HANDBOOK

Bio-T kit® BHV1 DIVA

Cat. N° BIOTK098 - 50 reactions

Detection of all strains of Bovine Herpes Virus type 1 (BHV1gB) and discrimination of gE deleted vaccines of BHV1 (BHV1gE) by real-time PCR (qPCR) with Endogenous internal positive control (IPC)

BOVINE

Sample types

- Alveolar bronchial washing (ABW)
- Trans-tracheal aspiration liquid (TTA)
- Deep Nasopharyngeal swab (DNS)
- Cervical swab
- Organs (lungs)
- Bull sheath wash
- Semen
- Foetal organs (brain, liver, lungs, spleen)
- Individual analysis or by pool up to 3 according to the sample type

Recommended nucleic acids (NA) extractions

- Magnetic beads extraction (e.g.: BioSellal – BioExtract® SuperBall® Cat. N° BES384)
- Silica membrane columns extraction (e.g.: BioSellal – BioExtract® Column Cat. N° BEC050 or BEC250 ; Qiagen – RNeasy® Mini Kit Cat N° 74104)

Veterinary use only

DOCUMENTS MANAGEMENT

The Bio-T kit® BHV1 DIVA has two technical handbooks:

- The extraction handbook shared between all the Bio-T kit® of the RESPIRATORY line, displaying BioSellal's validated or recommended extraction protocols for each type of sample.
- The Bio-T kit® BHV1 DIVA qPCR handbook, presenting the instruction information to perform the qPCR.

The last versions in use for each handbook are indicated on the certificate of analysis (CA) provided with the Bio-T kit® BHV1 DIVA.

Besides these two handbooks, a summary report of the validation file and a performances confirmation handbook are available on request, contact BioSellal (contact@biosellal.com).

MODIFICATIONS MANAGEMENT

BioSellal indicates modifications done to this document by highlighting them using the rules presented in the Table below:

MODIFICATIONS MANAGEMENT			
Type of modification Highlighting color	**Minor modifications**	**Type 1 Major modifications**	**Type 2 Major modifications**
Impact on revision / version	**Change of revision date** **No change of version**	**Change of revision date** **+ change of version**	**Change of revision date** **+ change of version**
Examples of modifications	Corrections: typographical, grammatical or turns of phrase	EPC reference modification	Modification of Master Mix composition
	Addition of new sample type for extraction	Exogenous IPC reference modification	Modification of validated extraction protocol
	Addition of information giving more details or alternative protocol		
	Addition/Suppression of optional information		

PRESENTATION

Recommendations for sampling, shipping and storage of samples

Real-time PCR is a powerful technique allowing the detection of few amounts of pathogen genome. Genome can be rapidly degraded depending on the pathogen nature (bacteria / parasites, enveloped viruses...), the genome nature (DNA / RNA) and the sample type (presence of DNase / RNase). Thus, BioSellal recommends the following instructions to guarantee an optimal diagnosis.

Sampling

To prevent cross-contamination between samples leading to false positive results, it is mandatory to use disposable materials for single use and to avoid direct contact between specimens.

Shipping

It is mandatory to ship immediately after sampling or by default to store it at ≤ -16°C. Shipment has to be done within 24h under cover of positive cold.

Storage after reception

It is recommended to immediately analyze samples after receipt or freezing at ≤ -16 ° C for a few months and ≤ -65°C beyond 1 year.

RESPIRATORY Line

This kit belongs to the RESPIRATORY line which gather a set of kits sharing common extraction and qPCR protocols. It is compatible with BioSellal's other kits except with the ones belonging to the PIG and AVIAN lines. (information available on www.biosellal.com).

In addition to the kits belonging to the RESPIRATORY line, BioSellal offers other Bio-T kit® kits allowing the diagnostic of other pathogens involved in Bovine Respiratory Disease (BRD) such as BVDV. For more informations, contact BioSellal (contact@biosellal.com)

Description of the Bio-T kit® BHV1 DIVA

The **Bio-T kit® BHV1 DIVA** (Cat. N° BIOTK098) contains a ready to use **PCR Master Mix** allowing the detection **in the same reaction well of**:

- **All Bovine Herpes Virus type 1 strains (field and vaccine, BHV1gB)** with a 6-FAM labelling,
- **All Bovine Herpes Virus type 1 strains except gE deleted vaccine strains (BHV1gE)** with a VIC labelling,
- **An Endogenous internal positive control IPC (gapdh)**, with a Cy5 labelling, to assess the presence of sufficient amount of host cells, sample integrity, nucleic acids extraction quality and absence of PCR inhibitors.

The **Bio-T kit® BHV1 DIVA** allow the discrimination between field strains and gE deleted vaccine strains with the following interpretation plan:

Table 1. interpretation plan according to the animal status

Animal status	BHV1gB (FAM)*	BHV1gE (VIC)
Healthy	Undetected	Undetected
Infected	Detected	Detected
Vaccinated† and healthy	Detected	Undetected
Vaccinated† and infected	Detected	Detected

*The FAM labeling also detect the following Alphaherpesvirus : Bovine Herpes Virus 5 (BoHV5), Caprine Herpes Virus 1 (CpHV1) and Cervid Herpes Virus 1 and 2 (CvHV1 and 2). See the validation file for more information.

†In case of vaccination with a gE deleted vaccine.

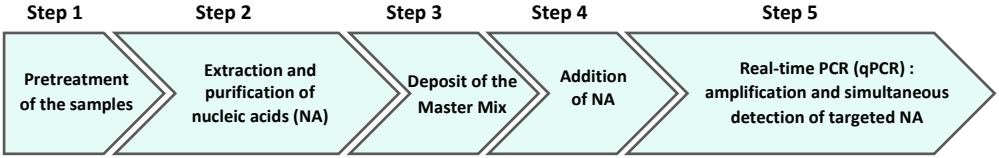
This kit, based on qualitative detection of field and vaccinal strains (detected or non detected) from alveolar bronchial washing samples, trans-tracheal aspiration liquid (TTA), deep nasopharyngeal swab, cervical swab¥, organs (lungs), bull sheath wash, semen and foetal organs (brain, liver, lungs, spleen)Ж, was developed and validated according to the **French regulatory standard NF U47-600-2 edited by AFNOR**. It was not validated by the French Reference Laboratory of the infectious bovine rhinotracheitis.

¥The cervical swab matrix was validated according to the protocols described in the extraction handbook of the RESPIRATORY line. However, in case of simultaneous diagnosis between BHV1 and pathogens of the REPRO line, it is necessary to follow the instructions of the REPRO line extraction handbook. Those conditions are not validated for the complete method.

ЖThe foetal organs (brain, liver, lungs, spleen) matrix was not validated for the complete method by BioSellal for the BHV1 detection. With this matrix, it is necessary to follow the instructions of the REPRO line extraction handbook.

Extraction protocols validated by BioSellal are described in the extraction handbook of the RESPIRATORY line.

Description of the whole process



RESPIRATORY line Extraction handbook		qPCR handbook of the Bio-T kit® BHV1 DIVA		
Trans-tracheal aspiration liquid (TTA) Deep Nasopharyngeal swab (DNS) Cervical swab Alveolar bronchial washing (ABW) Organs (lungs) Bull sheath wash Semen foetal organs (brain, liver, lungs, spleen)	BioExtract® SuperBall® BioExtract® Column RNeasy® Mini Kit	Ready-to-use Master Mix MMBHV1DIVA-A	Samples NC/NCS Process positive control EPC (EPCBHV1DIVA-A)	Dyes: FAM/VIC/Cy5 Passive reference: ROX Programs: Classical program ± RT Standard or Fast ramping

Because of the zoonotic risk, for foetal organs (brain, liver, lungs, spleen) matrix or in case of simultaneous diagnosis between BHV1 and pathogens of REPRO line, it is necessary to follow the instructions of the REPRO line extraction handbook.

Kit contents and storage

Table 2. Description of the kit contents				
Description	**Reference**	**Volume/tube**	**Presentation**	**Storage**
Master Mix (MM) Ready to use	MMBHV1DIVA-A	750 µl	**White** cap tube Bag A	≤-16°C Protected from light, « MIX » Area
External Positive Control (EPC) PCR positive control of BHV1 (BHV1gB and BHV1gE)	EPCBHV1DIVA-A	110µl	**Orange** cap tube Bag B	≤-16°C « Addition of Nucleic acids » Area
Water RNase/DNase free	Aqua-A	1 ml	**Blue** cap tube Bag B	5°C ± 3 or ≤-16°C « Addition of Nucleic acids » Area

Kit reagents are stable until the expiration date stated on the label, subject to compliance with good storage conditions.

List of consumables and reagents not included in kit

Table 3. Consumables and reagents not included in kit			
Consumables/ Reagents	**Description**	**Provider**	**Cat. N°**
BioExtract® Column	DNA/RNA column extraction kit (50)	BioSellal	BEC050
BioExtract® Column	DNA/RNA column extraction kit (250)	BioSellal	BEC250
BioExtract® SuperBall®	DNA/RNA Magnetic beads extraction kit (4 x 96)	BioSellal	BES384
RNeasy® Mini Kit	RNA column extraction kit (50)	Qiagen	74104

For consumables related to the thermal cycler, refer to the user manual of the device.

List of reagents to confirm laboratory performances

Synthetic DNA of BHV1gB and of BHV1gE (titrated in number of copies/qPCR) used by BioSellal for the validation of the kit can be used to confirm the performance of your thermal cycler(s). To confirm the performance of your complete method, a non-inactivated viral suspension of BHV1 (quantified in TCID50/ml) used by BioSellal in the validation file could be provided. The non-inactivated viral suspension could also be used to realize an internal reference material (MRI) to confirm the performance of the complete method over the time (extraction + PCR).

BioSellal sells these reagents under the following references:

Table 4. Optional reagents*

Reagent	Description	Provider	Cat. N°
BHV1gB DNA	Quantified DNA of BHV1gB (6×10^3 copies/qPCR)	BioSellal	cADN-BHV1gB-001
BHV1gE DNA	Quantified DNA of BHV1gE (6×10^3 copies/qPCR)	BioSellal	cADN-BHV1gE-001
Non-inactivated BHV1 virale suspension	Quantified BHV1 viral suspension (4×10^3 $TCID_{50}$/ml)	BioSellal	SV-BHV1-001

*These reagents are available only on demand, please contact BioSellal (contact@biosellal.com).

Main critical points

- Wear appropriate personal protective equipment (lab coat, disposable gloves frequently changed).
- Work in dedicated and separate areas to avoid contamination: "Extraction" (unextracted samples storage, extraction equipment area), "Mix" (ready to use MM storage, qPCR plates preparation), "Nucleic acids Addition" (Nucleic Acids storage and addition of extracted nucleic acids and controls in the qPCR plate), "PCR" (final area containing the thermal cycler(s)).
- Use dedicated equipment for each working area (gloves, lab coat, pipettes, vortex, ...).
- Use filter tips.
- Before use, thaw all components at room temperature.
- Vortex and spin briefly (mini-centrifuge) all reagents before use.
- Avoid the repetition of freezing-thawing cycles for samples, lysates, extracted nucleic acids.
- **Pathogen's genome detected by the RESPIRATORY line's kits can be DNA or RNA. Working with RNA is more demanding than working with DNA** (RNA instability and omnipresence of the RNases). For these reasons, special precautions must be taken:
    - Always wear gloves, change them frequently, especially after contact with skin or work surfaces.
    - Treat all surfaces and equipment with RNases inactivation agents (available commercially).
    - When wearing gloves and after material decontamination, minimize the contact with surfaces and equipment in order to avoid the reintroduction of RNases.
    - Use "RNase free" consumable.
    - It is recommended to store the RNA at ≤ 5°C ± 3 during the manipulation and then freeze it as soon as possible, preferably at ≤ -65°C or by default at ≤ -16°C.
    - Open and close tubes one by one in order to limit the opening times and avoid any contact with RNases present in the environment (skin, dust, working surfaces…).

DISCRIMINATION BETWEEN gE DELETED BHV1 VACCINAL STRAINS (BHV1gE) AND ALL OTHER STRAINS (BHV1gB) BY qPCR WITH THE KIT BIOTK098

Global Procedure

1) **Establish qPCR plate setup** defining each sample position and **including the following controls**:

- **Negative Control Sample (NCS)**: water (or PBS) replaces the sample from the first step of sample preparation.
  This control is mandatory for each extraction series.

- **Negative Amplification Control (NC)**: 5 µl of water RNase/DNase free (Aqua-A tube, **blue** cap) replaces sample Nucleic Acids extract on qPCR plate.
  This control is recommended when using the kit for the first time or to verify the absence of Master Mix contamination.

- **External Positive Control of BHV1 (BHV1gB and BHV1gE) (EPC)** : Synthetic DNA (tube **EPCBHV1DIVA-A**, **orange** cap), containing specifics targets of BHV1gB and BHV1gE.
  This control is mandatory.

⚠ CAUTION: *EPC and standards tube handling represents nucleic acids contamination hazard, it is thus recommended to open and handle it in a restricted area, away from other PCR components and to take precautions to avoid cross-contamination with nucleic acids extracts during deposit on the qPCR plate.*

- If available, **a Process Positive Control (MRI),** a weak positive sample is extracted in parallel with tested samples. After qPCR, MRI Ct values will be monitored on a Shewhart control card. Obtaining conform Ct values validates the whole process. In this case, the use of the EPC, provided with the kit, is not mandatory.
- BioSellal offers a viral suspension to constitute the MRI (Cat. N° SV-BHV1-001)

2) qPCR plate preparation

In the "MIX" dedicated area

1. After thawing, vortex and rapid centrifugation, **transfer 15 µl of Master Mix MMBHV1DIVA-A (white** cap) in each well of interest (samples and controls).

In the "Nucleic Acids addition" dedicated area

2. **Add 5 µl of extracted nucleic acids (or NCS, water, MRI or EPC**: **EPCBHV1DIVA-A orange** cap tube) in each well of interest. Make sure to pipet out in the bottom of the well, in the Master Mix, and to avoid the formation of bubbles.

3. **Seal the plate with an optically clear sealer** or **close the strip caps**.

In the "PCR" amplification dedicated area

4. **Define the thermal cycler parameters** (see Table 5, Table 6, Table 7, Table 8)

5. It is recommended to **spin the plate down prior to place it in the thermal cycler**, to prevent drops in the well pit walls.

6. Start the qPCR program. Approximate run time: 60min.

3) Thermal cycler settings

This kit was developed and validated on AriaMx™ (Agilent Technologies, Fast ramping by default) and confirmed on ABI PRISM® 7500 Fast (Applied Biosystems) in standard and fast ramping. It is compatible with all thermal cyclers with at least 6-FAM, VIC and Cy5 channels. For more information, contact our technical support.

Table 5. Thermal cycler configuration

	ABI PRISM® 7500 Fast	AriaMx™
Mode	Quantitation – Standard curve	Quantitative PCR, Fluorescence Probe
Ramping	Standard or Fast Ramping	Ramping Fast by default
Passive Reference	**ROX**	**ROX**

Table 6. Thermal cycler Settings			
Target	**Detectors**		**Final Volume / well**
	Reporter	**Quencher**	
BHV1gB	FAM	NFQ-MGB or None*	**20 µl** = 15 µl Master Mix + 5 µl extracted nucleic acids or controls†
BHV1gE	VIC	NFQ-MGB or None*	
Endogenous IPC	Cy5	NFQ-MGB or None*	
To assign to samples and controls†			

* Depends on the thermal cycler model. Do not hesitate to contact the BioSellal Technical Support (tech@biosellal.com)
† Controls are NC (water), NCS (extracted water), EPC and or extracted MRI.

Table 7. CLASSICAL Amplification program settings without RT†		
Standard or Fast ramping		
Cycles	**Time**	**Temperature**
1 cycle	5 min	95°C
40 cycles	15 sec	95°C
	30 sec* + data acquisition	60°C

* Set 31s for some thermal cyclers such as ABI PRISM® 7500.
† optional step, in case of simultaneous detection of RNA genomes. Achieving a reverse-transcription (RT) step prior to PCR for the amplification of RNA genomes has no impact on the performances of the Bio-T kit® BHV1 DIVA (see the summary of the validation file).
NB: This amplification program is compatible with all Bio-T kit® except for ones belonging to the PIG and AVIAN LINES.

For thermal cycler such as LightCycler®480 and LightCycler®96 (Roche Life Science), it is recommended to use the following program:

Table 8. PIG/AVIAN Amplification program settings without RT†		
Standard or Fast ramping		
Cycles	**Time**	**Temperature**
1 cycle	5 min	95°C
40 cycles	10 sec	95°C
	45 sec + data acquisition	60°C

NB: This amplification program is compatible with all Bio-T kit® of the PIG and AVIAN LINES.
† An optional step of 50°C for 20 min is possible in case of simultaneous detection of RNA genome.

RESULTS INTERPRETATION

To analyze and interpret the signals obtained by qPCR, the Threshold must be set up.
The threshold must be assigned carefully in order to obtain the most reproducible result between different manipulations according to the requirements defined in Annex C of the French Standard **NF U47-600 (part 1)**. A consistent set of positives controls, usually an In-house Reference Material (MRI) or the EPC, is used to set the threshold value above the baseline and in the exponential amplification phase of the plot.
The Threshold Cycle, named « Ct » or « Cq » (depending on thermal cyclers), corresponds to the intersection between the amplification curves and the threshold line. It allows the relative measurement of the concentration of the target in the PCR reaction when a calibrated extract is analyzed in the same series.
The qPCR series is validated if the controls (EPC, MRI, NCS and NC) present valid results, then the result of each sample can be interpreted.

Main Scenarios

Controls Reading

Table 9. PCR Controls results interpretation

	Targets			Interpretation
	BHV1gB (FAM)	BHV1gE (VIC)	Endogenous IPC (Cy5)	
NCS Negative Control Sample **MANDATORY**	Neg	Neg	Neg	Valid
	At least one of the three targets **Pos**			Contamination with a positive/negative sample during extraction step or during qPCR plate preparation.
NC Negative PCR Control **OPTIONAL**	Neg	Neg	Neg	Valid
	At least one of the three targets **Pos**			Contamination with a positive/negative sample during extraction step or during qPCR plate preparation or Master Mix/water contamination.
EPC BHV1gB and BHV1gE PCR external positive control	Pos*	Pos*	Neg	Valid
	Neg	Neg	Neg	Problem during qPCR plate preparation: Master Mix error? EPC omission?
MANDATORY *IN ABSENCE OF MRI*	Pos*	Pos*	Pos	Contamination with a sample during qPCR plate preparation?
Sample process positive Control MRI **RECOMMENDED** *IF AVAILABLE*	Pos†	Pos†	Pos¥	Valid
	Neg	Neg	Neg	Problem during qPCR plate preparation: Master Mix error? Nucleic acids extract omission or extract not in contact with Master Mix? Process drift: extraction and/or qPCR ? Degradation of the sample process positive control?

* The Ct value obtained must be conform with the value indicated on the Certificate of Analysis (CA).
† The Ct value must be included within control card limits.
¥ The obtained Ct value depends on the thermal cycler, the sample type and the used extraction protocol. IPC Ct values for validated extraction protocols are available upon request. BioSellal recommends you to determine your own maximal IPC Ct value depending on your own extraction method and thermal cycler.

Note: Endogenous IPC targets a gene expressed by bovine cells, thus it cannot be detected in NCS, NC and EPC. However, due to cross-reaction between ruminant GAPDH and human GAPDH, a slight signal can be observed for IPC in the controls, the Ct value of this signal must be lower than 35.

Samples reading

Table 10. Different types of results obtained for the samples			
Targets			Interpretation
BHV1gB (FAM)	BHV1gE (VIC)	Endogenous IPC (Cy5)	
Neg	Neg	Pos*	**Negative or Undetected**
Pos	Neg		**Positive or Detected** Detection of a gE deleted vaccine strains (healthy vaccinated animals or with a viral titer lower than the method detectability threshold)
Pos	Pos		**Positive or Detected** Detection of a BHV1 field strain and/or a non gE deleted vaccinal strain. The sample could also be a mix of a field strain and a gE deleted vaccine strain (infected animals vaccinated with a gE deleted vaccine)
Pos	Pos	Neg ou Ct>35	**Positive or Detected for the positive target** **Uninterpretable fort he negative target** **= repeat the analysis** Competition with the main target ? Extraction problem ? Presence of inhibitors[ǂ] ? Sampling problem : lack of cells ?
Pos	Neg		
Neg	Pos		
Neg	Neg	Neg ou Ct>35	**Uninterpretable = repeat the analysis** Problem during plate preparation : Master Mix error ? Nucleic acids extract omission or extract not in contact with the Mix ? Presence of inhibitors[ǂ] ? Nucleic acids degradation in the sample ? Sampling problem : lack of cells ? Extraction problem ?

*The obtained Ct value depends on the thermal cycler, the sample type and the used extraction protocol. IPC Ct values for validated extraction protocols are available upon request. BioSellal recommends you to determine your own maximal IPC Ct value depending on your own extraction method and thermal cycler.

ǂ In case of inhibition suspicion, 1) Repeat the qPCR with the dilution of extracted nucleic acids at 1/10 or 1/100 in the DNase/RNase free water. 2)Restart the analysis from the extraction step.

Notes :

biosellal

www.biosellal.com

Technical Support

tech@biosellal.com +33 (0) 4 26 78 47 62

Information and orders

contact@biosellal.com +33 (0) 4 26 78 47 60