**Table ST2**

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|  | **ACAC** | **AUAU** |
|  | **Substrate** | **Residue** | **bond length****(% occupancy)** | **Substrate** | **Residue** | **bond length****(% occupancy)** |
| **bRNaseA** | C(-1) (N3)C(-1) (O2)A(1) (N1)C(-1) (O2')A(1) (N6) | Thr45 (Oϒ1)Thr45 (N)Asn71 (Nδ2)Phe120 (O)Asn71 (Oδ1) | 2.88 (91.4%)2.88 (86.4%)3.02 (58.7%)2.74 (48.7%)2.99 (46.3%) | A(1) (N1)U(-1) (O2)A(1) (N6)U(-1) (N3) | Asn71 (Nδ2)Thr45 (N)Asn71 (Oδ1)Thr45 (Oϒ1) | 3.02 (79.2%)2.91 (78.8%)2.96 (76.8%)2.93 (74.9%) |
| **hRNase1** | C(-1) (N3)C(-1) (O2)A(1) (N1)A(1) (N6)C(-1)(O2') | Thr45 (Oϒ1)Thr45 (N)Asn71 (Nδ2)Asn71 (Oδ1)Phe120 (O) | 2.87 (93.6%)2.88 (84.4%)3.02 (70.1%)2.98 (61.2%)2.74 (45.4%) | U(-1) (N3)A(1) (N1)U(-1) (O2)A(1) (N6)U(-1) (O2') | Thr45 (Oϒ1)Asn71 (Nδ2)Thr45 (N)Asn71 (Oδ1)Phe120 (O) | 2.92 (93.9%)3.00 (80.0%)2.91 (76.9%)2.97 (73.3%)2.73 (52.0%) |
| **hRNase2** | A(1) (OP2)C(-1) (N3) | Gln15 (Nε2)Thr43 (Oϒ1) | 2.92 (56.4%)2.84 (49.6%) | A(1) (OP2)U(-1) (O2) | Gln15 (Nε2)Thr43 (Oϒ1) | 2.94 (57.2%)2.81 (56.8%) |
| **hRNase3** |  |  |  | A(1) (N1)A(1) (O)A(1) (OP2)A(1) (N6) | Asn71 (Nδ2)His129 (Nδ1)Gln15 (Nε2)Asn71 (Oδ1) | 2.98 (47.9%)2.83 (47.4%)2.89 (46.8%)2.97 (45.1%) |
| **hRNase4** | C(-1) (N4)A(1) (O)A(1) (OP1) | Thr45 (Oϒ1)Phe118 (N)His117 (Nδ1) | 2.90 (86.0%)2.92 (58.0%)2.78 (49.4%) | U(-1) (N3)U(-1) (O2)A(1) (O)A(1) (N1)A(1) (N6)A(1) (O) | Thr45 (Oϒ1)Thr45 (N)Phe118 (N)Asn71 (Nδ2)Asn71 (Oδ1)His117 (Nδ1) | 2.94 (92.6%)2.92 (88.1%)2.88 (69.8%)3.02 (48.7%)2.96 (48.5%)2.79 (47.4%) |
| **hRNase5** | C(-1) (N3)C(-1) (O2) | Thr44 (Oϒ1)Thr44 (N) | 2.85 (76.3%)2.90 (70.7%) | U(-1) (O4)U(-1) (N3) | Thr44 (N)Asn43 (Oδ1) | 2.91 (56.9%)2.92 (54.2%) |
| **hRNase6** | A(1) (N6)A(1) (N1)A(1) (O)A(1) (O)C(-1) (N4)A(1) (N6) | Asn69 (Oδ1)Asn69 (Nδ2)Trp11 (Nε1)Gln15 (Nε2)Thr43 (Oϒ1)Asn65 (Oδ1) | 2.97 (93.6%)3.03 (90.4%)2.87 (87.2%)2.97 (70.6%)2.95 (48.2%)2.97 (47.2%) | A(1) (N6)A(1) (N1)A(1) (N6)A(1) (O) | Asn69 (Oδ1)Asn69 (Nδ2)Asn65 (Oδ1)Gln15 (Nε2) | 2.95 (95.6%)3.05 (85.0%)2.95 (59.2%)2.90 (46.7%) |
| **hRNase7** | C(-1) (N3)C(-1) (O2)C(-1) (O2')C(-1) (N4) | Thr43 (Oϒ1)Thr43 (N)Leu125 (O)Thr43 (Oϒ1) | 2.83 (81.3%)2.94 (74.8%)2.71 (60.2%)3.04 (50.6%) |  |  |  |