.1.7 Negative Control

Always run a negative control with the samples. To prepare a negative control, replace the template DNA with H_2O, PCR-grade (vial 5, colorless cap). Include a negative control during sample preparation to monitor reaction purity and cross-contamination. This extraction control can be used as an additional negative control reaction.

2.2 Procedure

2.2.1 Program Setup

Program the PCR instrument before preparing the reaction mixes. The amplification is carried out according to the following temperature-time program (for details on how to program the experimental protocol, see the operation manual of your real-time PCR cycler):

Pre-incubation Step 1: 37°C for 4 minutes Step 2: 95°C for 5 minutes	**1** cycle	For some real-time PCR instruments, the type of probe quencher as well as the use of a passive reference dye must be specified. The foodproof *Listeria* Genus Detection Kit contains probes with TAMRA as quencher and no passive reference dye.
Amplification Step 1: 95°C for 5 seconds Step 2*: 60°C for 60 seconds * Fluorescence detection in step 2	**50** cycles	NOTE for users of the Agilent Mx3005P instrument: Click “Instrument → Filter Set Gain Settings” to open the Filter Set Gain Settings dialog box. For FAM, modify the Filter Set Gain Setting to “x1”.

2.2.2 Preparation of the PCR Mix

Proceed as described below to prepare a 25 µL standard reaction.

Always wear gloves when handling the PCR vessels.

1. Thaw the solutions and, for maximal recovery of contents, briefly spin vials in a microcentrifuge before opening. Mix carefully but thoroughly by pipetting up and down.
2. In a reaction tube (0.5 – 2.0 mL depending on the number of reactions), prepare the PCR Mix by adding the following components in the order listed below:

   The volumes indicated below are based on a single 25 µL standard reaction. Prepare the PCR mix by multiplying the amount in the "Volume" column by the number of reactions to be cycled plus one or two additional reactions to cover pipetting losses.

Component	Volume (µL)
foodproof *Listeria* Genus Master Mix (vial 1, yellow cap)	18.0
foodproof *Listeria* Genus Enzyme Solution (vial 2, red cap)	1.0
foodproof *Listeria* Genus Internal Control (vial 3, white cap)	1.0
Total volume	**20.0**

3. Prepare reaction mixtures:
   - Mix carefully but thoroughly by pipetting up and down. Do not vortex.
   - Pipet 20 µL of PCR mix into each PCR vessel.
   - For the samples of interest, add 5 µL of sample DNA.
   - For the negative control, add 5 µL of H_2O, PCR-grade (vial 5, colorless cap).
   - For the positive control, add 5 µL of foodproof *Listeria* Genus Control Template (vial 4, purple cap).
4. Seal the PCR vessels accurately with optical caps or foil.
5. Briefly spin the PCR vessels in a suitable centrifuge.
6. Cycle the samples as described above.

2.3 Data Interpretation

The amplification of DNA of *Listeria* Genus is analyzed in the fluorescence channel suitable for FAM-labeled probe detection. The specific amplification of the Internal Control is analyzed in the fluorescence channel suitable for VIC/HEX. Compare the results from the FAM channel (*Listeria* spp.) and VIC/HEX channel (Internal Control) for each sample, and interpret the results as described in the table below.

Listeria Genus	Internal Control	Result Interpretation
FAM Channel	VIC/HEX Channel	
Positive	Positive	Positive
Negative	Positive	Negative
Positive	Negative	Positive
Negative	Negative	Invalid

Note: A prerequisite for the unambiguous discrimination of *Listeria* DNA and Internal Control DNA in this dual-colored experiment is a suitable calibration of the PCR instrument for FAM and VIC/HEX channels. Please refer to the operation manual of your real-time PCR cycler for further information.

3. Troubleshooting

Observation	Possible Reason	Recommendation
No signal increase is observed, even with positive controls.	Incorrect detection channel has been chosen.	• Set Channel settings to FAM or VIC/HEX.
	Pipetting errors or omitted reagents.	• Check for correct pipetting scheme and reaction setup. Repeat the PCR run. • Always run a positive control along with your samples.
	No data acquisition programmed.	• Check the cycle programs.
No signal increase in the VIC/HEX channel.	Inhibitory effects of the sample material (e.g., caused by insufficient purification).	• Use a recommended DNA sample preparation kit to purify template DNA. • Dilute samples or pipet a lower amount of sample DNA (e.g., 2.5 µL instead of 5 µL, substituting with H_2O, PCR-Grade). • Perform a sub-cultivation of the enrichment culture (e.g., 1:100 in broth according to Fraser) to dilute the proportion of food matrix in the sample.
Fluorescence intensity is too low.	Inappropriate storage of kit components.	• Store the foodproof *Listeria* Genus Master Mix (vial 1, yellow cap) at –15 to –25 °C, protected from light. • Avoid repeated freezing and thawing.
	foodproof *Listeria* Genus Master Mix (vial 1, yellow cap) is not homogeneously mixed.	• Mix the foodproof *Listeria* Genus Master Mix (vial 1, yellow cap) thoroughly before pipetting.
	Low initial amount of target DNA.	• Increase the amount of sample DNA. Depending on the chosen DNA isolation method, inhibitory effects may occur.
Negative control samples are positive.	Carryover contamination is present.	• Exchange all critical solutions. • Repeat the complete experiment with fresh aliquots of all reagents. • Always handle samples, kit components and consumables in accordance with commonly accepted practices to prevent carryover contamination. • Add positive controls after sample and negative control reaction vessels have been sealed.

Observation	Possible Reason	Recommendation
Fluorescence intensity varies.	Insufficient centrifugation of the PCR vessels. Prepared PCR mix is still in the upper part of the vessel.	• Always centrifuge reaction vessels.
	Outer surface of the vessel or seal is dirty (e.g., by direct skin contact).	• Always wear gloves when handling the vessel and seal.

4. Additional Information on this Product

4.1 How this Product Works

The foodproof *Listeria* Genus Detection Kit provides primers and hydrolysis probes (for sequence-specific detection), convenient premixed reagents and a control template for reliable interpretations of results. To ensure maximum reliability of the detection system and to prevent misinterpretation of negative results due to inhibition of the amplification, an Internal Control (IC) is supplied (vial 3, white cap). The IC must be added to each reaction. The hydrolysis probe was designed to bind specifically to the IC, allowing detection in the VIC/HEX channel, whereas the *Listeria* DNA is detected in the FAM channel.

In cases of a negative result due to inhibition of amplification by the sample DNA of interest, the amplification of the IC is suppressed as well. A negative result for the sample DNA of interest and amplification of the IC clearly indicates the absence of *Listeria* DNA in the sample.

The foodproof *Listeria* Genus Detection Kit minimizes contamination risk and contains all reagents needed for detection of *Listeria* DNA. Primers and probes provide specific detection of *Listeria* DNA in food samples. This kit has been developed for real-time PCR instruments with FAM and VIC/HEX detection channels.

4.2 Test Principle

1. Using the supplied sequence-specific primers in a polymerase chain reaction (PCR), the PCR instrument and its associated reagents amplify and simultaneously detect fragments of *Listeria* genomic DNA.
2. The PCR instrument detects these amplified fragments in real time through fluorescence generated by cleavage of the hybridized probe due to the 5´-nuclease activity of the Taq DNA polymerase. The probe is labeled at the 5´-end with a reporter fluorophore and at the 3´-end with a quencher.
3. During the annealing/elongation phase of each PCR cycle, the probe hybridizes to an internal sequence of the amplicon downstream from one of the primer sites and is cleaved by the 5' nuclease activity of the Taq DNA polymerase. This cleavage of the probe separates the reporter dye from the quencher dye, increasing the reporter dye signal.
4. The real-time PCR instrument measures the emitted fluorescence of the reporter dye.

4.3 Prevention of Carryover Contamination

The heat-labile Uracil-DNA Glycosylase (UNG) is suitable for preventing carryover contamination between PCRs. This technique relies on the incorporation of deoxyuridine triphosphate (dUTP) during all amplification reactions, and the pretreatment of all successive PCR mixtures with the heat-labile UNG. The UNG cleaves DNA

at any site where a dUTP residue has been incorporated. The resulting abasic sites are hydrolyzed due to the high temperatures during the initial denaturation step and can no longer serve as PCR templates. The heat-labile UNG is inactivated during the initial denaturation step. Native DNA (e.g., the isolated *Listeria* genomic DNA) does not contain uracil and is therefore not degraded by this procedure. Since dTTP is replaced with dUTP and UNG is included in the foodproof *Listeria* Genus Detection Kit, decontamination can be achieved with the provided reagents.

4.4 Background Information

The genus *Listeria* includes six species, *L. grayi*, *L. innocua*, *L. ivanovii, L. monocytogenes*, *L. seeligeri*, and *L. welshimeri*, characterized as gram-positive rod-shaped bacteria. Only *L. monocytogenes* causes Listeriosis, a severe human disease. Main clinical manifestations of Listeriosis are meningoencephalitis and septicemia. The mortality rate is up to 33% [1]. Most susceptible persons are pregnant women, neonates, the elderly and immunosuppressed persons. *L. monocytogenes* is often found in samples that contain other *Listeria* spp. Therefore, the survey for all *Listeria* spp. might be a useful indicator of sanitation and an early warning of potential presence of pathogenic species [2].

The bacteria *Listeria* is typically transmitted to humans through the ingestion of contaminated food such as dairy products, meat and raw vegetables [3]. Those foods have relatively short shelf lives, and food industries need to shorten in-process control to prevent in-house contamination. Therefore, the need for rapid, accurate and sensitive methods for the detection of *Listeria* is a major food safety issue. Since conventional microbiological methods for the detection and identification of *Listeria* are very time-consuming, PCR has been introduced to the food industry as a highly sensitive and specific detection method [4].

4.5 Product Characteristics

Specificity: The foodproof *Listeria* Genus Master Mix is specific for sequences found in all *Listeria* species. Inclusivity has been tested with 105 strains of all 6 species (*L. grayi*, *L. innocua*, *L. ivanovii*, *L. monocytogenes*, *L. seeligeri*, *L. welshimeri*) whereas all of them could be detected (100% inclusivity). Exclusivity was determined using 56 non-*Listeria* strains.

Sensitivity: A relative detection limit of 1 to 10 cells per 25 g of sample can be achieved with all kinds of foods. The foodproof *Listeria* Genus Detection Kit detects down to 10^2 – 10^3 CFU/mL in enrichment cultures (depending on the sample preparation kit used.

4.6 References

1. Centers for Disease Control and Prevention – Listeriosis http://www.cdc.gov.
2. Robinson RK, Batt CA, Patel PD (ed.) (2000) Encyclopedia of food microbiology. volume 2, Academic Press.
3. Scheu P, Gasch A, Berghof K. (1999) Rapid detection of *Listeria monocytogenes* by PCR-ELISA. *Letters in Applied Microbiology* **29**, 416–420.
4. Scheu PM, Berghof K, Stahl U. (1998) Detection of pathogenic and spoilage micro-organisms in food with the polymerase chain reaction. *Food Microbiology* 15, 13–31.
5. Fraser JA and Sperber WH. (1988) Rapid detection of *Listeria* spp. in food and environmental samples by esculin hydrolysis. *J. Food Protect*. 51(10), 762–765.

4.7 Quality Control

The foodproof *Listeria* Genus Detection Kit is function tested using the LightCycler 480 System.

5. Supplementary Information

5.1 Ordering Information

In addition to the foodproof *Listeria* Genus Detection Kit, Hygiena Diagnostics offers a broad range of reagents and services. For a complete overview and for more information, visit us at www.hygiena.com and contact us via email or phone.

5.2 License Notice

The purchase price of this product includes limited, nontransferable rights under US Patent No. 7,687,247 owned by Life Technologies Corporation to use only this amount of the product to practice the claims in said patent solely for activities of the purchaser for bioburden testing, environmental testing, food testing, or testing for genetically modified organisms (GMO) in accordance with the instructions for use accompanying this product. No other rights are conveyed, including no right to use this product for *in vitro* diagnostic, therapeutic, or prophylactic purposes. Further information on purchasing licenses under the above patent may be obtained by contacting the Licensing Department, Life Technologies Corporation, 5791 Van Allen Way, Carlsbad, CA 92008. Email: outlicensing@lifetech.com.

5.3 Trademarks

foodproof® and ShortPrep® are trademarks of Hygiena Diagnostics GmbH. Hygiena® is a trademark of Hygiena. Other brand or product names are trademarks of their respective holders.

5.4 Contact and Support

If you have questions or experience problems with this or any other product of Hygiena Diagnostics, contact our Technical Support staff (for details, see www.hygiena.com/support). Our scientists commit themselves to providing rapid and effective help. Contact us if you have suggestions for enhancing our product performance or using our products in new or specialized ways. Such customer information has repeatedly proven invaluable to us and the worldwide research community.

5.5 Reference Number

The reference number and original Hygiena Diagnostics GmbH article number: R 302 20.

6. Change Index

Version 1, June 2008
First version of the package insert.

Version 2, December 2008
New product name extension: 5'-Nuclease.

Version 3, July 2010
Page 8: Note for users of the Agilent Mx3005P instrument added.

Version 4, April 2016
Added foodproof StarPrep Two Kit as a suitable DNA extraction kit.

Version 5, March 2017
License Notice changed.

Revision A, December 2023
Rebranding and new layout. Change document tracking number (R 302 20 20 -> INS-KIT230047-REVA).

Hygiena®
Camarillo, CA 93012
USA
diagnostics.support@hygiena.com

Manufactured by
Hygiena Diagnostics GmbH
Hermannswerder 17
14473 Potsdam
Germany
www.hygiena.com