

***Babesia* sp., Strain MO1 (in vitro)**

**Catalog No. NR-50441**

**For research use only. Not for use in humans.**

**Contributor:**

Patricia J. Holman, Research Associate Professor, Department of Veterinary Pathobiology, Texas A&M University, College Station, Texas, USA

**Manufacturer:**

BEI Resources

**Product Description:**

Protozoa Classification: Apicomplexa, *Babesia*

Species: *Babesia* sp.

Strain: MO1 (also referred to as strain NR774<sup>1,2</sup>)

Original Source: *Babesia* sp., strain MO1 was isolated in 2003 from the blood of a wild Eastern cottontail rabbit (*Sylvilagus floridanus*) on Nantucket Island, Massachusetts, USA, and adapted to continuous *in vitro* culture in human erythrocytes.<sup>1,2</sup>

*Babesia* species are intraerythrocytic protozoan parasites of the phylum Apicomplexa that are the causal agents of babesiosis, which is transmitted to both humans and mammals by infected ixodid ticks.<sup>4,5,6</sup> In humans, babesiosis is usually asymptomatic or can result in mild flu-like symptoms that subside within a few days. Severe cases featuring acute anemia, thrombocytopenia, organ failure, or even death may occur among the elderly, splenectomized and immunocompromised individuals.<sup>4,5</sup> Four species of *Babesia* confirmed to infect humans have been identified: *B. microti*, *B. divergens*, *B. duncani* and *B. venatorum*.<sup>3</sup> *B. microti* has a worldwide distribution and is the most commonly identified etiologic agent of human babesiosis in the United States.<sup>3</sup> In Europe, *B. divergens* is the primary cause of babesiosis in humans and cattle.<sup>4</sup>

The small-subunit ribosomal RNA (SSU rRNA) sequence of *Babesia* sp., strain MO1 is identical to that of the three cases of human babesiosis in the United States, suggesting that the cottontail rabbit is a potential reservoir host.<sup>2,6,7</sup>

**Material Provided:**

Each vial contains approximately 0.5 mL of infected human erythrocytes in Glycerolyte 57 solution. Please see Appendix I for cryopreservation instructions.

**Packaging/Storage:**

NR-50441 was packaged aseptically in screw-capped plastic cryovials and is provided frozen on dry ice. The product should be stored at -130°C or colder, preferably in the vapor phase of a liquid nitrogen freezer. If liquid nitrogen storage facilities are not available, frozen cryovials may be stored at -70°C or colder for approximately one week.

Note: Do not under any circumstances store vials at temperatures warmer than -70°C. Storage under these conditions will result in the death of the culture.

To ensure the highest level of viability, the culture should be initiated immediately upon receipt. Any warming of the product during shipping and transfer must be avoided, as this will adversely affect the viability of the product. For transfer between freezers and for shipping, the product may be placed on dry ice for brief periods, although use of a portable liquid nitrogen carrier is preferred. Please read the following recommendations prior to using this material.

**Growth Conditions:**

*Babesia* Growth Medium (Appendix II)

Human erythrocytes (Appendix III)

Incubation:

Temperature: 37°C

Atmosphere: Initially, in a humidified atmosphere of 93% N<sub>2</sub>, 5% CO<sub>2</sub>, 2% O<sub>2</sub>. Once cultures are established, a humidified, ambient atmosphere with 5% CO<sub>2</sub>.

Propagation:

1. Place the frozen vial in a 35°C to 37°C water bath until the culture is completely thawed. Transfer the vial to a biological safety hood and wipe the outside surface of the vial with 70% ethanol.
2. Immediately after thawing, aseptically transfer the contents of the vial to a sterile 50 mL conical centrifuge tube using a 1 mL pipette.
3. Add dropwise a 12% sodium chloride (NaCl) solution to reach approximately a 1:5 ratio of NaCl to cell mixture (approximately 0.2× the original culture volume). Allow the vial to incubate for 5 minutes at room temperature.
4. Using a 10 mL pipette, add dropwise while shaking 10 volumes of a 1.6% NaCl solution (10:1 ratio of NaCl to original culture volume).
5. Centrifuge at 400 × g for 5 minutes. Remove the supernatant, leaving approximately 0.5 mL to 1 mL of supernatant in the tube. Resuspend the cells by gently swirling the tube.
6. Add dropwise while shaking 10 volumes of growth medium. Centrifuge at 400 × g for 5 minutes and carefully remove the supernatant.
7. Add 5 mL of growth medium (warmed to 37°C) and transfer the culture to a vented cap 25-cm<sup>2</sup> cell culture flask (T-25).
8. For continuous culture, add uninfected donor red blood cells (RBCs) to a 10% hematocrit solution.
9. Gently aerate the culture with a 95% air, 5% CO<sub>2</sub> mixture through a sterile, 2 mL Pasteur pipet.
10. Incubate the flask at 37°C. Monitor the infection daily by microscopic examination of blood films stained with a 5% Giemsa solution. Subculture when the culture reaches ≥ 6% parasitemia.

Assessment of infection:

1. To determine parasitemia of the culture, prepare thin smears of 1 µL to 3 µL of cell culture samples on microscopic slides. Fix in methanol, allow to air dry. Stain with a 5% Giemsa solution, allowing the slides to incubate in the stain for 40 minutes. Prepare fresh Giemsa stain on a daily basis.
2. Examine the slides under a microscope at 1000× magnification for the presence of intracellular parasite forms.

- Count the number of infected red blood cells (RBC) versus the total number of red blood cells under oil immersion and determine the % parasitemia:

$$\% \text{ parasitemia} = (\text{Infected RBC} / \text{Total RBC}) \times 100$$

**Note:** A minimum of 500 red blood cells should be counted.

**Maintenance:**

- When the culture is at or near peak density, carefully aspirate the supernatant with a sterile, unplugged Pasteur pipet under vacuum, removing as much of the supernatant as possible without aspirating the red blood cells and determine parasitemia.
- Carefully remove a small cell sample for microscopic examination by Giemsa staining.
- To the flask, gently add 5 to 10 mL of sterile growth medium warmed to 37°C in a water bath. Mix the media and red blood cells by gently swirling. Aerate the flask, tighten the cap and incubate at 37°C.
- Monitor the culture every 2 to 3 days. Subculture when the culture reaches ≥ 6% parasitemia. Alternatively, add uninfected RBCs every 3 days to increase the parasitemia within the same culture flask.

**Note:** During continuous incubation, the growth medium of *Babesia* sp., strain MO1 may change color and range from bright red to almost black as a result of oxygen utilization by the parasites and deoxygenation of hemoglobin.<sup>8</sup>

Please refer to Appendix I for cryopreservation, Appendix II for medium preparation instructions and Appendix III for preparation of human erythrocytes instructions.

**Citation:**

Acknowledgment for publications should read “The following reagent was obtained through BEI Resources, NIAID, NIH: *Babesia* sp., Strain MO1 (*in vitro*), NR-50441.”

**Biosafety Level: 2**

Appropriate safety procedures should always be used with this material. Laboratory safety is discussed in the following publication: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, and National Institutes of Health. [Biosafety in Microbiological and Biomedical Laboratories \(BMBL\)](#), 6th ed. Washington, DC: U.S. Government Printing Office, 2020.

All blood cultures should be handled with appropriate safety precautions necessary for the handling of bloodborne pathogens. Personnel must be trained in accordance with their institutional policy regarding bloodborne pathogens.

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## APPENDIX I: CRYOPRESERVATION

1. Harvest *Babesia* cultures from multiple flasks using a pipette and transfer the cell suspensions to 15 mL or 50 mL plastic centrifuge tubes. Cultures should be well established and growing vigorously with a parasitemia  $\geq 4\%$ .
2. Centrifuge at  $1000 \times g$  for 5 minutes at room temperature.
3. Wash the pellet once with 10 or more volumes of incomplete RPMI 1640 medium. Centrifuge the cell suspension at  $1000 \times g$  for 5 minutes. Remove the supernatant, leaving enough supernatant to resuspend the pellet. Estimate the volume of the remaining cell suspension.
4. To the volume of packed red blood cells, slowly add dropwise one volume of cold ( $4^{\circ}\text{C}$ ) Glycerolyte 57 solution (or equivalent). Allow to incubate for 5 minutes at room temperature.
5. Add dropwise an additional 4 volumes of cold Glycerolyte 57 solution to the pellet and mix well.
6. Dispense 0.5 mL aliquots into 1 mL to 2 mL sterile plastic screw-capped vials for cryopreservation.
7. Place the vials in a controlled rate freezing unit. From room temperature cool the vials at  $-1^{\circ}\text{C}/\text{min}$  to  $-40^{\circ}\text{C}$ . If the freezing unit can compensate for the heat of fusion, maintain rate at  $-1^{\circ}\text{C}/\text{min}$  through this phase. At  $-40^{\circ}\text{C}$ , plunge vials into liquid nitrogen. Alternatively, place the vials in a Nalgene  $1^{\circ}\text{C}$  freezing container. Place the container at  $-80^{\circ}\text{C}$  for 1 to 2 days and then plunge vials into liquid nitrogen.
8. Store in either the vapor or liquid phase of a nitrogen refrigerator ( $-130^{\circ}\text{C}$  or colder).

## APPENDIX II: *BABESIA* GROWTH MEDIUM

1. Prepare a 10 mM hypoxanthine and 1.6 mM thymidine stock solution in distilled, deionized water and filter sterilize using a  $0.22 \mu\text{m}$  filter. An equivalent prepared solution may also be used. The final concentration in the *Babesia* Growth Medium is 200  $\mu\text{M}$  hypoxanthine and 32  $\mu\text{M}$  thymidine.
2. Aseptically prepare the *Babesia* Growth Medium (see recipe below), filter sterilize using a  $0.22 \mu\text{m}$  filter and store at  $4^{\circ}\text{C}$ . Use prepared medium within two weeks. Adjust the complete medium pH to 7.2, if needed.

### Babesia Growth Medium

DMEM/F12 Medium with L-glutamine	75 mL
Human Serum Type A Positive	20 mL
HB 101® supplement (Irvine Scientific® T151)	1 mL
200 mM L-glutamine stock solution (ATCC® 30-2214™)	1 mL
10 mM Hypoxanthine/1.6 mM Thymidine stock solution	2 mL

**Note:** To prevent culture contamination, Penicillin-Streptomycin-Amphotericin B (Antibiotic/Antimycotic) Solution (ATCC® PCS-999-002™) may be added to a final concentration of 100 IU/mL penicillin, 100  $\mu\text{g}/\text{mL}$  streptomycin and 0.25  $\mu\text{g}/\text{mL}$  amphotericin B. Gentamicin may also be added to a final concentration of 100  $\mu\text{g}/\text{mL}$ .

## APPENDIX III: PREPARATION OF HUMAN ERYTHROCYTES

1. Prepare the Puck's Saline Glucose (PSG) medium (see recipe below), mix well, adjust pH to 7.2, and adjust the volume to 1 L with distilled, deionized water. Filter sterilize using a  $0.22 \mu\text{m}$  filter and store at  $4^{\circ}\text{C}$ .
2. Prepare the PSG+G solution (see recipe below), mix well, filter sterilize using a  $0.22 \mu\text{m}$  filter and store at  $4^{\circ}\text{C}$ .

### Puck's Saline Glucose Medium

CaCl <sub>2</sub> • 7H <sub>2</sub> O	0.016 g
KCl	0.40 g
KH <sub>2</sub> PO <sub>4</sub>	0.15 g
MgSO <sub>4</sub> • 7H <sub>2</sub> O	0.15 g
NaCl	8.0 g
Na <sub>2</sub> HPO <sub>4</sub> • 7H <sub>2</sub> O	0.29 g
D-glucose	1.10 g
Phenol red	0.005 g
Distilled, deionized water to	1 L

### PSG+G Solution

Puck's Saline Glucose Medium	500 mL
D-glucose	10 g
Antibiotic/Antimycotic Solution (ATCC® PCS-999-002™)	5 mL

3. Aseptically, wash donor blood three times by centrifugation at 600 to 800 × g for 15 minutes at 4°C in RPMI 1640 medium.
4. After each wash, aseptically remove the supernatant, consisting of the plasma and buffy (leukocyte) layers located on the top of the red blood cell (erythrocyte) pellet.
5. After the last wash, aseptically resuspend human erythrocytes in sterile PSG+G solution at a concentration of 50% erythrocytes. The human erythrocytes in PSG+G solution may be stored at 4°C until use, for a maximum of two weeks.