**A naturally occurring bovine APOBEC3 confers resistance to bovine lentiviruses: implication for the co-evolution of bovids and their lentiviruses**

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**Supplementary Information:**
Supplementary figure 1: Scheme of bovine genome encoding *APOBEC3* and the position of the primers used in this study
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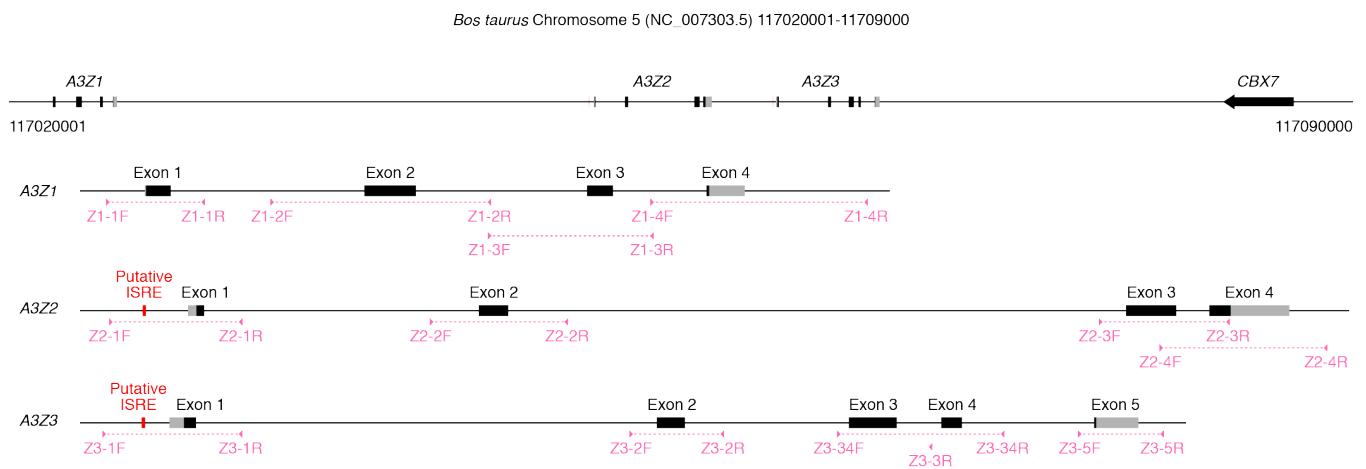
**Supplementary Figure 1. Scheme of bovine genome encoding *APOBEC3* and the position of the primers used in this study – Related to Figure 1.**
The scheme of *Bos taurus* chromosome 5 including the exons of bovine *APOBEC3Z1, Z2,* and *Z3* is shown. The primers used for PCR/sequencing are shown in pink arrowheads, and the names are identical to those in **Supplementary table 4**.

|  | *A3Z2* putative ISRE | *A3Z3* putative ISRE |
|---|---|---|
| Cattle | TTTACTTTCTCTTTCCCTTT | TTTACTTTCTCTTTCCCCTT |
| Zebu | .................... | .................... |
| European bison | .................... | .................... |
| Banteng | .................... | .................... |
| Gaur | .................... | .................... |
| American bison | .................... | .................... |
| Yak | .................... | .................... |
| Water buffalo | .................... | ............G........ |

**Supplementary Figure 2. Summary of putative bovine ISRE.**
The sequence of putative ISRE of each bovid, which is indicated by red in
**Supplementary figure 1**, is summarized.
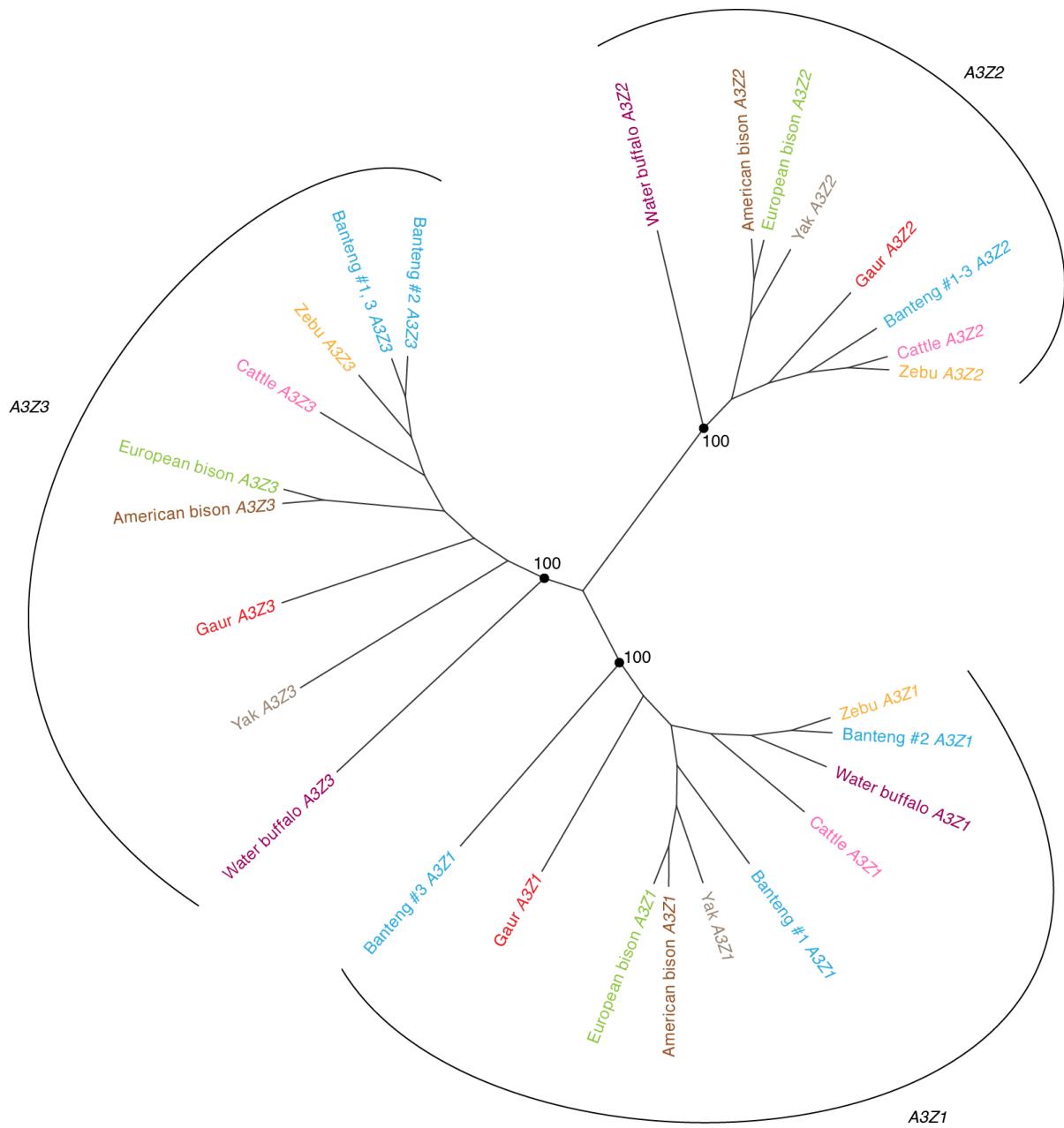
**Supplementary Figure 3. Unrooted phylogenetic tree of all bovine *A3* genes.**
Phylogenetic tree of all bovine *A3* genes reconstructed using ML method. The bootstrap value for each cluster (indicated with black dot) is indicated.
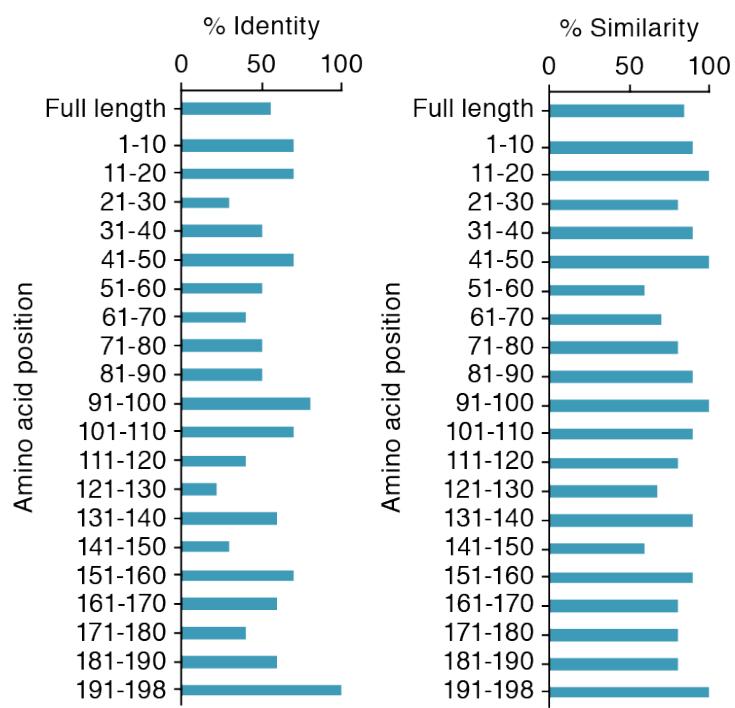
**Supplementary Figure 4. Identity and similarity of BIV Vif and JDV Vif – Related to Figure 4.**
The identity (left) and similarity (right) of BIV/JDV Vif is summarized.
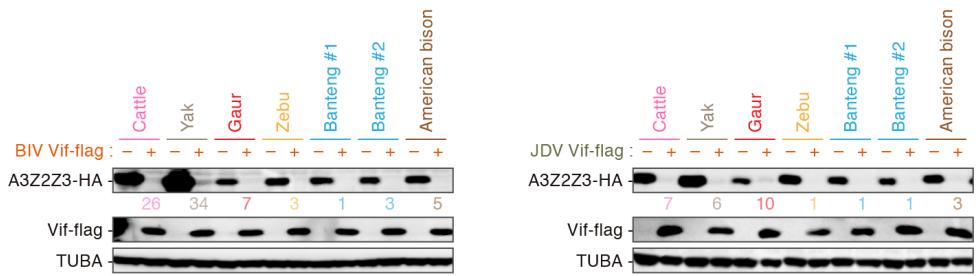
**Supplementary Figure 5. Degradation of bovine APOBEC3Z2Z3 by BIV Vif and JDV Vif.**

The HA-tagged expression plasmids for bovine APOBEC3Z2Z3 (150 ng) was co-transfected with the flag-tagged expression plasmid for either BIV Vif or JDV Vif (1,000 ng). Representative results of Western blotting are shown. The value under the band of respective bovine A3Z2Z3-HA represents the percentage of band intensity compared to the absence of Vif. Blots have been cropped; full uncropped blots are available as **Supplementary figure 7**.
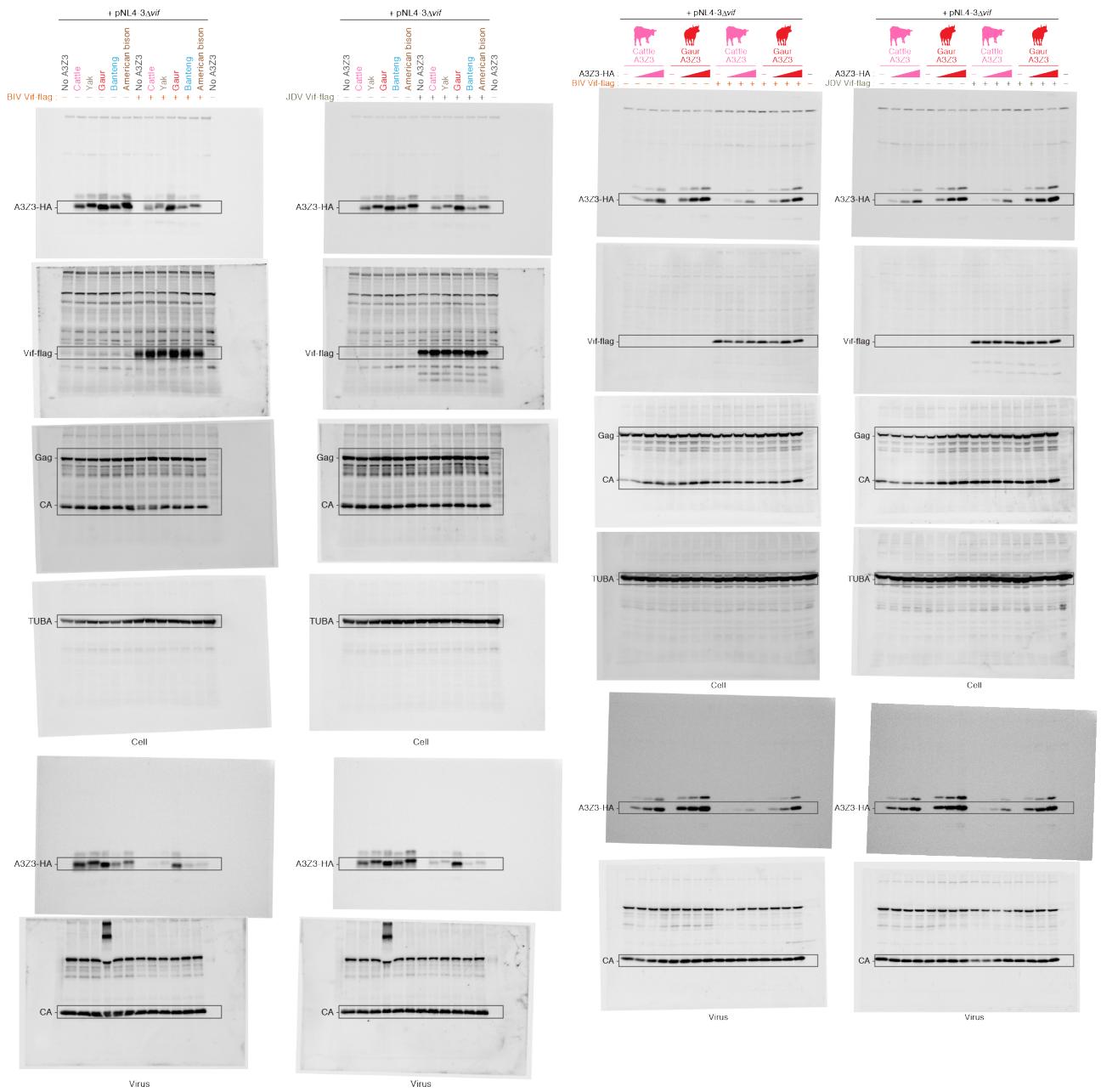
**Supplementary Figure 6. Original (uncropped) blots of Figures 3A and 3C.**
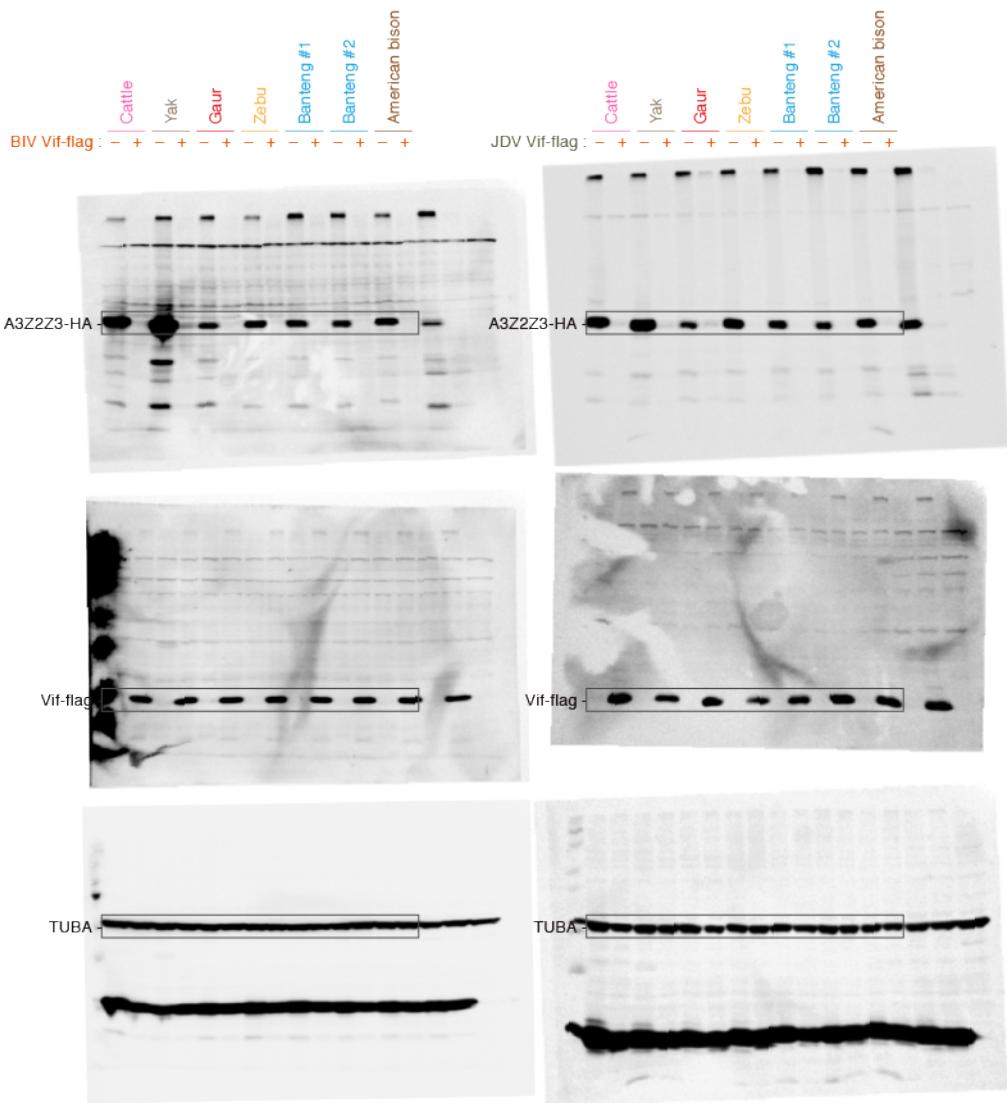
**Supplementary Figure 7. Original (uncropped) blots of Supplementary figure 5.**
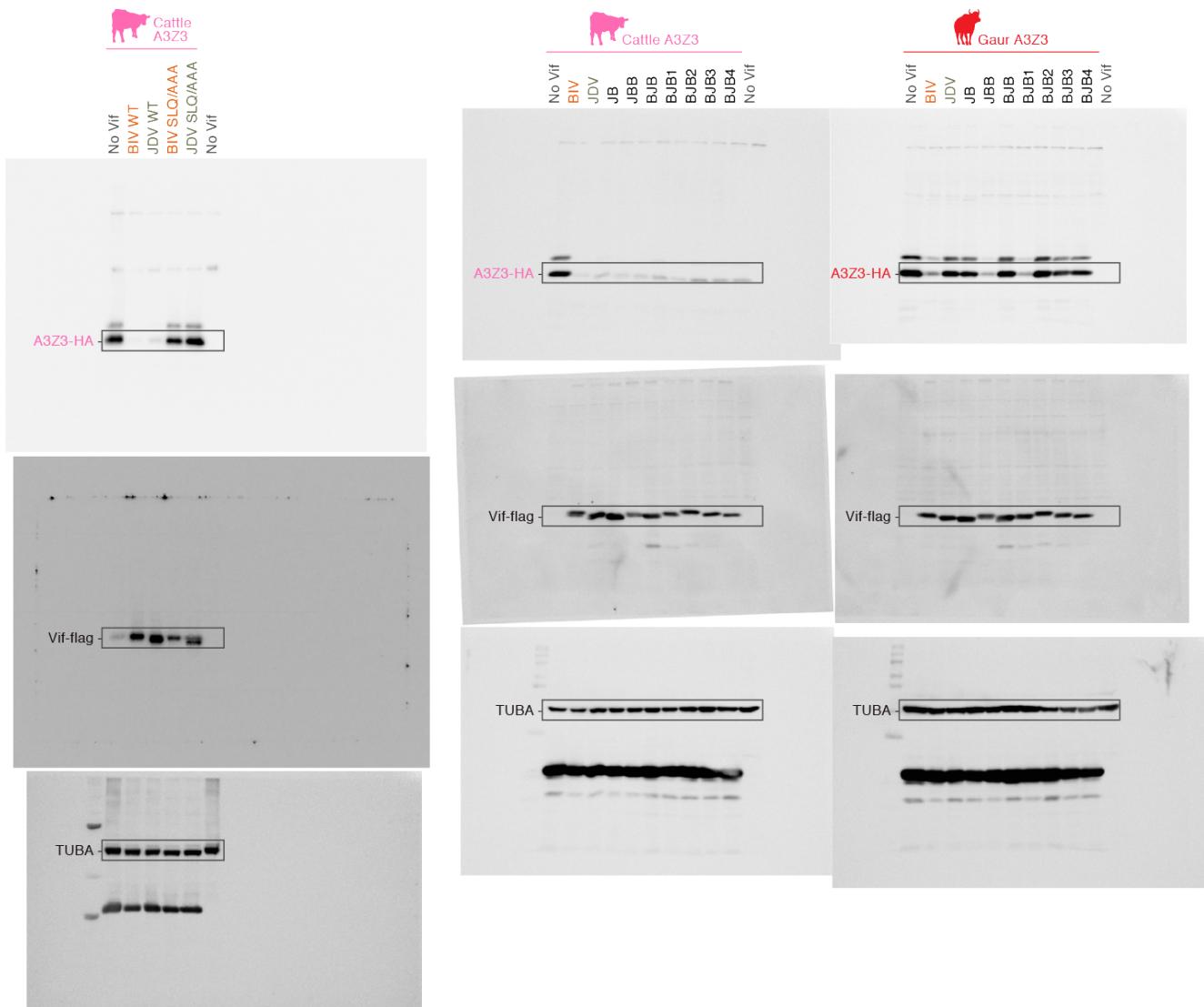
**Supplementary Figure 8. Original (uncropped) blots of Figures 4B and 4D.**

**Supplementary Figure 9. Original (uncropped) blots of Figures 5B and 5C.**
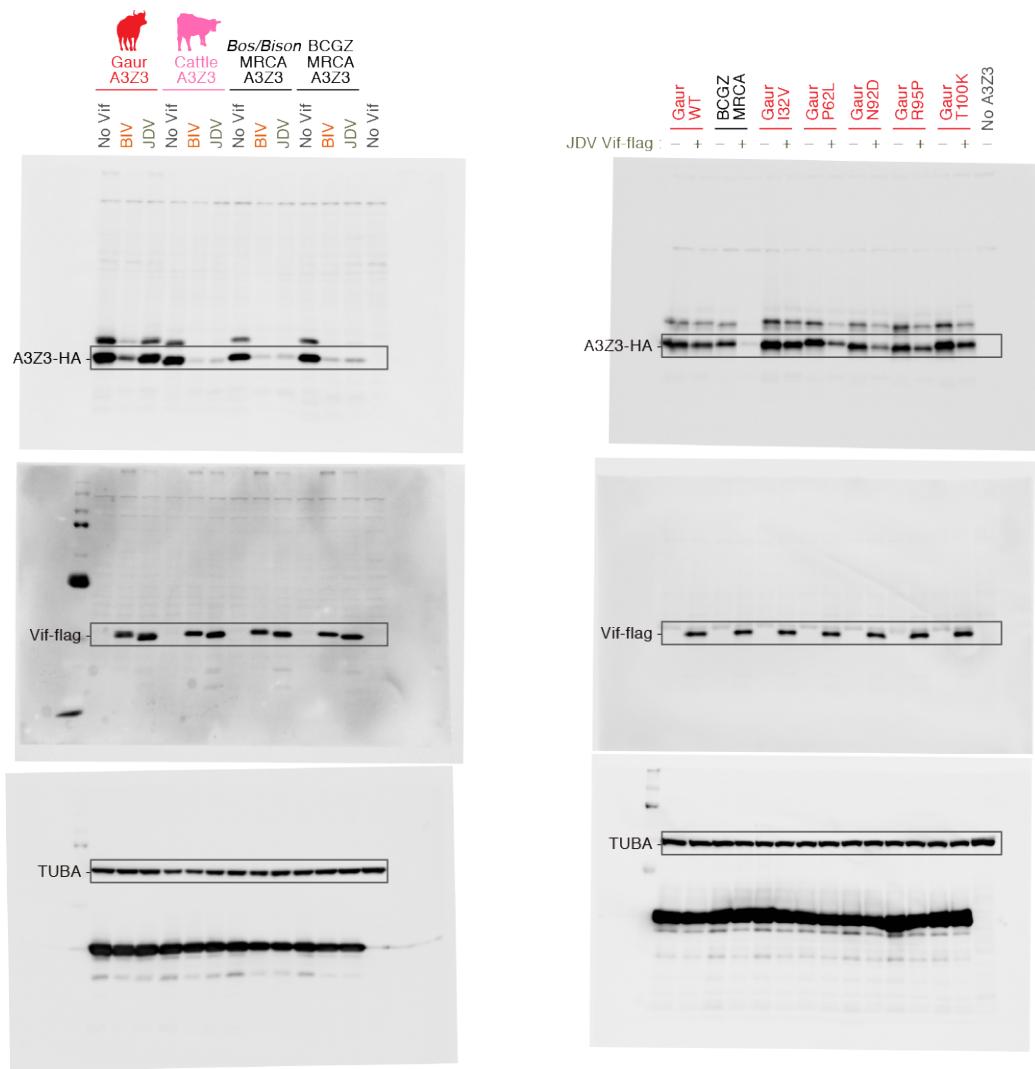
**Supplementary table 1. Summary of site model analyses on bovine *APOBEC3Z1*.**

| Site | Posterior probability | dN/dS ratio | Site | Posterior probability | dN/dS ratio | Site | Posterior probability | dN/dS ratio |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.19 | 1.40 | 65 | 0.19 | 1.40 | 129 | 0.22 | 1.61 |
| 2 | 0.18 | 1.28 | 66 | 0.75 | 5.32 | 130 | 0.23 | 1.68 |
| 3 | 0.22 | 1.60 | 67 | 0.22 | 1.62 | 131 | 0.20 | 1.48 |
| 4 | 0.21 | 1.54 | 68 | 0.22 | 1.60 | 132 | 0.22 | 1.60 |
| 5 | 0.19 | 1.41 | 69 | 0.21 | 1.51 | 133 | 0.19 | 1.39 |
| 6 | 0.20 | 1.42 | 70 | 0.22 | 1.61 | 134 | 0.20 | 1.41 |
| 7 | 0.22 | 1.59 | 71 | 0.18 | 1.28 | 135 | 0.23 | 1.68 |
| 8 | 0.19 | 1.36 | 72 | 0.20 | 1.46 | 136 | 0.19 | 1.40 |
| 9 | 0.18 | 1.29 | 73 | 0.21 | 1.51 | 137 | 0.19 | 1.41 |
| 10 | 0.20 | 1.42 | 74 | 0.22 | 1.56 | 138 | 0.19 | 1.40 |
| 11 | 0.18 | 1.29 | 75 | 0.18 | 1.33 | 139 | 0.19 | 1.40 |
| 12 | 0.21 | 1.51 | 76 | 0.18 | 1.32 | 140 | 0.19 | 1.41 |
| 13 | 0.23 | 1.68 | 77 | 0.19 | 1.37 | 141 | 0.22 | 1.60 |
| 14 | 0.77 | 5.43 | 78 | 0.20 | 1.44 | 142 | 0.19 | 1.36 |
| <span style="color:red">15</span> | <span style="color:red">0.96</span> | <span style="color:red">6.72</span> | 79 | 0.19 | 1.41 | 143 | 0.18 | 1.28 |
| 16 | 0.22 | 1.61 | 80 | 0.22 | 1.56 | 144 | 0.22 | 1.60 |
| 17 | 0.74 | 5.22 | 81 | 0.20 | 1.42 | 145 | 0.19 | 1.37 |
| 18 | 0.19 | 1.37 | 82 | 0.19 | 1.40 | 146 | 0.18 | 1.33 |
| 19 | 0.19 | 1.41 | 83 | 0.20 | 1.45 | 147 | 0.19 | 1.35 |
| 20 | 0.18 | 1.32 | 84 | 0.22 | 1.60 | 148 | 0.22 | 1.60 |
| 21 | 0.22 | 1.61 | 85 | 0.18 | 1.29 | 149 | 0.22 | 1.60 |
| 22 | 0.19 | 1.35 | 86 | 0.20 | 1.43 | 150 | 0.19 | 1.41 |
| 23 | 0.18 | 1.32 | 87 | 0.22 | 1.56 | 151 | 0.20 | 1.42 |
| 24 | 0.19 | 1.36 | 88 | 0.18 | 1.32 | 152 | 0.20 | 1.47 |
| 25 | 0.74 | 5.20 | 89 | 0.21 | 1.50 | 153 | 0.18 | 1.28 |
| 26 | 0.19 | 1.36 | 90 | 0.22 | 1.56 | 154 | 0.18 | 1.33 |
| 27 | 0.19 | 1.37 | 91 | 0.20 | 1.41 | 155 | 0.19 | 1.37 |
| 28 | 0.22 | 1.61 | 92 | 0.22 | 1.56 | 156 | 0.23 | 1.64 |
| 29 | 0.18 | 1.28 | 93 | 0.22 | 1.60 | 157 | 0.22 | 1.60 |
| 30 | 0.20 | 1.43 | 94 | 0.22 | 1.61 | 158 | 0.20 | 1.43 |
| 31 | 0.69 | 4.88 | 95 | 0.22 | 1.59 | 159 | 0.22 | 1.60 |
| 32 | 0.22 | 1.60 | 96 | 0.23 | 1.67 | 160 | 0.22 | 1.56 |
| 33 | 0.20 | 1.47 | 97 | 0.20 | 1.42 | 161 | 0.20 | 1.43 |
| 34 | 0.19 | 1.40 | 98 | 0.23 | 1.63 | 162 | 0.22 | 1.60 |
| 35 | 0.22 | 1.61 | 99 | 0.19 | 1.37 | 163 | 0.19 | 1.36 |
| 36 | 0.22 | 1.61 | 100 | 0.19 | 1.36 | 164 | 0.19 | 1.39 |
| 37 | 0.18 | 1.28 | 101 | 0.18 | 1.29 | 165 | 0.24 | 1.73 |
| 38 | 0.19 | 1.36 | 102 | 0.71 | 4.97 | 166 | 0.21 | 1.51 |
| 39 | 0.18 | 1.32 | 103 | 0.18 | 1.33 | 167 | 0.23 | 1.67 |
| 40 | 0.19 | 1.37 | 104 | 0.21 | 1.50 | 168 | 0.19 | 1.37 |
| 41 | 0.18 | 1.32 | 105 | 0.18 | 1.29 | 169 | 0.21 | 1.52 |
| 42 | 0.22 | 1.60 | 106 | 0.22 | 1.61 | 170 | 0.22 | 1.56 |
| 43 | 0.20 | 1.47 | 107 | 0.18 | 1.33 | 171 | 0.21 | 1.50 |
| 44 | 0.18 | 1.33 | 108 | 0.19 | 1.40 | 172 | 0.20 | 1.44 |
| 45 | 0.18 | 1.29 | 109 | 0.22 | 1.61 | 173 | 0.22 | 1.56 |
| 46 | 0.19 | 1.37 | 110 | 0.20 | 1.41 | 174 | 0.75 | 5.27 |
| 47 | 0.21 | 1.54 | 111 | 0.20 | 1.45 | 175 | 0.22 | 1.60 |
| 48 | 0.23 | 1.65 | 112 | 0.18 | 1.33 | 176 | 0.22 | 1.61 |
| 49 | 0.75 | 5.27 | 113 | 0.19 | 1.40 | 177 | 0.22 | 1.56 |
| 50 | 0.23 | 1.68 | 114 | 0.21 | 1.54 | 178 | 0.20 | 1.41 |
| 51 | 0.21 | 1.51 | 115 | 0.19 | 1.41 | 179 | 0.22 | 1.58 |
| 52 | 0.19 | 1.36 | <span style="color:red">116</span> | <span style="color:red">0.95</span> | <span style="color:red">6.64</span> | 180 | 0.20 | 1.44 |
| <span style="color:red">53</span> | <span style="color:red">0.96</span> | <span style="color:red">6.72</span> | 117 | 0.70 | 4.94 | 181 | 0.19 | 1.37 |
| 54 | 0.74 | 5.22 | 118 | 0.75 | 5.33 | 182 | 0.22 | 1.59 |
| 55 | 0.19 | 1.35 | 119 | 0.22 | 1.60 | 183 | 0.22 | 1.56 |
| 56 | 0.21 | 1.53 | 120 | 0.19 | 1.39 | 184 | 0.23 | 1.68 |
| 57 | 0.23 | 1.67 | 121 | 0.19 | 1.35 | 185 | 0.18 | 1.29 |
| 58 | 0.19 | 1.36 | 122 | 0.21 | 1.53 | | | |
| 59 | 0.20 | 1.44 | 123 | 0.22 | 1.56 | | | |
| 60 | 0.18 | 1.32 | 124 | 0.21 | 1.52 | | | |
| 61 | 0.20 | 1.42 | 125 | 0.18 | 1.32 | | | |
| 62 | 0.22 | 1.61 | 126 | 0.22 | 1.61 | | | |
| 63 | 0.23 | 1.64 | 127 | 0.19 | 1.35 | | | |
| 64 | 0.19 | 1.37 | 128 | 0.22 | 1.60 | | | |

**Supplementary table 2. Summary of site model analyses on bovine *APOBEC3Z2*.**

| Site | Posterior probability | dN/dS ratio | Site | Posterior probability | dN/dS ratio | Site | Posterior probability | dN/dS ratio | Site | Posterior probability | dN/dS ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.30 | 1.74 | 65 | 0.30 | 1.78 | 129 | 0.29 | 1.68 | 193 | 0.32 | 1.87 |
| 2 | 0.32 | 1.89 | 66 | 0.30 | 1.76 | 130 | 0.30 | 1.73 | 194 | 0.33 | 1.92 |
| 3 | 0.33 | 1.93 | 67 | 0.32 | 1.88 | 131 | 0.30 | 1.73 | 195 | 0.32 | 1.87 |
| 4 | 0.31 | 1.78 | 68 | 0.32 | 1.85 | 132 | 0.30 | 1.77 | 196 | 0.30 | 1.74 |
| 5 | 0.29 | 1.69 | 69 | 0.29 | 1.66 | 133 | 0.79 | 4.87 | 197 | 0.33 | 1.91 |
| 6 | 0.33 | 1.94 | 70 | 0.31 | 1.80 | 134 | 0.32 | 1.90 | 198 | 0.30 | 1.74 |
| 7 | 0.78 | 4.81 | 71 | 0.30 | 1.76 | 135 | 0.30 | 1.76 | 199 | 0.29 | 1.66 |
| 8 | 0.29 | 1.69 | 72 | 0.32 | 1.89 | 136 | 0.29 | 1.69 | 200 | 0.32 | 1.89 |
| 9 | 0.29 | 1.68 | 73 | 0.81 | 4.98 | 137 | 0.78 | 4.80 | 201 | 0.30 | 1.76 |
| 10 | 0.80 | 4.90 | 74 | 0.30 | 1.78 | 138 | 0.30 | 1.73 | 202 | 0.30 | 1.78 |
| 11 | 0.30 | 1.74 | 75 | 0.33 | 1.92 | 139 | 0.31 | 1.80 | | | |
| 12 | 0.30 | 1.77 | 76 | 0.78 | 4.81 | 140 | 0.30 | 1.74 | | | |
| 13 | 0.31 | 1.83 | 77 | 0.29 | 1.69 | 141 | 0.30 | 1.74 | | | |
| 14 | 0.30 | 1.77 | 78 | 0.29 | 1.66 | <span style="color:red">142</span> | <span style="color:red">0.96</span> | <span style="color:red">5.92</span> | | | |
| 15 | 0.32 | 1.88 | 79 | 0.30 | 1.77 | 143 | 0.30 | 1.77 | | | |
| 16 | 0.29 | 1.66 | 80 | 0.32 | 1.87 | 144 | 0.30 | 1.75 | | | |
| 17 | 0.30 | 1.77 | 81 | 0.30 | 1.76 | 145 | 0.31 | 1.80 | | | |
| 18 | 0.29 | 1.68 | 82 | 0.29 | 1.71 | 146 | 0.30 | 1.78 | | | |
| 19 | 0.32 | 1.87 | 83 | 0.30 | 1.73 | 147 | 0.32 | 1.87 | | | |
| 20 | 0.29 | 1.66 | 84 | 0.32 | 1.87 | 148 | 0.30 | 1.76 | | | |
| 21 | 0.30 | 1.74 | 85 | 0.33 | 1.92 | 149 | 0.30 | 1.75 | | | |
| 22 | 0.33 | 1.93 | 86 | 0.31 | 1.83 | 150 | 0.32 | 1.87 | | | |
| 23 | 0.31 | 1.79 | 87 | 0.30 | 1.73 | 151 | 0.29 | 1.68 | | | |
| 24 | 0.33 | 1.94 | 88 | 0.77 | 4.73 | 152 | 0.29 | 1.66 | | | |
| 25 | 0.32 | 1.85 | 89 | 0.31 | 1.78 | 153 | 0.31 | 1.80 | | | |
| 26 | 0.33 | 1.92 | 90 | 0.30 | 1.74 | 154 | 0.33 | 1.92 | | | |
| 27 | 0.32 | 1.87 | 91 | 0.30 | 1.73 | 155 | 0.31 | 1.78 | | | |
| 28 | 0.30 | 1.77 | 92 | 0.32 | 1.87 | 156 | 0.32 | 1.85 | | | |
| 29 | 0.30 | 1.73 | 93 | 0.29 | 1.71 | 157 | 0.31 | 1.81 | | | |
| 30 | 0.29 | 1.69 | 94 | 0.81 | 5.00 | 158 | 0.29 | 1.66 | | | |
| 31 | 0.30 | 1.73 | 95 | 0.29 | 1.66 | 159 | 0.32 | 1.89 | | | |
| 32 | 0.31 | 1.80 | 96 | 0.30 | 1.74 | 160 | 0.30 | 1.74 | | | |
| 33 | 0.32 | 1.88 | 97 | 0.32 | 1.90 | 161 | 0.30 | 1.77 | | | |
| <span style="color:red">34</span> | <span style="color:red">0.96</span> | <span style="color:red">5.91</span> | 98 | 0.29 | 1.69 | 162 | 0.29 | 1.69 | | | |
| 35 | 0.29 | 1.66 | 99 | 0.29 | 1.66 | 163 | 0.32 | 1.89 | | | |
| 36 | 0.33 | 1.95 | 100 | 0.30 | 1.73 | 164 | 0.32 | 1.87 | | | |
| 37 | 0.30 | 1.76 | 101 | 0.30 | 1.77 | 165 | 0.30 | 1.73 | | | |
| 38 | 0.32 | 1.89 | 102 | 0.31 | 1.83 | 166 | 0.32 | 1.86 | | | |
| 39 | 0.31 | 1.78 | 103 | 0.30 | 1.73 | 167 | 0.29 | 1.69 | | | |
| 40 | 0.29 | 1.66 | 104 | 0.30 | 1.74 | 168 | 0.32 | 1.87 | | | |
| 41 | 0.30 | 1.75 | 105 | 0.33 | 1.95 | 169 | 0.31 | 1.83 | | | |
| 42 | 0.30 | 1.75 | 106 | 0.31 | 1.83 | 170 | 0.32 | 1.86 | | | |
| 43 | 0.29 | 1.66 | 107 | 0.29 | 1.68 | 171 | 0.30 | 1.73 | | | |
| 44 | 0.29 | 1.69 | 108 | 0.30 | 1.77 | 172 | 0.32 | 1.88 | | | |
| 45 | 0.79 | 4.87 | 109 | 0.29 | 1.69 | 173 | 0.33 | 1.92 | | | |
| 46 | 0.32 | 1.89 | 110 | 0.30 | 1.74 | 174 | 0.77 | 4.75 | | | |
| 47 | 0.30 | 1.73 | 111 | 0.30 | 1.73 | 175 | 0.32 | 1.86 | | | |
| 48 | 0.29 | 1.69 | 112 | 0.32 | 1.87 | 176 | 0.31 | 1.80 | | | |
| 49 | 0.29 | 1.69 | 113 | 0.31 | 1.83 | 177 | 0.31 | 1.81 | | | |
| 50 | 0.30 | 1.73 | 114 | 0.30 | 1.73 | 178 | 0.30 | 1.75 | | | |
| 51 | 0.31 | 1.81 | 115 | 0.30 | 1.74 | 179 | 0.30 | 1.77 | | | |
| 52 | 0.32 | 1.87 | 116 | 0.31 | 1.81 | 180 | 0.30 | 1.73 | | | |
| 53 | 0.32 | 1.88 | 117 | 0.33 | 1.92 | 181 | 0.30 | 1.75 | | | |
| 54 | 0.30 | 1.75 | 118 | 0.29 | 1.66 | 182 | 0.33 | 1.92 | | | |
| 55 | 0.32 | 1.86 | 119 | 0.30 | 1.73 | 183 | 0.31 | 1.83 | | | |
| 56 | 0.29 | 1.69 | 120 | 0.32 | 1.87 | 184 | 0.30 | 1.73 | | | |
| 57 | 0.29 | 1.66 | 121 | 0.30 | 1.78 | 185 | 0.32 | 1.86 | | | |
| 58 | 0.33 | 1.95 | 122 | 0.30 | 1.75 | 186 | 0.33 | 1.95 | | | |
| 59 | 0.32 | 1.90 | 123 | 0.29 | 1.66 | 187 | 0.29 | 1.69 | | | |
| 60 | 0.79 | 4.87 | 124 | 0.31 | 1.80 | 188 | 0.32 | 1.88 | | | |
| 61 | 0.30 | 1.77 | 125 | 0.31 | 1.84 | 189 | 0.31 | 1.84 | | | |
| 62 | 0.30 | 1.73 | 126 | 0.31 | 1.81 | 190 | 0.32 | 1.89 | | | |
| 63 | 0.29 | 1.66 | 127 | 0.31 | 1.82 | 191 | 0.31 | 1.80 | | | |
| 64 | 0.31 | 1.83 | 128 | 0.32 | 1.87 | 192 | 0.31 | 1.79 | | | |

**Supplementary table 3. Summary of site model analyses on bovine *APOBEC3Z3*.**

| Site | Posterior probability | dN/dS ratio | Site | Posterior probability | dN/dS ratio | Site | Posterior probability | dN/dS ratio | Site | Posterior probability | dN/dS ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.31 | 2.60 | 65 | 0.33 | 2.76 | 129 | 0.32 | 2.75 | 193 | 0.31 | 2.61 |
| 2 | 0.31 | 2.66 | 66 | 0.31 | 2.67 | 130 | 0.31 | 2.63 | 194 | 0.32 | 2.69 |
| 3 | 0.31 | 2.63 | 67 | 0.33 | 2.78 | 131 | 0.31 | 2.64 | 195 | 0.32 | 2.75 |
| 4 | 0.31 | 2.66 | 68 | 0.31 | 2.61 | 132 | 0.33 | 2.77 | 196 | 0.33 | 2.81 |
| 5 | 0.32 | 2.74 | 69 | 0.32 | 2.75 | 133 | 0.32 | 2.69 | 197 | 0.31 | 2.63 |
| 6 | 0.33 | 2.79 | 70 | 0.31 | 2.66 | 134 | 0.32 | 2.70 | 198 | 0.32 | 2.68 |
| 7 | 0.31 | 2.67 | 71 | 0.31 | 2.67 | 135 | 0.31 | 2.66 | 199 | 0.32 | 2.69 |
| 8 | 0.33 | 2.82 | 72 | 0.31 | 2.67 | 136 | 0.32 | 2.74 | 200 | 0.31 | 2.63 |
| 9 | 0.31 | 2.66 | 73 | 0.31 | 2.66 | 137 | 0.31 | 2.65 | 201 | 0.31 | 2.64 |
| 10 | 0.32 | 2.73 | 74 | 0.31 | 2.59 | 138 | 0.31 | 2.67 | 202 | 0.33 | 2.82 |
| 11 | 0.33 | 2.79 | 75 | 0.31 | 2.61 | 139 | 0.31 | 2.62 | 203 | 0.31 | 2.67 |
| 12 | 0.31 | 2.67 | 76 | 0.31 | 2.61 | 140 | 0.32 | 2.74 | 204 | 0.32 | 2.69 |
| 13 | 0.33 | 2.77 | 77 | 0.32 | 2.69 | 141 | 0.31 | 2.64 | 205 | 0.33 | 2.79 |
| 14 | 0.33 | 2.79 | 78 | 0.32 | 2.68 | 142 | 0.31 | 2.61 | 206 | 0.32 | 2.75 |
| 15 | 0.33 | 2.79 | 79 | 0.32 | 2.73 | 143 | 0.88 | 7.24 | | | |
| 16 | 0.31 | 2.67 | 80 | 0.33 | 2.80 | 144 | 0.33 | 2.77 | | | |
| 17 | 0.33 | 2.78 | 81 | 0.32 | 2.75 | 145 | 0.31 | 2.61 | | | |
| 18 | 0.32 | 2.74 | 82 | 0.32 | 2.75 | 146 | 0.31 | 2.60 | | | |
| 19 | 0.33 | 2.77 | 83 | 0.31 | 2.66 | 147 | 0.31 | 2.67 | | | |
| 20 | 0.32 | 2.69 | 84 | 0.33 | 2.77 | 148 | 0.32 | 2.74 | | | |
| 21 | 0.33 | 2.79 | 85 | 0.32 | 2.75 | 149 | 0.32 | 2.69 | | | |
| 22 | 0.31 | 2.66 | 86 | 0.31 | 2.61 | 150 | 0.32 | 2.73 | | | |
| 23 | 0.32 | 2.75 | 87 | 0.31 | 2.61 | 151 | 0.32 | 2.74 | | | |
| 24 | 0.31 | 2.59 | 88 | 0.31 | 2.64 | 152 | 0.32 | 2.69 | | | |
| 25 | 0.31 | 2.67 | 89 | 0.31 | 2.59 | 153 | 0.87 | 7.18 | | | |
| 26 | 0.31 | 2.60 | 90 | 0.33 | 2.82 | 154 | 0.33 | 2.79 | | | |
| 27 | 0.32 | 2.72 | 91 | 0.32 | 2.74 | 155 | 0.31 | 2.67 | | | |
| 28 | 0.32 | 2.74 | 92 | 0.99 | 8.10 | 156 | 0.31 | 2.64 | | | |
| 29 | 0.33 | 2.82 | 93 | 0.32 | 2.74 | 157 | 0.33 | 2.82 | | | |
| 30 | 0.32 | 2.75 | 94 | 0.31 | 2.59 | 158 | 0.32 | 2.67 | | | |
| 31 | 0.32 | 2.75 | 95 | 0.87 | 7.19 | 159 | 0.33 | 2.79 | | | |
| 32 | 0.99 | 8.10 | 96 | 0.31 | 2.61 | 160 | 0.31 | 2.67 | | | |
| 33 | 0.32 | 2.74 | 97 | 0.32 | 2.69 | 161 | 0.31 | 2.60 | | | |
| 34 | 0.31 | 2.67 | 98 | 0.31 | 2.61 | 162 | 0.31 | 2.66 | | | |
| 35 | 0.31 | 2.61 | 99 | 0.31 | 2.65 | 163 | 0.31 | 2.62 | | | |
| 36 | 0.32 | 2.69 | 100 | 0.87 | 7.21 | 164 | 0.33 | 2.78 | | | |
| 37 | 0.32 | 2.69 | 101 | 0.31 | 2.64 | 165 | 0.31 | 2.63 | | | |
| 38 | 0.33 | 2.77 | 102 | 0.31 | 2.64 | 166 | 0.33 | 2.77 | | | |
| 39 | 0.31 | 2.66 | 103 | 0.31 | 2.67 | 167 | 0.32 | 2.75 | | | |
| 40 | 0.31 | 2.59 | 104 | 0.33 | 2.77 | 168 | 0.31 | 2.61 | | | |
| 41 | 0.32 | 2.69 | 105 | 0.31 | 2.64 | 169 | 0.31 | 2.67 | | | |
| 42 | 0.32 | 2.69 | 106 | 0.33 | 2.78 | 170 | 0.32 | 2.74 | | | |
| 43 | 0.32 | 2.68 | 107 | 0.32 | 2.74 | 171 | 0.32 | 2.75 | | | |
| 44 | 0.31 | 2.67 | 108 | 0.31 | 2.61 | 172 | 0.32 | 2.69 | | | |
| 45 | 0.33 | 2.79 | 109 | 0.33 | 2.79 | 173 | 0.33 | 2.77 | | | |
| 46 | 0.33 | 2.80 | 110 | 0.31 | 2.67 | 174 | 0.32 | 2.67 | | | |
| 47 | 0.33 | 2.79 | 111 | 0.32 | 2.69 | 175 | 0.31 | 2.61 | | | |
| 48 | 0.31 | 2.65 | 112 | 0.31 | 2.59 | 176 | 0.31 | 2.59 | | | |
| 49 | 0.31 | 2.65 | 113 | 0.33 | 2.77 | 177 | 0.32 | 2.69 | | | |
| 50 | 0.32 | 2.68 | 114 | 0.32 | 2.69 | 178 | 0.33 | 2.82 | | | |
| 51 | 0.31 | 2.63 | 115 | 0.32 | 2.72 | 179 | 0.31 | 2.63 | | | |
| 52 | 0.31 | 2.61 | 116 | 0.31 | 2.63 | 180 | 0.32 | 2.69 | | | |
| 53 | 0.31 | 2.66 | 117 | 0.32 | 2.74 | 181 | 0.31 | 2.67 | | | |
| 54 | 0.31 | 2.65 | 118 | 0.31 | 2.67 | 182 | 0.32 | 2.69 | | | |
| 55 | 0.32 | 2.74 | 119 | 0.32 | 2.72 | 183 | 0.32 | 2.69 | | | |
| 56 | 0.31 | 2.67 | 120 | 0.31 | 2.67 | 184 | 0.32 | 2.74 | | | |
| 57 | 0.31 | 2.65 | 121 | 0.31 | 2.64 | 185 | 0.31 | 2.61 | | | |
| 58 | 0.32 | 2.69 | 122 | 0.31 | 2.66 | 186 | 0.31 | 2.61 | | | |
| 59 | 0.32 | 2.74 | 123 | 0.31 | 2.63 | 187 | 0.32 | 2.74 | | | |
| 60 | 0.31 | 2.61 | 124 | 0.32 | 2.72 | 188 | 0.31 | 2.63 | | | |
| 61 | 0.32 | 2.69 | 125 | 0.31 | 2.59 | 189 | 0.33 | 2.77 | | | |
| 62 | 0.99 | 8.10 | 126 | 0.31 | 2.62 | 190 | 0.31 | 2.65 | | | |
| 63 | 0.32 | 2.72 | 127 | 0.32 | 2.74 | 191 | 0.32 | 2.73 | | | |
| 64 | 0.31 | 2.61 | 128 | 0.32 | 2.73 | 192 | 0.32 | 2.69 | | | |

**Supplementary table 4. Primers used for bovine *APOBEC3* and *CYTB* sequencing.[a]**

| Primer name | Sequences (5' to 3') | Product (bp) |
|---|---|---|
| Z1-1F | agaggactgggtcatcatcg | 552 |
| Z1-1R | tctgacatgtggctcaaagc | |
| Z1-2F | ggttagtggggtagggtcgt | 1232 |
| Z1-2R | acttcgtcagcacgttcctt | |
| Z1-3F | aaggaacgtgctgacgaagt | 925 |
| Z1-3R | tggtctgggaatgaagatcc | |
| Z1-4F | ggatcttcattcccagacca | 1214 |
| Z1-4R | tcctctccagggcagtagaa | |
| | | |
| Z2-1F | cctacctcataagggccaca | 744 |
| Z2-1R | ggccagttcagaagcaagag | |
| Z2-2F | tggggattagggtgctacag | 773 |
| Z2-2R | agcaccgagtcttcaccact | |
| Z2-3F | agaaaagaagggaggggaca | 730 |
| Z2-3R | ccgagaatgtcctcaagctc | |
| Z2-4F | gcccgtctctacaacttcca | 937 |
| Z2-4R | gaaaggccatctgaggacac | |
| | | |
| Z3-1F | cacagatctgcccaacacag | 780 |
| Z3-1R | actggcatcgatacctggtc | |
| Z3-2F | ctggtcagccaagaaggaag | 528 |
| Z3-2R | gagctgagacctggaggatg | |
| Z3-34F | atgtgtgacctctggcctct | 934 |
| Z3-34R | atcagggaagccacaaagaa | |
| Z3-5F | ctagtccctgcgttttcagc | 479 |
| Z3-5R | atggtcccactgttccagac | |
| | | |
| *Bos CYTB* Fwd | acaaatcctcacaggcctattc | |
| *Bos CYTB* Rev | taggacgtatcctatgaatgct | |

[a] The primer names are identical to those in Supplementary figure 1.

**Supplementary table 5. Primers used for the construction of bovine APOBEC3Z3 expression plasmids.**

| Primer name | Sequences (5' to 3') | Template | Species | Purpose |
|---|---|---|---|---|
| btA3Z3-HA Fwd | tatatatatataaagcttgtcctgggagtgtctatga | cDNA | Cattle | HA-tagged ORF preparation |
| btA3Z3-HA Rev | ttttttttttctcgagtcaagcgtaatctggaacatcgtatgggtaaattggggccgttaggatc | cDNA | Cattle | HA-tagged ORF preparation |
| BGY Z3 exons 1,2 Fwd | aaacacgatgaatctgctaagagaaattctgttcaagcagcag | genomic DNA | Banteng, Gaur and Yak | ORF/exon conjugation |
| BGY Z3 exons 1,2 Rev | ctgcttgaacagaatttctcttagcagattcatcgtgtttctggttccgggagtccaaac | genomic DNA | Banteng, Gaur and Yak | ORF/exon conjugation |
| BGY Z3 exons 2,3 Fwd | gaggctgcttccgcaacaagaagcagcggcatgcagaaattc | genomic DNA | Banteng, Gaur and Yak | ORF/exon conjugation |
| BGY Z3 exons 2,3 Rev | atttctgcatgccgctgcttcttgttgcggaagcagcc | genomic DNA | Banteng, Gaur and Yak | ORF/exon conjugation |
| BGY Z3 exons 3,4 Fwd | ggctgtcatgacccacacagagtttgaagactgctgggaac | genomic DNA | Banteng, Gaur and Yak | ORF/exon conjugation |
| BGY Z3 exons 3,4 Rev | ttcccagcagtcttcaaactctgtgtgggtcatgacagcc | genomic DNA | Banteng, Gaur and Yak | ORF/exon conjugation |
| BGYA Z3 exons 4,5 Rev | aattggggccgttaggatcctctggagcc | genomic DNA | American bison, Banteng, Gaur and Yak | ORF/exon conjugation |
| American bison Z3 exons 1,2 Fwd | gactcccggaaccagaaacacgatgaatctgct | genomic DNA | American bison | ORF/exon conjugation |
| American bison Z3 exons 1,2 Rev | agattcatcgtgtttctggttccgggagtccaa | genomic DNA | American bison | ORF/exon conjugation |
| American bison Z3 exons 2,3 Fwd | gcttccgcaacaagaagcagcggcatgcagaaatt | genomic DNA | American bison | ORF/exon conjugation |
| American bison Z3 exons 2,3 Rev | tgcatgccgctgcttcttgttgcggaagcagcc | genomic DNA | American bison | ORF/exon conjugation |
| American bison Z3 exons 3,4 Fwd | tcatgacccacacagagtttgaagactgctgg | genomic DNA | American bison | ORF/exon conjugation |
| American bison Z3 exons 3,4 Rev | agcagtcttcaaactctgtgtgggtcatgacag | genomic DNA | American bison | ORF/exon conjugation |

**Supplementary table 6. Primers used for the construction of bovine APOBEC3 MRCA expression plasmids.**

| Primer name | Sequences (5' to 3') | Template | Product |
|---|---|---|---|
| Yak Z3 I32V Fwd | ctgctaagagaagttctgttcaagcagc | Yak APOBEC3Z3, Gaur APOBEC3Z3 | *Bos/Bison* MRCA, Gaur APOBEC3Z3 V32I |
| Yak Z3 I32V Rev | gctgcttgaacagaacttctcttagcag | Yak APOBEC3Z3, Gaur APOBEC3Z3 | *Bos/Bison* MRCA, Gaur APOBEC3Z3 V32I |
| BB MRCA P143S Fwd | ccactggatcaagtcatttaagatggggct | *Bos/Bison* MRCA | BCGZ MRCA |
| BB MRCA P143S Rev | agccccatcttaaatgacttgatccagtgg | *Bos/Bison* MRCA | BCGZ MRCA |
| Gaur APOBEC3Z3 P62L Fwd | cagctgaagcagcttaatgacttgacgc | Gaur APOBEC3Z3 | Gaur APOBEC3Z3 P62L |
| Gaur APOBEC3Z3 P62L Rev | gcgtcaagtcattaagctgcttcagctg | Gaur APOBEC3Z3 | Gaur APOBEC3Z3 P62L |
| Gaur APOBEC3Z3 N92D Fwd | gatcaactcactggatctgaaccgga | Gaur APOBEC3Z3 | Gaur APOBEC3Z3 N92D |
| Gaur APOBEC3Z3 N92D Rev | tccggttcagatccagtgagttgatc | Gaur APOBEC3Z3 | Gaur APOBEC3Z3 N92D |
| Gaur APOBEC3Z3 R95P Fwd | ctgaatctgaacccgagccagagctaca | Gaur APOBEC3Z3 | Gaur APOBEC3Z3 R95P |
| Gaur APOBEC3Z3 R95P Rev | tgtagctctggctcgggttcagattcag | Gaur APOBEC3Z3 | Gaur APOBEC3Z3 R95P |
| Gaur APOBEC3Z3 T100K Fwd | cggagccagagctacaaaatcatctgctatatcac | Gaur APOBEC3Z3 | Gaur APOBEC3Z3 T100K |
| Gaur APOBEC3Z3 T100K Rev | gtgatatagcagatgattttgtagctctggctccg | Gaur APOBEC3Z3 | Gaur APOBEC3Z3 T100K |

**Supplementary table 7. Primers used for the construction of expression plasmids for BIV/JDV Vif derivatives.**

| Primer name | Sequences (5' to 3') | Product |
|---|---|---|
| BIV Vif SLQ/AAA Fwd | gcacacctagacacgccgccgccagactggccgccctg | BIV Vif SLQ/AAA |
| BIV Vif SLQ/AAA Rev | cagggcggccagtctggcggcggcgtgtctaggtgtgc | BIV Vif SLQ/AAA |
| JDV Vif SLQ/AAA Fwd | cacaccaaacctcacgccgccgccagactggccggcctg | JDV Vif SLQ/AAA |
| JDV Vif SLQ/AAA Rev | caggccggccagtctggcggcggcgtgaggtttggtgtg | JDV Vif SLQ/AAA |
| Vif JB Fwd | gtcgacgttaacgcatgc | Vif JB |
| Vif JB Rev | ccagaacaggtccagctc | Vif JB |
| Vif JB in-Fwd | ctggacctgttctgggtgcgctacaccctgtgc | Vif JB |
| Vif JB in-Rev | atgcgttaacgtcgactcatttgtcgtcgtcc | Vif JB |
| Vif JBB Fwd | gcggcagaccgagtacag | Vif JBB |
| Vif JBB Rev | agcttaagtttaaacgctagcgg | Vif JBB |
| Vif JBB in-Fwd | agcgtttaaacttaagcttggtaccgagctcggatc | Vif JBB |
| Vif JBB in-Rev | gtactcggtctgccgcacgaactcccatctggg | Vif JBB |
| Vif BJB Fwd | ctgcggtactgcagctgc | Vif BJB |
| Vif BJB Rev | cacgaactcccatctggg | Vif BJB |
| Vif BJB in-Fwd | cagatgggagttcgtgatgaacgacctgtacagc | Vif BJB |
| Vif BJB in-Rev | gctgcagtaccgcagccagaacaggtccagctc | Vif BJB |
| Vif BJB1 Fwd | gacctgtacagccagaccgcctgtgtgcggaag | Vif BJB1 |
| Vif BJB1 Rev | ctggctgtacaggtcgttcatcacgaactcccatctgggg | Vif BJB1 |
| Vif BJB2 Fwd | tcatcacctaccgctacgccatctggaagagagtgtg | Vif BJB2 |
| Vif BJB2 Rev | gcggtaggtgatgatgatttcctctttctgcagtctggcggtcatgctgtactcggtctgccg | Vif BJB2 |
| Vif BJB3 Fwd | gagtggaagatccagacaggcttcaccgacccc | Vif BJB3 |
| Vif BJB3 Rev | ctggatcttccactctctggcccacacggcgtactggtaggtcagcaccagcttg | Vif BJB3 |
| Vif BJB4 Fwd | ggacctgggctacctgatgacccctgccggcac | Vif BJB4 |
| Vif BJB4 Rev | caggtagcccaggtccaggaagccggtctcgatggtccacactctcttcc | Vif BJB4 |