

Supplemental file 3 – SPARQL queries of *Brucella* mutants that are attenuated inside macrophages during the macrophage-*Brucella* interactions

This supplemental file includes two scripts, both related to the queries of *Brucella* mutants that are attenuated inside macrophages during the macrophage-*Brucella* interactions.

- Query 1: SPARQL query of **the total number of** *Brucella* mutants that are attenuated inside macrophages during a macrophage-*Brucella* interaction (IDO_0100832).
- Query 2: SPARQL query of **the list of** *Brucella* mutants that are attenuated inside macrophages during a macrophage-*Brucella* interaction (IDO_0100832).

Note: each mutant is associated with one gene and one protein. Therefore, these queries also found those virulence genes and protein virulence factors that participate in various macrophage-*Brucella* interactions.

```
#####
#this query was running on http://sparql.hegroup.org/sparql
# Date: on 3/23/2015
# IDOBRU version: 86
#
#####

#SPARQL query 1: the total number of Brucella mutants that are attenuated inside macrophages during
a macrophage-Brucella interaction
#
# IDO_0100879 attenuated disposition;
# IDO_0100832 macrophage-Brucella interaction;
# BFO_0000051 has part
# BFO_0000112 has disposition at some time
# BFO_0000054 realized in

prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix owl: <http://www.w3.org/2002/07/owl#>

SELECT (count(distinct ?s) as ?count)
from <http://purl.obolibrary.org/obo/merged/IDOBRU>

WHERE {
?s rdfs:subClassOf ?n6 .
?n6 owl:complementOf ?n7.
?n7 owl:onProperty <http://purl.obolibrary.org/obo/BFO_0000051>; owl:someValuesFrom ?p.
{
SELECT ?s
WHERE
{
?n rdfs:subClassOf ?n1 .
?n1 owl:onProperty <http://purl.obolibrary.org/obo/BFO_0000112>; owl:someValuesFrom ?n2.
?n2 owl:intersectionOf ?n3 .
```

```

?n3 rdf:first <http://purl.obolibrary.org/obo/IDO_0100879>; rdf:rest ?n4 .
?n4 rdf:first ?n5 .
?n5 owl:onProperty <http://purl.obolibrary.org/obo/BFO_0000054>; owl:someValuesFrom
<http://purl.obolibrary.org/obo/IDO_0100832> .
?s rdfs:subClassOf ?n .
}
}
FILTER REGEX(str(?p), "PR") .
}

```

```

#####
#Result: (as returned by the server on 3/24/2015 12:18pm)
count
269
#####

```

```

#SPARQL query 2: the list of Brucella mutants that are attenuated inside macrophages during a
macrophage-Brucella interaction
#
# IDO_0100879 attenuated disposition;
# IDO_0100832 macrophage-Brucella interaction;
# BFO_0000051 has part
# BFO_0000112 has disposition at some time
# BFO_0000054 realized in

```

```

prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix owl: <http://www.w3.org/2002/07/owl#>

```

```

SELECT distinct ?s ?l

```

```

from <http://purl.obolibrary.org/obo/merged/IDOBRO>

```

```

WHERE {
?s rdfs:subClassOf ?n6 .
?n6 owl:complementOf ?n7.
?n7 owl:onProperty <http://purl.obolibrary.org/obo/BFO_0000051>; owl:someValuesFrom ?p.
?s rdfs:label ?l .
{
SELECT ?s
WHERE
{
?n rdfs:subClassOf ?n1 .
?n1 owl:onProperty <http://purl.obolibrary.org/obo/BFO_0000112>; owl:someValuesFrom ?n2.
?n2 owl:intersectionOf ?n3 .
?n3 rdf:first <http://purl.obolibrary.org/obo/IDO_0100879>; rdf:rest ?n4 .
?n4 rdf:first ?n5 .
?n5 owl:onProperty <http://purl.obolibrary.org/obo/BFO_0000054>; owl:someValuesFrom
<http://purl.obolibrary.org/obo/IDO_0100832> .

```

```
?s rdfs:subClassOf ?n .
}
}
FILTER REGEX(str(?p), "PR") .
}
```

#####

Result: (as returned by the server on 3/24/2015 12:20pm)

(269 rows)

| s | l |
|---|---------------------------|
| http://purl.obolibrary.org/obo/IDO_0110000 | B. suis 1330 rbsK mutant |
| http://purl.obolibrary.org/obo/IDO_0110001 | B. suis 1330 mgtB mutant |
| http://purl.obolibrary.org/obo/IDO_0110002 | B. suis 1330 nodV mutant |
| http://purl.obolibrary.org/obo/IDO_0110006 | B. suis 1330 virB9 mutant |
| http://purl.obolibrary.org/obo/IDO_0110009 | B. suis 1330 virB5 mutant |
| http://purl.obolibrary.org/obo/IDO_0110010 | B. suis 1330 virB4 mutant |
| http://purl.obolibrary.org/obo/IDO_0110012 | B. suis 1330 virB2 mutant |
| http://purl.obolibrary.org/obo/IDO_0110013 | B. suis 1330 virB1 mutant |
| http://purl.obolibrary.org/obo/IDO_0110014 | B. suis 1330 hemH mutant |
| http://purl.obolibrary.org/obo/IDO_0110017 | B. suis 1330 vjbR mutant |
| http://purl.obolibrary.org/obo/IDO_0110018 | B. suis 1330 gtrB mutant |
| http://purl.obolibrary.org/obo/IDO_0110019 | B. suis 1330 deoR mutant |
| http://purl.obolibrary.org/obo/IDO_0110021 | B. suis 1330 gntR mutant |
| http://purl.obolibrary.org/obo/IDO_0110022 | B. suis 1330 caiB mutant |
| http://purl.obolibrary.org/obo/IDO_0110024 | B. suis 1330 norD mutant |
| http://purl.obolibrary.org/obo/IDO_0110025 | B. suis 1330 narG mutant |
| http://purl.obolibrary.org/obo/IDO_0110027 | B. suis 1330 wbpW mutant |
| http://purl.obolibrary.org/obo/IDO_0110028 | B. suis 1330 manB mutant |
| http://purl.obolibrary.org/obo/IDO_0110030 | B. suis 1330 xfp mutant |
| http://purl.obolibrary.org/obo/IDO_0110031 | B. suis 1330 glpK mutant |
| http://purl.obolibrary.org/obo/IDO_0110034 | B. suis 1330 cydC mutant |
| http://purl.obolibrary.org/obo/IDO_0110036 | B. suis 1330 rbsC mutant |
| http://purl.obolibrary.org/obo/IDO_0110038 | B. suis 1330 aidB mutant |
| http://purl.obolibrary.org/obo/IDO_0110044 | B. suis 1330 fbpA mutant |
| http://purl.obolibrary.org/obo/IDO_0110045 | B. suis 1330 sodC mutant |
| http://purl.obolibrary.org/obo/IDO_0110048 | B. suis 1330 gcvT mutant |
| http://purl.obolibrary.org/obo/IDO_0110050 | B. suis 1330 zwf mutant |
| http://purl.obolibrary.org/obo/IDO_0110051 | B. suis 1330 nikA mutant |
| http://purl.obolibrary.org/obo/IDO_0110052 | B. suis 1330 galcD mutant |
| http://purl.obolibrary.org/obo/IDO_0110053 | B. suis 1330 eryB mutant |
| http://purl.obolibrary.org/obo/IDO_0110057 | B. suis 1330 dacF mutant |
| http://purl.obolibrary.org/obo/IDO_0110058 | B. suis 1330 cobW mutant |
| http://purl.obolibrary.org/obo/IDO_0110059 | B. suis 1330 dppA mutant |

| | |
|---|---------------------------|
| http://purl.obolibrary.org/obo/IDO_0110060 | B. suis 1330 znuA mutant |
| http://purl.obolibrary.org/obo/IDO_0110061 | B. suis 1330 znuC mutant |
| http://purl.obolibrary.org/obo/IDO_0110065 | B. suis 1330 rpsA mutant |
| http://purl.obolibrary.org/obo/IDO_0110066 | B. suis 1330 pheA mutant |
| http://purl.obolibrary.org/obo/IDO_0110068 | B. suis 1330 ilvD mutant |
| http://purl.obolibrary.org/obo/IDO_0110070 | B. suis 1330 glnD mutant |
| http://purl.obolibrary.org/obo/IDO_0110071 | B. suis 1330 cysI mutant |
| http://purl.obolibrary.org/obo/IDO_0110072 | B. suis 1330 metH mutant |
| http://purl.obolibrary.org/obo/IDO_0110073 | B. suis 1330 malK mutant |
| http://purl.obolibrary.org/obo/IDO_0110074 | B. suis 1330 hisD mutant |
| http://purl.obolibrary.org/obo/IDO_0110075 | B. suis 1330 pgi mutant |
| http://purl.obolibrary.org/obo/IDO_0110077 | B. suis 1330 vsrB mutant |
| http://purl.obolibrary.org/obo/IDO_0110078 | B. suis 1330 bacA mutant |
| http://purl.obolibrary.org/obo/IDO_0110079 | B. suis 1330 purD mutant |
| http://purl.obolibrary.org/obo/IDO_0110080 | B. suis 1330 aroC mutant |
| http://purl.obolibrary.org/obo/IDO_0110082 | B. suis 1330 purF mutant |
| http://purl.obolibrary.org/obo/IDO_0110084 | B. suis 1330 thrC mutant |
| http://purl.obolibrary.org/obo/IDO_0110085 | B. suis 1330 dsbA mutant |
| http://purl.obolibrary.org/obo/IDO_0110086 | B. suis 1330 wbpL mutant |
| http://purl.obolibrary.org/obo/IDO_0110088 | B. suis 1330 rfbD mutant |
| http://purl.obolibrary.org/obo/IDO_0110089 | B. suis 1330 perA mutant |
| http://purl.obolibrary.org/obo/IDO_0110092 | B. suis 1330 pmm mutant |
| http://purl.obolibrary.org/obo/IDO_0110093 | B. suis 1330 wbpZ mutant |
| http://purl.obolibrary.org/obo/IDO_0110094 | B. suis 1330 feuP mutant |
| http://purl.obolibrary.org/obo/IDO_0110095 | B. suis 1330 feuQ mutant |
| http://purl.obolibrary.org/obo/IDO_0110096 | B. suis 1330 htrA mutant |
| http://purl.obolibrary.org/obo/IDO_0110097 | B. suis 1330 lpsA mutant |
| http://purl.obolibrary.org/obo/IDO_0110099 | B. suis 1330 spotT mutant |
| http://purl.obolibrary.org/obo/IDO_0110104 | B. suis 1330 glyA mutant |
| http://purl.obolibrary.org/obo/IDO_0110105 | B. suis 1330 purL mutant |
| http://purl.obolibrary.org/obo/IDO_0110107 | B. suis 1330 dsbA mutant |
| http://purl.obolibrary.org/obo/IDO_0110108 | B. suis 1330 amiC mutant |
| http://purl.obolibrary.org/obo/IDO_0110109 | B. suis 1330 nifS mutant |
| http://purl.obolibrary.org/obo/IDO_0110110 | B. suis 1330 dsbA mutant |
| http://purl.obolibrary.org/obo/IDO_0110112 | B. suis 1330 wbdA mutant |
| http://purl.obolibrary.org/obo/IDO_0110113 | B. suis 1330 glnA mutant |
| http://purl.obolibrary.org/obo/IDO_0110114 | B. suis 1330 cysK mutant |
| http://purl.obolibrary.org/obo/IDO_0110115 | B. suis 1330 caiB mutant |
| http://purl.obolibrary.org/obo/IDO_0110116 | B. suis 1330 uvrA mutant |
| http://purl.obolibrary.org/obo/IDO_0110118 | B. suis 1330 hfq mutant |
| http://purl.obolibrary.org/obo/IDO_0110121 | B. suis 1330 ppiD mutant |
| http://purl.obolibrary.org/obo/IDO_0110122 | B. suis 1330 uppS mutant |
| http://purl.obolibrary.org/obo/IDO_0110125 | B. suis 1330 gloA mutant |

| | |
|---|-----------------------------------|
| http://purl.obolibrary.org/obo/IDO_0110127 | B. suis 1330 aspB mutant |
| http://purl.obolibrary.org/obo/IDO_0110129 | B. suis 1330 miaA mutant |
| http://purl.obolibrary.org/obo/IDO_0110130 | B. suis 1330 serB mutant |
| http://purl.obolibrary.org/obo/IDO_0110131 | B. suis 1330 pncA mutant |
| http://purl.obolibrary.org/obo/IDO_0110132 | B. suis 1330 pncA mutant |
| http://purl.obolibrary.org/obo/IDO_0110134 | B. suis 1330 lysR mutant |
| http://purl.obolibrary.org/obo/IDO_0110135 | B. suis 1330 pth mutant |
| http://purl.obolibrary.org/obo/IDO_0110136 | B. suis 1330 leuA mutant |
| http://purl.obolibrary.org/obo/IDO_0110137 | B. suis 1330 dsbB mutant |
| http://purl.obolibrary.org/obo/IDO_0110138 | B. suis 1330 alkA mutant |
| http://purl.obolibrary.org/obo/IDO_0110139 | B. suis 1330 macA mutant |
| http://purl.obolibrary.org/obo/IDO_0110140 | B. suis 1330 dut mutant |
| http://purl.obolibrary.org/obo/IDO_0110141 | B. suis 1330 ansC mutant |
| http://purl.obolibrary.org/obo/IDO_0110142 | B. suis 1330 purE mutant |
| http://purl.obolibrary.org/obo/IDO_0110143 | B. suis 1330 pyc mutant |
| http://purl.obolibrary.org/obo/IDO_0110145 | B. suis 1330 purH mutant |
| http://purl.obolibrary.org/obo/IDO_0110146 | B. suis 1330 leuC mutant |
| http://purl.obolibrary.org/obo/IDO_0110147 | B. suis 1330 rplS mutant |
| http://purl.obolibrary.org/obo/IDO_0110149 | B. suis 1330 lysA mutant |
| http://purl.obolibrary.org/obo/IDO_0110150 | B. suis 1330 hpt mutant |
| http://purl.obolibrary.org/obo/IDO_0110152 | B. suis 1330 hisF mutant |
| http://purl.obolibrary.org/obo/IDO_0110153 | B. suis 1330 bvrR mutant |
| http://purl.obolibrary.org/obo/IDO_0110154 | B. suis 1330 bvrS mutant |
| http://purl.obolibrary.org/obo/IDO_0110155 | B. suis 1330 dnaK mutant |
| http://purl.obolibrary.org/obo/IDO_0110156 | B. suis 1330 pmtA mutant |
| http://purl.obolibrary.org/obo/IDO_0110158 | B. melitensis 16M hpt mutant |
| http://purl.obolibrary.org/obo/IDO_0110159 | B. melitensis 16M lysA mutant |
| http://purl.obolibrary.org/obo/IDO_0110160 | B. melitensis 16M BMEI0085 mutant |
| http://purl.obolibrary.org/obo/IDO_0110162 | B. melitensis 16M rplS mutant |
| http://purl.obolibrary.org/obo/IDO_0110163 | B. melitensis 16M leuC mutant |
| http://purl.obolibrary.org/obo/IDO_0110165 | B. melitensis 16M pstP mutant |
| http://purl.obolibrary.org/obo/IDO_0110166 | B. melitensis 16M purH mutant |
| http://purl.obolibrary.org/obo/IDO_0110168 | B. melitensis 16M pyc mutant |
| http://purl.obolibrary.org/obo/IDO_0110170 | B. melitensis 16M mgps mutant |
| http://purl.obolibrary.org/obo/IDO_0110171 | B. melitensis 16M purE mutant |
| http://purl.obolibrary.org/obo/IDO_0110174 | B. melitensis 16M ansC mutant |
| http://purl.obolibrary.org/obo/IDO_0110175 | B. melitensis 16M dut mutant |
| http://purl.obolibrary.org/obo/IDO_0110176 | B. melitensis 16M macA mutant |
| http://purl.obolibrary.org/obo/IDO_0110177 | B. melitensis 16M alkA mutant |
| http://purl.obolibrary.org/obo/IDO_0110178 | B. melitensis 16M dsbB mutant |
| http://purl.obolibrary.org/obo/IDO_0110180 | B. melitensis 16M dppA mutant |
| http://purl.obolibrary.org/obo/IDO_0110181 | B. melitensis 16M leuA mutant |
| http://purl.obolibrary.org/obo/IDO_0110182 | B. melitensis 16M BMEI0455 mutant |

| | |
|---|-----------------------------------|
| http://purl.obolibrary.org/obo/IDO_0110183 | B. melitensis 16M pth mutant |
| http://purl.obolibrary.org/obo/IDO_0110184 | B. melitensis 16M lpsB mutant |
| http://purl.obolibrary.org/obo/IDO_0110186 | B. melitensis 16M lysR mutant |
| http://purl.obolibrary.org/obo/IDO_0110188 | B. melitensis 16M carAB mutant |
| http://purl.obolibrary.org/obo/IDO_0110189 | B. melitensis 16M pncA mutant |
| http://purl.obolibrary.org/obo/IDO_0110190 | B. melitensis 16M bicA mutant |
| http://purl.obolibrary.org/obo/IDO_0110191 | B. melitensis 16M serB mutant |
| http://purl.obolibrary.org/obo/IDO_0110192 | B. melitensis 16M miaA mutant |
| http://purl.obolibrary.org/obo/IDO_0110193 | B. melitensis 16M ilvI mutant |
| http://purl.obolibrary.org/obo/IDO_0110195 | B. melitensis 16M aspB mutant |
| http://purl.obolibrary.org/obo/IDO_0110196 | B. melitensis 16M BMEI0671 mutant |
| http://purl.obolibrary.org/obo/IDO_0110198 | B. melitensis 16M thrA mutant |
| http://purl.obolibrary.org/obo/IDO_0110199 | B. melitensis 16M gloA mutant |
| http://purl.obolibrary.org/obo/IDO_0110202 | B. melitensis 16M uppS mutant |
| http://purl.obolibrary.org/obo/IDO_0110203 | B. melitensis 16M ppiD mutant |
| http://purl.obolibrary.org/obo/IDO_0110205 | B. melitensis 16M hfq mutant |
| http://purl.obolibrary.org/obo/IDO_0110207 | B. melitensis 16M uvrA mutant |
| http://purl.obolibrary.org/obo/IDO_0110209 | B. melitensis 16M caiB mutant |
| http://purl.obolibrary.org/obo/IDO_0110210 | B. melitensis 16M cysK mutant |
| http://purl.obolibrary.org/obo/IDO_0110211 | B. melitensis 16M glnA mutant |
| http://purl.obolibrary.org/obo/IDO_0110212 | B. melitensis 16M wbdA mutant |
| http://purl.obolibrary.org/obo/IDO_0110214 | B. melitensis 16M dsbA mutant |
| http://purl.obolibrary.org/obo/IDO_0110215 | B. melitensis 16M nifS mutant |
| http://purl.obolibrary.org/obo/IDO_0110216 | B. melitensis 16M amiC mutant |
| http://purl.obolibrary.org/obo/IDO_0110217 | B. melitensis 16M dsbA mutant |
| http://purl.obolibrary.org/obo/IDO_0110220 | B. melitensis 16M cbbE mutant |
| http://purl.obolibrary.org/obo/IDO_0110221 | B. melitensis 16M purL mutant |
| http://purl.obolibrary.org/obo/IDO_0110222 | B. melitensis 16M glyA mutant |
| http://purl.obolibrary.org/obo/IDO_0110224 | B. melitensis 16M galE mutant |
| http://purl.obolibrary.org/obo/IDO_0110229 | B. melitensis 16M pyrC mutant |
| http://purl.obolibrary.org/obo/IDO_0110230 | B. melitensis 16M spotT mutant |
| http://purl.obolibrary.org/obo/IDO_0110231 | B. melitensis 16M lpsA mutant |
| http://purl.obolibrary.org/obo/IDO_0110232 | B. melitensis 16M htrA mutant |
| http://purl.obolibrary.org/obo/IDO_0110233 | B. melitensis 16M feuQ mutant |
| http://purl.obolibrary.org/obo/IDO_0110234 | B. melitensis 16M feuP mutant |
| http://purl.obolibrary.org/obo/IDO_0110235 | B. melitensis 16M BMEI1339 mutant |
| http://purl.obolibrary.org/obo/IDO_0110237 | B. melitensis 16M wbpZ mutant |
| http://purl.obolibrary.org/obo/IDO_0110238 | B. melitensis 16M pmm mutant |
| http://purl.obolibrary.org/obo/IDO_0110240 | B. melitensis 16M rfbD mutant |
| http://purl.obolibrary.org/obo/IDO_0110241 | B. melitensis 16M perA mutant |
| http://purl.obolibrary.org/obo/IDO_0110242 | B. melitensis 16M wbpL mutant |
| http://purl.obolibrary.org/obo/IDO_0110243 | B. melitensis 16M dsbA mutant |
| http://purl.obolibrary.org/obo/IDO_0110244 | B. melitensis 16M BMEI1443 mutant |

| | |
|---|------------------------------------|
| http://purl.obolibrary.org/obo/IDO_0110245 | B. melitensis 16M BMEI1448 mutant |
| http://purl.obolibrary.org/obo/IDO_0110246 | B. melitensis 16M thrC mutant |
| http://purl.obolibrary.org/obo/IDO_0110248 | B. melitensis 16M purF mutant |
| http://purl.obolibrary.org/obo/IDO_0110250 | B. melitensis 16M aroC mutant |
| http://purl.obolibrary.org/obo/IDO_0110251 | B. melitensis 16M purD mutant |
| http://purl.obolibrary.org/obo/IDO_0110252 | B. melitensis 16M BMEI1531 mutant |
| http://purl.obolibrary.org/obo/IDO_0110253 | B. melitensis 16M bacA mutant |
| http://purl.obolibrary.org/obo/IDO_0110255 | B. melitensis 16M vsrB mutant |
| http://purl.obolibrary.org/obo/IDO_0110257 | B. melitensis 16M pgi mutant |
| http://purl.obolibrary.org/obo/IDO_0110258 | B. melitensis 16M BMEI1658 mutant |
| http://purl.obolibrary.org/obo/IDO_0110259 | B. melitensis 16M hisD mutant |
| http://purl.obolibrary.org/obo/IDO_0110260 | B. melitensis 16M malK mutant |
| http://purl.obolibrary.org/obo/IDO_0110262 | B. melitensis 16M metH mutant |
| http://purl.obolibrary.org/obo/IDO_0110263 | B. melitensis 16M cysI mutant |
| http://purl.obolibrary.org/obo/IDO_0110264 | B. melitensis 16M glnL mutant |
| http://purl.obolibrary.org/obo/IDO_0110265 | B. melitensis 16M glnD mutant |
| http://purl.obolibrary.org/obo/IDO_0110266 | B. melitensis 16M BMEI1809 mutant |
| http://purl.obolibrary.org/obo/IDO_0110268 | B. melitensis 16M BMEI1844 mutant |
| http://purl.obolibrary.org/obo/IDO_0110269 | B. melitensis 16M ilvD mutant |
| http://purl.obolibrary.org/obo/IDO_0110270 | B. melitensis 16M cysY mutant |
| http://purl.obolibrary.org/obo/IDO_0110271 | B. melitensis 16M BMEI1859 mutant |
| http://purl.obolibrary.org/obo/IDO_0110272 | B. melitensis 16M BMEI1879 mutant |
| http://purl.obolibrary.org/obo/IDO_0110274 | B. melitensis 16M BMEI1902 mutant |
| http://purl.obolibrary.org/obo/IDO_0110276 | B. melitensis 16M rpsA mutant |
| http://purl.obolibrary.org/obo/IDO_0110278 | B. melitensis 16M dnaK mutant |
| http://purl.obolibrary.org/obo/IDO_0110279 | B. melitensis 16M bvrS mutant |
| http://purl.obolibrary.org/obo/IDO_0110280 | B. melitensis 16M bvrR mutant |
| http://purl.obolibrary.org/obo/IDO_0110281 | B. melitensis 16M hisF mutant |
| http://purl.obolibrary.org/obo/IDO_0110283 | B. melitensis 16M hemH mutant |
| http://purl.obolibrary.org/obo/IDO_0110284 | B. melitensis 16M virb1 mutant |
| http://purl.obolibrary.org/obo/IDO_0110285 | B. melitensis 16M virB2 mutant |
| http://purl.obolibrary.org/obo/IDO_0110287 | B. melitensis 16M virb4 mutant |
| http://purl.obolibrary.org/obo/IDO_0110288 | B. melitensis 16M virB5 mutant |
| http://purl.obolibrary.org/obo/IDO_0110291 | B. melitensis 16M virb9 mutant |
| http://purl.obolibrary.org/obo/IDO_0110293 | B. melitensis 16M virb11 mutant |
| http://purl.obolibrary.org/obo/IDO_0110296 | B. melitensis 16M nodV mutant |
| http://purl.obolibrary.org/obo/IDO_0110297 | B. melitensis 16M mgtB mutant |
| http://purl.obolibrary.org/obo/IDO_0110299 | B. melitensis 16M rbsK mutant |
| http://purl.obolibrary.org/obo/IDO_0110301 | B. melitensis 16M BMEI10128 mutant |
| http://purl.obolibrary.org/obo/IDO_0110303 | B. melitensis 16M fliC mutant |
| http://purl.obolibrary.org/obo/IDO_0110309 | B. melitensis 16M znuC mutant |
| http://purl.obolibrary.org/obo/IDO_0110310 | B. melitensis 16M znuA mutant |
| http://purl.obolibrary.org/obo/IDO_0110311 | B. melitensis 16M BMEI10274 mutant |

| | |
|---|------------------------------------|
| http://purl.obolibrary.org/obo/IDO_0110313 | B. melitensis 16M cobW mutant |
| http://purl.obolibrary.org/obo/IDO_0110314 | B. melitensis 16M BMEI10318 mutant |
| http://purl.obolibrary.org/obo/IDO_0110315 | B. melitensis 16M BMEI10336 mutant |
| http://purl.obolibrary.org/obo/IDO_0110316 | B. melitensis 16M dacF mutant |
| http://purl.obolibrary.org/obo/IDO_0110321 | B. melitensis 16M eryB mutant |
| http://purl.obolibrary.org/obo/IDO_0110322 | B. melitensis 16M gntR1 mutant |
| http://purl.obolibrary.org/obo/IDO_0110323 | B. melitensis 16M galcD mutant |
| http://purl.obolibrary.org/obo/IDO_0110324 | B. melitensis 16M nikA mutant |
| http://purl.obolibrary.org/obo/IDO_0110325 | B. melitensis 16M zwf mutant |
| http://purl.obolibrary.org/obo/IDO_0110329 | B. melitensis 16M sodC mutant |
| http://purl.obolibrary.org/obo/IDO_0110333 | B. melitensis 16M BMEI10626 mutant |
| http://purl.obolibrary.org/obo/IDO_0110335 | B. melitensis 16M pyrC mutant |
| http://purl.obolibrary.org/obo/IDO_0110337 | B. melitensis 16M aidB mutant |
| http://purl.obolibrary.org/obo/IDO_0110338 | B. melitensis 16M rbsC mutant |
| http://purl.obolibrary.org/obo/IDO_0110340 | B. melitensis 16M cydC mutant |
| http://purl.obolibrary.org/obo/IDO_0110343 | B. melitensis 16M glpK mutant |
| http://purl.obolibrary.org/obo/IDO_0110344 | B. melitensis 16M xfp mutant |
| http://purl.obolibrary.org/obo/IDO_0110345 | B. melitensis 16M manB mutant |
| http://purl.obolibrary.org/obo/IDO_0110346 | B. melitensis 16M wbpW mutant |
| http://purl.obolibrary.org/obo/IDO_0110350 | B. melitensis 16M BMEI10935 mutant |
| http://purl.obolibrary.org/obo/IDO_0110351 | B. melitensis 16M narG mutant |
| http://purl.obolibrary.org/obo/IDO_0110354 | B. melitensis 16M BMEI11045 mutant |
| http://purl.obolibrary.org/obo/IDO_0110356 | B. melitensis 16M gntR mutant |
| http://purl.obolibrary.org/obo/IDO_0110358 | B. melitensis 16M deoR mutant |
| http://purl.obolibrary.org/obo/IDO_0110359 | B. melitensis 16M gtrB mutant |
| http://purl.obolibrary.org/obo/IDO_0110360 | B. melitensis 16M vjbR mutant |
| http://purl.obolibrary.org/obo/IDO_0110362 | B. abortus 2308 methH mutant |
| http://purl.obolibrary.org/obo/IDO_0110363 | B. abortus 2308 pgi mutant |
| http://purl.obolibrary.org/obo/IDO_0110365 | B. abortus 2308 uvrA mutant |
| http://purl.obolibrary.org/obo/IDO_0110366 | B. abortus 2308 miaA mutant |
| http://purl.obolibrary.org/obo/IDO_0110367 | B. abortus 2308 aroC mutant |
| http://purl.obolibrary.org/obo/IDO_0110369 | B. abortus 2308 bacA mutant |
| http://purl.obolibrary.org/obo/IDO_0110370 | B. abortus 2308 cysl mutant |
| http://purl.obolibrary.org/obo/IDO_0110371 | B. abortus 2308 dut mutant |
| http://purl.obolibrary.org/obo/IDO_0110372 | B. abortus 2308 glnA mutant |
| http://purl.obolibrary.org/obo/IDO_0110373 | B. abortus 2308 gloA mutant |
| http://purl.obolibrary.org/obo/IDO_0110374 | B. abortus 2308 glyA mutant |
| http://purl.obolibrary.org/obo/IDO_0110376 | B. abortus 2308 hfq mutant |
| http://purl.obolibrary.org/obo/IDO_0110378 | B. abortus 2308 hisD mutant |
| http://purl.obolibrary.org/obo/IDO_0110379 | B. abortus 2308 hisF mutant |
| http://purl.obolibrary.org/obo/IDO_0110380 | B. abortus 2308 hpt mutant |
| http://purl.obolibrary.org/obo/IDO_0110381 | B. abortus 2308 ilvD mutant |
| http://purl.obolibrary.org/obo/IDO_0110382 | B. abortus 2308 leuA mutant |

| | |
|---|-----------------------------------|
| http://purl.obolibrary.org/obo/IDO_0110383 | B. abortus 2308 leuC mutant |
| http://purl.obolibrary.org/obo/IDO_0110384 | B. abortus 2308 lysA mutant |
| http://purl.obolibrary.org/obo/IDO_0110390 | B. abortus 2308 pheA mutant |
| http://purl.obolibrary.org/obo/IDO_0110391 | B. abortus 2308 pth mutant |
| http://purl.obolibrary.org/obo/IDO_0110392 | B. abortus 2308 purD mutant |
| http://purl.obolibrary.org/obo/IDO_0110393 | B. abortus 2308 purF mutant |
| http://purl.obolibrary.org/obo/IDO_0110394 | B. abortus 2308 purH mutant |
| http://purl.obolibrary.org/obo/IDO_0110397 | B. abortus 2308 pyc mutant |
| http://purl.obolibrary.org/obo/IDO_0110400 | B. abortus 2308 rfbD mutant |
| http://purl.obolibrary.org/obo/IDO_0110401 | B. abortus 2308 rplS mutant |
| http://purl.obolibrary.org/obo/IDO_0110403 | B. abortus 2308 rpsA mutant |
| http://purl.obolibrary.org/obo/IDO_0110408 | B. abortus 2308 znuA mutant |
| http://purl.obolibrary.org/obo/IDO_0110409 | B. abortus 2308 znuC mutant |
| http://purl.obolibrary.org/obo/IDO_0110412 | B. abortus 2308 sodC mutant |
| http://purl.obolibrary.org/obo/IDO_0110415 | B. abortus 2308 narG mutant |
| http://purl.obolibrary.org/obo/IDO_0110416 | B. abortus 2308 virB5 mutant |
| http://purl.obolibrary.org/obo/IDO_0110418 | B. abortus 2308 virB2 mutant |
| http://purl.obolibrary.org/obo/IDO_0110424 | B. abortus 2308 gcvT mutant |
| http://purl.obolibrary.org/obo/IDO_0110427 | B. abortus 2308 hemH mutant |
| http://purl.obolibrary.org/obo/IDO_0110428 | B. melitensis 16M BMEI0066 mutant |
| http://purl.obolibrary.org/obo/IDO_0110431 | B. abortus 2308 pgk mutant |

#####