

CLAIMS

1. A recombinant terminal deoxynucleotidyl transferase (TdT) comprising an amino acid sequence that is at least 80% identical to SEQ ID NO: 1, wherein the recombinant TdT comprises one or more amino acid substitution mutations at one or more positions functionally equivalent to Glu191, Lys193, Glu194, Asp242, Lys287, Phe296, Met299, Thr342, and His421 in the *Bos taurus* TdT of SEQ ID NO: 12.
2. The recombinant TdT of claim 1, wherein the amino acid substitution mutation at the position functionally equivalent to Glu191 in the *Bos taurus* TdT of SEQ ID NO: 12 is Glu191Val.
3. The recombinant TdT of claim 1, wherein the amino acid substitution mutation at the position functionally equivalent to Lys193 in the *Bos taurus* TdT of SEQ ID NO: 12 is Lys193Asn.
4. The recombinant TdT of claim 1, wherein the amino acid substitution mutation at the position functionally equivalent to Glu194 in the *Bos taurus* TdT of SEQ ID NO: 12 is Glu194Gly.
5. The recombinant TdT of claim 1, wherein the amino acid substitution mutation at the position functionally equivalent to Asp242 in the *Bos taurus* TdT of SEQ ID NO: 12 is Asp242Tyr.
6. The recombinant TdT of claim 1, wherein the amino acid substitution mutation at the position functionally equivalent to Lys287 in the *Bos taurus* TdT of SEQ ID NO: 12 is Lys287Glu.
7. The recombinant TdT of claim 1, wherein the amino acid substitution mutation at the position functionally equivalent to Phe296 in the *Bos taurus* TdT of SEQ ID NO: 12 is Phe296Leu.
8. The recombinant TdT of claim 1, wherein the amino acid substitution mutation at the position functionally equivalent to Met299 in the *Bos taurus* TdT of SEQ ID NO: 12 is Met299Lys.
9. The recombinant TdT of claim 1, wherein the amino acid substitution mutation at the position functionally equivalent to Thr342 in the *Bos taurus* TdT of SEQ ID NO: 12 is Thr342Ser.
10. The recombinant TdT of claim 1, wherein the amino acid substitution mutation at the position functionally equivalent to His421 in the *Bos taurus* TdT of SEQ ID NO: 12 is His421Pro.
11. The recombinant TdT of claim 1, wherein the recombinant TdT comprises two or more amino acid substitution mutations at two or more positions functionally equivalent to

Glu191, Lys193, Glu194, Asp242, Lys287, Phe296, Met299, Thr342, and His421 in the *Bos taurus* TdT of SEQ ID NO: 12.

12. The recombinant TdT of claim 1, wherein the recombinant TdT comprises nine amino acid substitution mutations at positions functionally equivalent to Glu191, Lys193, Glu194, Asp242, Lys287, Phe296, Met299, Thr342, and His421 in the *Bos taurus* TdT of SEQ ID NO: 12.

13. The recombinant TdT of claim 1, wherein the recombinant TdT comprises an amino acid sequence that is at least 85% identical to SEQ ID NO: 1.

14. The recombinant TdT of claim 1, wherein the recombinant TdT comprises an amino acid sequence that is at least 95% identical to SEQ ID NO: 11.

15. The recombinant TdT of claim 1, wherein the recombinant TdT comprises an amino acid sequence that is at least 80% identical to SEQ ID NO: 12.

16. The recombinant TdT of claim 1, wherein the recombinant TdT is stable at a temperature of 47 °C or higher.

17. The recombinant TdT of claim 1, wherein the terminal deoxynucleotidyl transferase activity of the recombinant TdT is at least 80%, 85%, 90%, 95%, 100%, 105%, 110%, 115%, or 120%, of the terminal deoxynucleotidyl transferase activity of the *Bos taurus* TdT of SEQ ID NO: 12 at a same test temperature.

18. The recombinant TdT of claim 1, wherein the recombinant TdT comprises a small ubiquitin-like modifier (SUMO) fragment.

19. The recombinant TdT of claim 1, wherein the recombinant TdT comprises the SUMO fragment on the N-terminus of the recombinant TdT.

20. A polynucleotide encoding the recombinant terminal deoxynucleotidyl transferase (TdT) of claim 1.