

MutaPLEX[®] Babesia

real time PCR kit

*Für den qualitativen Nachweis von Babesia-DNA
aus klinischen Proben oder Zecken*

*For the qualitative detection of Babesia DNA,
extracted from clinical specimens and ticks*

Gültig ab / Valid from 2018-11-19



KG192432
KG192496



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1 INTENDED USE

The MutaPLEX® Babesia real time PCR is an assay for the detection of DNA of *Babesia divergens*, *Babesia microti* and *Babesia sp.* EU1 (*Babesia venatorum*), extracted from clinical specimens and ticks.

2 BACKGROUND INFORMATION

Babesiosis is a malaria-like parasitic disease caused by infection with *Babesia*, a genus of protozoal piroplasm.

The parasites are transmitted by ticks such as *Dermacentor reticulatus*, a hard-bodied tick nowadays common throughout Central Europe.

Dependent on the species, the incubation time varies between 7 to 20 days. Rupture of the erythrocytes causes anaemia. Infections can remain without symptoms or with mild fever and diarrhea. However, in more severe cases, high fever with chills can occur.

In Europe infections are mainly caused by *B. divergens* and *B. sp.* EU1, while in the US *B. microti* (East Coast and Mid-West) and *B. duncani* (North-West Coast) are the causative agents for human babesiosis.

3 PRINCIPLE OF THE TEST

The MutaPLEX® Babesia real time PCR contains specific primers and dual-labelled probes for the amplification and detection of the DNA of *Babesia*. The presence of nucleic acids is detected by an increase in fluorescence due to hydrolysis of the probes during amplification. The fluorescence signals of the pathogen-specific probes are measured in the FAM channel.

Furthermore, MutaPLEX® Babesia real time PCR contains a control DNA, which is added during DNA extraction and detected in the same reaction by a differently labelled probe.

The control DNA allows the detection of PCR inhibition and acts as control for the isolation of the nucleic acid from the clinical specimen. The fluorescence of the control DNA is measured in the VIC®/HEX/JOE/TET channel.

4 PACKAGE CONTENTS

The reagents supplied are sufficient for 32 or 96 reactions, respectively.

Table 1: Components of the MutaPLEX® Babesia real time PCR Kit.

Label	Lid Colour	Content	
		KG192432	KG192496
Reaction mix	yellow	1 x 512 µl	2 x 768 µl
Positive control	red	1 x 50 µl	1 x 100 µl
Negative control	green	1 x 50 µl	1 x 100 µl
Control DNA	colourless	1 x 160 µl	2 x 240 µl

5 EQUIPMENT AND REAGENTS TO BE SUPPLIED BY USER

- DNA purification kit (e.g. MutaCLEAN® Universal RNA/DNA, KG1038, or NukEx Complete Mag RNA/DNA, KG1020)
- PCR grade water
- Sterile microtubes
- Pipets (adjustable volume)
- Sterile, DNase/RNase-free disposable pipet tips with aerosol barriers
- Table centrifuge
- Vortex
- Real time PCR instrument
- Optical PCR reaction tubes with lid
- Optional: Liquid handling system for automation

6 TRANSPORT, STORAGE AND STABILITY

The MutaPLEX® Babesia real time PCR kit is shipped on dry ice or cool packs. All components must be stored at maximum -20 °C in the dark immediately after receipt. Do not use reagents after the date of expiry printed on the package. Up to 20 freeze and thaw cycles are possible.

For convenience, opened reagents can be stored at 2–8 °C for up to 6 months.

Protect kit components from direct sunlight during the complete test run.

7 IMPORTANT NOTES

- The MutaPLEX® Babesia real time PCR must be performed by qualified personnel only.
- Good Laboratory Practice (GLP) has to be applied.

- Clinical samples must always be regarded as potentially infectious material and all equipment used has to be treated as potentially contaminated.

8 GENERAL PRECAUTIONS

- Stick to the protocol described in the instructions for use.
- Set up different laboratory areas for the preparation of samples and for the set up of the PCR in order to avoid contaminations.
- Pipettes, tubes and other materials must not circulate between those different laboratory areas.
- Always use filter tips.
- Regularly decontaminate equipment and benches with ethanol-free decontaminant.
- Do not combine MutaPLEX® Babesia real time PCR kit components of different lot numbers.

9 SAMPLE MATERIAL

Starting material for the MutaPLEX® Babesia real time PCR is DNA, extracted from clinical specimens (e.g. EDTA-blood, plasma, serum, cerebrospinal fluid and tissue samples) or from ticks.

10 SAMPLE PREPARATION

The MutaPLEX® Babesia real time PCR is suitable for the detection of Babesia DNA isolated from clinical specimens or ticks with appropriate isolation methods.

Commercial kits for DNA isolation such as the following are recommended:

- MutaCLEAN® Universal RNA/DNA, KG1038
- NukEx Complete Mag RNA/DNA, KG1020

It is recommended to use mechanical disruption of ticks before DNA extraction. Please follow the instructions for use of the respective extraction kit.

Important: In addition to the samples, always run a water control in your extraction. Treat this water control analogous to a sample.

Comparing the amplification of the control DNA in the sample to the amplification of the internal control in the water control will give insights on possible inhibitions of the real time PCR. Furthermore, possible contaminations during DNA extraction will be detectable.

If the real time PCR is not performed immediately, store extracted DNA according to the instructions given by the DNA extraction kit's manufacturer.

11 CONTROL DNA

A control DNA can be used as extraction control or only as inhibition control. This allows the user to control the DNA extraction procedure and to check for possible real time PCR inhibition.

11.1 Control DNA used as extraction control

Add 5 µl control DNA per extraction (5 µl x (N+1)). Mix well. Perform the DNA isolation according to the manufacturer's instructions. Please follow protocol A.

The control DNA must be added to the lysis buffer of the extraction kit.

11.2 Control DNA used as internal control of the real time PCR

If only inhibition will be checked, please follow protocol B.

12 REAL TIME PCR

12.1 Important points before starting

- Please pay attention to the chapter „Important notes“.
- Before setting up the real time PCR, familiarise yourself with the real time PCR instrument and read the user manual supplied with the instrument.
- The programming of the thermal profile should take place before the PCR set up.
- In every PCR run, a positive control and a negative control should be included.
- Before each use, all reagents should be thawed completely at room temperature, thoroughly mixed, and centrifuged very briefly.

12.2 Procedure

If the control DNA is used to control both, the real time PCR and the DNA isolation procedure, please follow protocol A. If the control DNA is solely used to detect possible inhibition of the real time PCR, please follow protocol B.

Protocol A

The control DNA was added during DNA extraction (chapter „Control DNA“). In this case, prepare the master mix according to table 2.

The master mix contains all of the components needed for PCR except the sample. Prepare a volume of master mix for at least one sample more than required, in order to compensate for pipetting inaccuracy.

Table 2: Preparation of the master mix (control DNA was added during DNA extraction)

Volume per reaction	Volume master mix
16.0 µl reaction mix	16.0 µl x (N+1)

Protocol B

The control DNA is used for the control of the real time PCR only (see chapter „Control DNA“). In this case, prepare the master mix according to table 3.

The master mix contains all of the components needed for real time PCR except the sample. Prepare a volume of master mix for at least one sample more than required, in order to compensate for pipetting inaccuracy.

Table 3: Preparation of the master mix (control DNA is added directly to the master mix)

Volume per reaction	Volume master mix
16.0 µl Reaction Mix	16.0 µl x (N+1)
0.5 µl Control DNA*	0.5 µl x (N+1)*

* The increase in volume caused by adding the control DNA is not taken into account when preparing the PCR assay.

Protocol A and B: real time PCR set up

- Place the number of optical PCR reaction tubes needed into the respective tray of the real time PCR instrument.
- Pipet 16 µl of the master mix into each optical PCR reaction tube.
- Add 4 µl of the eluates from the DNA isolation (including the eluate of the water control), the positive control and the negative control to the corresponding optical PCR reaction tube (table 4).
- Close the optical PCR reaction tubes immediately after filling in order to reduce the risk of contamination.

Table 4: Preparation of the real time PCR

Component	Volume
Master mix	16.0 µl
Sample	4.0 µl
Total volume	20.0 µl

12.3 Instrument settings

For the real time PCR use the thermal profiles shown in table 5.

Table 5: real time PCR thermal profile

Description	Time	Temperature	No of cycles
Initial denaturation	10 min	95 °C	1
Amplification			45
Denaturation	10 s	95 °C	
Annealing and extension	20 s	60 °C	
	Aquisition at the end of this step		
Extension	10 s	72 °C	

If in the same run samples should be tested for pathogens with RNA genome, e.g. with the MutaPLEX® FSME-TBE real time RT-PCR kit, use the thermal profile shown in table 6.

Table 6: real time RT-PCR thermal profile

Description	Time	Temperature	No of cycles
Reverse transcription	20 min	45 °C	1
Initial denaturation	5 min	95 °C	1
Amplification			45
Denaturation	10 s	95 °C	
Annealing and extension	20 s	60 °C	
	Aquisition at the end of this step		
Extension	10 s	72 °C	

Dependent on the real time PCR instrument used, further instrument settings have to be adjusted according to table 7.

Table 7: Overview of the instrument settings required for the MutaPLEX® Babesia real time PCR.

Real time PCR Instrument	Parameter Reaction Mix	Detection Channel	Notes
LightCycler 480I	<i>Babesia</i> Control DNA	483–533 523–568	use pre-installed universal CC FAM (510) – VIC (580)
LightCycler 480II	<i>Babesia</i> Control DNA	FAM (465–510) HEX (533–580)	

Real time PCR Instrument	Parameter Reaction Mix	Detection Channel	Notes		
Stratagene Mx3000P / Mx3005P	<i>Babesia</i> Control DNA	FAM HEX	Gain 8 Gain 1	Reference Dye: None	
ABI 7500	<i>Babesia</i> Control DNA	FAM JOE	Option Reference Dye ROX: NO		
Rotor-Gene Q, Rotor-Gene 3000 Rotor-Gene 6000	<i>Babesia</i> Control DNA	Green Yellow	Gain 5 Gain 5		
mic qPCR Cycler	<i>Babesia</i> Control DNA	Green Yellow	Gain 8 Gain 10		

13 DATA ANALYSIS

The *Babesia*-specific amplification is measured in the FAM channel. The amplification of the control DNA is measured in the VIC®/HEX/JOE/TET channel.

The following results can occur:

A signal in the FAM channel is detected:

The result is positive, the sample contains Babesia DNA.

In this case, detection of a signal of the control DNA in the VIC®/HEX/JOE/TET channel is inessential, as high concentrations of parasitic DNA may reduce or completely inhibit amplification of the control DNA.

No signal in the FAM channel, but a signal in the VIC®/HEX/JOE/TET channel is detected:

The result is negative, the sample does not contain Babesia DNA.

The signal of the control DNA excludes the possibilities of DNA isolation failure (in case the control DNA is being used as an extraction control) and/or real time PCR inhibition. If the C_T value of a sample differs significantly from the C_T value of the water control, a partial inhibition occurred, which can lead to negative results in weak positive samples (see chapter „Troubleshooting“).

Neither in the FAM nor in the VIC®/HEX/JOE/TET channel a signal is detected:

A diagnostic statement cannot be made.

The DNA isolation was not successful or an inhibition of the PCR has occurred. In case the control DNA was added during DNA isolation and not directly to the PCR master mix, the negative control is negative in both channels.

Figure 1 and figure 2 show examples for positive and negative real time PCR results.

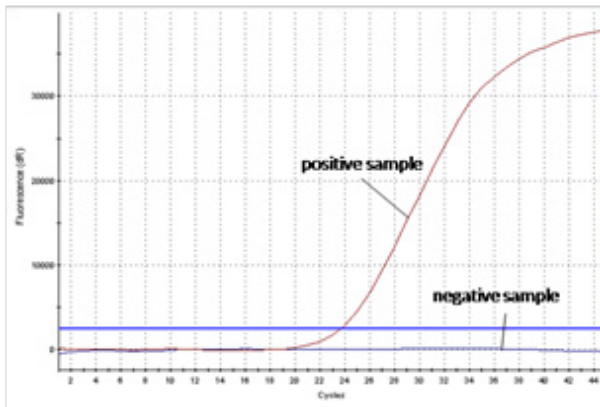


Figure 1: The positive eluate shows specific amplification in the FAM channel, whereas no fluorescence signal is detected in the negative eluate.

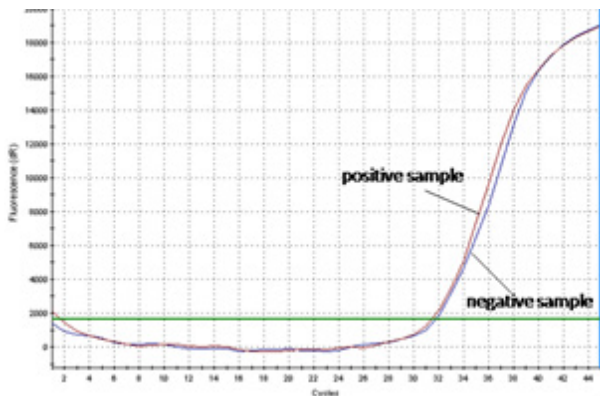


Figure 2: The positive eluate as well as the negative eluate show a signal in the control DNA-specific VIC®/HEX/JOE/TET channel. The amplification signal of the control DNA in the negative

eluate shows that the missing signal in the specific FAM channel is not due to PCR inhibition or failure of DNA isolation, but that the eluate is a true negative.

14 ASSAY VALIDATION

Set a threshold as follows:

Negative controls

All negative controls should be below the threshold. If there is a potential contamination (appearance of a curve in the negative control or a cluster of curves in specimens at high C_t – for example above 36), results obtained are not interpretable and the whole run (including extraction) has to be repeated.

Positive controls

All the positive controls must show a positive (i.e. exponential) amplification curve. The positive controls must fall below a C_t of 30.

Internal controls

All internal controls must show a positive (i.e. exponential) amplification curve. The internal control must fall below a C_t of < 33. If the internal control is above C_t 34, this points to a purification problem in DNA extraction or a strong positive eluate that can inhibit the internal control. In the latter case, the assay is valid. If a water control run is performed, the internal control must fall below a C_t of < 33.

15 LIMITATIONS

The results must always be considered in relation to the clinical symptoms. Therapeutical consequences should be made in consideration of clinical data.

A negative test result does not exclude a *Babesia* infection.

16 TROUBLESHOOTING

The following troubleshooting guide is included to help you with possible problems that may arise when performing a real time PCR. If you have further questions, please do not hesitate to contact our scientists on info@immundiagnostik.com.

No fluorescence signal in the specific channels of the positive control

The selected channel for analysis does not comply with the protocol

Select the channel according to table 7.

Incorrect configuration of the real time PCR

Check your work steps and compare with chapter „Procedure“.

The programming of the thermal profile is incorrect

Compare the thermal profile with the protocol (table 5/6).

Incorrect storage conditions for one or more kit components or kit expired

Check the storage conditions and the date of expiry printed on the kit label. If necessary, use a new kit and make sure kit components are stored as described in chapter „Transport, storage and stability“.

Weak or no signal of the control DNA and simultaneous absence of a signal in the specific channels.***Real time PCR conditions do not comply with the protocol***

Check the real time PCR conditions (see chapter „Real time PCR“).

Real time PCR inhibited

Make sure that you use an appropriate isolation method (see chapter „Sample preparation“) and follow the manufacturer’s instructions. Make sure that the ethanol-containing washing buffers have been completely removed. An additional centrifugation step at high speed is recommended before elution of the DNA.

DNA loss during isolation process

In case the control DNA was added before extraction, the lack of an amplification signal can indicate that the DNA isolation was not successful. Make sure that you use an appropriate isolation method (commercial kits are recommended) and stick to the manufacturer’s protocol.

Incorrect storage conditions for one or more components or kit expired

Check the storage conditions and the date of expiry printed on the kit label. If necessary, use a new kit and make sure kit components are stored as described in „Transport, storage and stability“.

Detection of a fluorescence signal in the bacteria specific channel of the negative control

Contamination during preparation of the PCR

Repeat the real time PCR in replicates. If the result is negative in the repetition, the contamination occurred when the samples were pipetted into the optical PCR reaction tubes. Make sure to pipet the positive control last and close the optical PCR reaction tube immediately after adding the sample. If the same result occurs, one or more of the kit components might be contaminated. Make sure that workspace and instruments are decontaminated regularly. Use a new kit and repeat the real time PCR.

17 KIT PERFORMANCE

17.1 Analytical sensitivity

The limit of detection (LoD) of MutaPLEX® Babesia was determined using serial dilutions of synthetic DNA fragments containing *Babesia microti* and *Babesia divergens* target sequence in a Stratagene Mx3000 real time PCR instrument. The results of the determinations in triplicates for the *Babesia microti* system and the *Babesia divergens* system within the MutaPLEX® Babesia real time PCR kit are shown in table 8 and table 9.

The LoD of MutaPLEX® Babesia for *Babesia* is >10 genome copies per reaction each.

Table 8: Determination of the analytical sensitivity of the *Babesia microti* system within the MutaPLEX® Babesia real time PCR kit

copies per reaction	C_T value FAM	mean C_T FAM
1.000.000	19,07	19,21
	19,86	
	18,69	
100.000	22,20	22,36
	22,52	
	22,37	
10.000	26,35	26,12
	26,02	
	26,00	

copies per reaction	C_T value FAM	mean C_T FAM
1.000	29,74	29,59
	29,64	
	29,39	
100	33,54	32,79
	32,32	
	32,51	
10	37,40	37,44
	36,79	
	38,14	
1	no C _T	no C _T
	no C _T	
	no C _T	

Table 9: Determination of the analytical sensitivity of the *Babesia divergens* system within the MutaPLEX® Babesia real time PCR kit

copies per reaction	C_T value FAM	mean C_T FAM
1.000.000	19,94	20,16
	20,41	
	20,12	
100.000	22,14	23,28
	24,35	
	23,35	
10.000	27,24	27,24
	27,51	
	26,97	
1.000	30,53	30,97
	31,32	
	31,05	

copies per reaction	C _T value FAM	mean C _T FAM
100	34,20	34,75
	34,97	
	35,08	
10	36,36	39,19
	38,22	
	42,99	
1	no C _T	no C _T
	no C _T	
	no C _T	

17.2 Analytical specificity

The specificity of the MutaPLEX® Babesia real time PCR was evaluated additionally with different other relevant viruses and bacteria found in clinical samples.

Results

The MutaPLEX® Babesia real time PCR kit showed a positive result for the samples containing *Babesia microti*, *Babesia divergens* and *Babesia sp.* EU1, whereas samples containing other pathogens were reliably tested negative. The results are shown in table 10.

Table 10: Parasite, bacterial and viral pathogens tested for the determination of the analytical specificity of the MutaPLEX® Babesia real time PCR kit

Strain	Expected result	Result MutaPLEX® Babesia
Enterovirus 68	negative	negative
Coxsackievirus B3	negative	negative
Coxsackievirus A16	negative	negative
Coxsackievirus A9	negative	negative
Coxsackievirus B5	negative	negative
Influenza virus A A/ Brisbane H1N1 59/2007 E40/08	negative	negative

Strain	Expected result	Result MutaPLEX® Babesia
Influenza virus A Indonesia H5N1 05/2005	negative	negative
Influenza virus A Panama H3N2 2007/99	negative	negative
Influenza virus B B/ Brisbane 60/2008 E09/09	negative	negative
TBEV (Tick-borne encephalitis virus)	negative	negative
<i>Ehrlichia chaffeensis</i>	negative	negative
<i>Ehrlichia ewingii</i>	negative	negative
<i>Ehrlichia canis</i>	negative	negative
<i>Ehrlichia phagocytophilum</i>	negative	negative
<i>Anaplasma platy</i>	negative	negative
<i>Coxiella burnetii</i>	negative	negative
<i>West Nile Virus</i>	negative	negative
<i>Borrelia burgdorferi</i> Strain 4681	negative	negative
<i>Borrelia burgdorferi sensu stricto</i>	negative	negative
<i>Borrelia afzelii</i>	negative	negative
<i>Borrelia garinii</i>	negative	negative
<i>Borrelia spielmanii</i>	negative	negative
<i>Borrelia bavariensis</i>	negative	negative
<i>Borrelia bisettii</i>	negative	negative
<i>Borrelia lustianae</i>	negative	negative
<i>Borrelia valaisiana</i>	negative	negative
<i>Borrelia kurtenbachii</i>	negative	negative
<i>Borrelia japonica</i>	negative	negative
<i>Borrelia miyamotoi</i>	negative	negative
<i>Treponema phagedenis</i>	negative	negative
<i>Leptospira</i>	negative	negative
<i>Babesia caballi</i>	negative	negative
<i>Babesia canis canis</i>	negative	negative

Strain	Expected result	Result MutaPLEX® Babesia
<i>Babesia canis vogeli</i>	negative	negative
<i>Babesia duncani</i>	negative	negative
<i>Babesia equi</i>	negative	negative
<i>Babesia gibsoni</i>	negative	negative
<i>Babesia divergens</i>	positive	positive
<i>Babesia microti</i>	positive	positive
<i>Babesia sp. EU1</i>	positive	positive



17.3 Diagnostic sensitivity




The diagnostic sensitivity of real time PCR assays is mainly dependent on the DNA/RNA extraction method used to isolate DNA and RNA from various clinical specimens. DNA/RNA extraction reagents are not part of the Immundiagnostik AG real time PCR kits. MutaPLEX® real time PCR kits include an extraction control and guidelines for the validation criteria of the extraction control in each reaction. The extraction control indicates inhibition of the real time PCR and/or inefficient nucleic acid extraction. It cannot be used as a calibrator.

Therefore, Immundiagnostik AG guarantees the analytical sensitivities and specificities of the real time PCR kits, performed with eluted DNA and RNA from reference materials and ring trial samples and with synthetic nucleic acid fragments. Immundiagnostik AG does not guarantee diagnostic sensitivities. If diagnostic sensitivities are mentioned in manuals of Immundiagnostik AG real time (RT-) PCR kits, the data are strictly correlated to a specific nucleic acid extraction method that has been used during the validation of the respective kits and cannot be transferred to other extraction methods.

It is the responsibility of the user, to qualify the extraction methods used for DNA/RNA isolation from clinical samples.

18 ABBREVIATIONS AND SYMBOLS

DNA	Deoxyribonucleid acid		Contains sufficient for <n> test
PCR	Polymerase chain reaction		Upper limit of temperature

REACTION MIX	Reaction mix		Manufacturer
CONTROL +	Positive control		Use by YYYY-MM-DD
CONTROL -	Negative control	LOT	Batch
CONTROL DNA IC	Control DNA	CONT	Content
REF	Catalog number		Consult instructions for use
→REF	To be used with	IVD	<i>In vitro</i> diagnostic medical device

19 LITERATURE

1. Tuvshintulga, B. et al. First detection of *Babesia venatorum* (EU1) in *Ixodes persulcatus* ticks in Mongolia. *J. Protozool. Res.* 25, 29-37 (2015).
2. Karbowski G. Zoonotic reservoir of *Babesia microti* in Poland. *Pol. J. Microbiol.* 53 Suppl: 61–5 (2004).

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