Volume 16 Number 21 1988 Nucleic Acids Research

Complete nucleotide sequence of the genomic ovine β-lactoglobulin gene

S.Harris, S.Ali, S.Anderson, A.L.Archibald and A.J.Clark

AFRC Institute of Animal Physiology and Genetics Research, Edinburgh Research Station, King's Buildings, West Mains Road, Edinburgh, EH9 3JQ, UK

Submitted September 23, 1988

Accession no. X12817

ß-lactoglobulin (BLG) is the major whey protein found in the milk of a number of species (1,2). The genomic organisation of the ovine BLG gene and its relationship to a number of other secretory proteins has recently been described (3); as has the ability of sequences derived from genomic clone SS1 to direct the synthesis of large quantities of BLG protein into the milk of lactating transgenic mice (4). We present here the 7379 bps of genomic DNA sequence of clone SS1 which are sufficient to direct the tissue-specific expression of this gene in transgenic mice (5).

```
   1 gtgctcagcaacacacccagcaccagcattcccgctgctcctgaggtctgcaggcagctcgctgtagcctgagcggtgtggaggg
  86 aagtgtcctgggagatttaaaatgtgagaggcgggaggtgggaggttgggccctgtgggcctgcccatcccacgtgcctgcatta
 171 gccccagtgctgctcagccgtgcccccgccgcaggggtcaggtcactttcccgtcctggggttattatgactcttgtcattgcca
 256 ttgccatttttgctaccctaactgggcagcaggtgcttgcagagccctcgataccgaccaggtcctccctcggagctcgacctga
 341 accccatgtcacccttgccccagcctgcagagggtgggtgactgcagagatcccttcacccaaggccacggtcacatggtttgga
 426 ggagctggtgcccaaggcagaggccaccctccaggacacacctgtccccagtgctggctctgacctgtccttgtctaagaggctg
 511 accccggaagtgttcctggcactggcagccagcctggacccagagtccagacacccacctgtgcccccgcttctggggtctacca
 596 ggaaccgtctaggcccagaggggggacttcctgcttggccttggatggaagaaggcctcctattgtcctcgtagaggaagccaccc
 681 cggggcctgaggatgagccaagtgggattccggaaccgcgtggctgggggcccagcccgggctggctggcctgcatgcgcctcc
 766 tgtataaggccccaagcctgcctgtctcagccctccACTCCCTGCAGAGCTCAGAAGCACGACCCCAGCTGCAGCCATGAAGTGC
 851 CTCCTGCTTGCCCTGGGCCTGGCCCTCGCCTGTGGCGTCCAGGCCATCATCGTCACCCAGACCATGAAAGGCCTGGACATCCAGA
 936 AGgttcgagggttggccgggtgggtgagttgcagggcgggcaggggagctgggcctcagagagccaagagaggctgtgacgttgg
1021 gttcccatcagtcagctagggccacctgacaaatccccgctggggcagcttcaaccaggcgttcactgtcttgcattctggaggc
1106 tggaagcccaagatccaggtgttggcagggctggcttctcctgcggccgctctctggggagcagacggccgtcttctccagtcct
1191 ctgcgcgccctgatttcctcttcctgtgaggccaccaggcctgctggaaacacgcctgcctgcgcagcttcacacgacctttgtc
1276 atctctttaaaggccatgtctccagagtcatgtgttgaagttctgggggttagtgggacacagttcagcccctaaaagagtctct
1361 ctgcccctcaaatttcccccacctccagccatgtctccccaagatccaaatgttgctacatgtgggggggctcatctgggtccct
1446 ctttgggttcagtgtgagtctggggagagcattccccagggtgcagagttgggggagtatctcagggctgcccaggccggggtg
1531 ggacagagagcccactgtggggctgggggcccctcccacccccagagtgcaactcaaggtccctctccagGTGGCGGGGACTTG
1616 GCACTCCTTGGCTATGGCGGCCAGCGACATCTCCCTGCTGGATGCCCAGAGTGCCCCCCTGAGAGTGTACGTGGAGGAGCTGAAG
1701 CCCACCCCCGAGGGCAACCTGGAGATCCTGCTGCAGAAATGgtgggcgtctctccccaacatggaacccccactccccagggctg
1786 tggaccccccgggggtggggtgcaggagggaccagggccccagggctggggaagagggctcagagtttactggtacccggcgct
1871 ccacccaaggctgcccacccagggctttttttttttttaaactttattaatttgatgcttcagaacatcatcaaacaaatgaac
1956 ataaaacattcatttttgtttacttggaaggggagataaaatcctctgaagtggaaatgcatagcaaagatacatacaatgaggc
2041 aggtattctgaattccctgttagtctgaggattacaagtgtatttgagcaacagagagacattttcatcatttctagtctgaaca
2126 cctcagtatctaaaatgaacaagaagtcctggaaacgaagcagtgtggggataggcccgtgtgaaggctgctgggaggcagcaga
2211 cctgggtcttcgggctcaagcagttcccgctaccagccctgtccacctcagacgggggtcagggtgcaggagagagctggatggg
2296 tgtgggggcagagatggggacctgaaccccagggctgccttttggggtgcctgtggtcaaggctctccctgacctttctctct
2381 ggcttcatctgacttctcctggcccatccacccggtcccctgtggcctgaggtgacagtgagtgcgccgaggctagttggccagc
2466 tggctcctatgcccatgccaccccccctccagccctcctgggccagcttctgcccctggccctcagttcatcctgatgaaaatggt
2551 ccatgccaatggctcagaaagcagctgtctttcagGGAGAACGGCGAGTGTGCTCAGAAGAAGATTATTGCAGAAAAAACCAAGA
2636 TCCCTGCGGTGTTCAAGATCGATGgtgagtccgggtccctgggggacacccaccacccccgccccggggactgtggacaggttc
2721 agggggctggcgtcgggccctgggatgctaagggactggtggtgatgaagacactgccttgacacctgcttcacttgcctcccct
2806 gccacctgcccggggccttggggcggtggccatgggcaggtcccggctggcgggctaacccaccagggtgacacccgagctctct
2891 ttgctgggggcgggcggtgctctgggccctcaggctgagctcaggagggtacctgtgccctcccaggggtaaccgagagccgttg
2976 cccactccaggggcccaggtgccccacgaccccagcccgctccacagctccttcatctcctggagacaaactctgtccgccctcg
3061 ctcattcacttgttcgtcctaaatccgagatgataaagcttcgagggggggttggggttccatcagggctgcccttccgccgggc
3146 agcctgggccacatctgcccttggcccccctcaggactcactctgactggaggccctgcactgactgacgccagggtgcccagccc
3231 agggtctctggcgccatccagctgcactgggtttgggtgctggtcctgcccccaagctgcccggacaccacaggcagccggggct
3316 gcccactggcctcggtcagggtgagccccagctgcccccgctcagggcttgccccgacaatgaccccatcctcaggacgcacccc
3401 ccttcccttgctgggcagtgtccagccccacccgagatcgggggaagccctatttcttgacaactccagtccctgggggagggg
3486 cctcagactgagtggtgagtgttcccaagtccaggaggtggtggagggtcctggcggatccagagttgacagtgagggcttcctg
3571 ggccccatgcgcctggcagtggcagcagggaagaggaagcaccatttcaggggtgggggatgccagaggcgctccccaccccgtc
3656 ttcgccgggtggtgaccccgggggagccccgctggtcgtggagggtgctgggggctgactagcaacccctcccccccgttggaa
3741 ctcactttctcccgtcttgaccgcgtccagCCTTGAATGAGAACAAAGTCCTTGTGCTGGACACCGACTACAAAAAGTACCTGC
3826 TCTTCTGCATGGAAAACAGTGCTGAGCCCGAGCAAAGCCTGGCCTGCCAGTGCCTGGgtgggtgccaaccctggctgcccaggga
3911 gaccagctgcgtggtccttgctgcaacagggggtgggggtgggagcttgatccccaggaggaggaggggtgggggtccctgag
3996 tcccgccaggagagagtggtcgcataccgggagccagtctgctgtgggcctgtgggtggctggggacgggggccagacacacagg
4081 ccgggagacgggtgggctgcagaactgtgactggtgtgaccgtcgcgatggggccggtggtcactgaatctaacagcctttgtta
```

© IRL Press Limited, Oxford, England.

4166 ccggggagtttcaattatttcccaaaataagaactcaggtacaaagccatctttcaactatcacatcctgaaaacaaatggcagg
4251 tgacattttctgtgccgtagcagtcccactggcattttcagggcccctgtgccagggggcgcgggcatcggcgagtggaggct
4336 cctggctgtgtcagccggcccagggggaggaagggacccggacagccagaggtgggggcaggctttccccctgtgacctgcaga
4421 cccactgcactgccctgggaggaagggagggaactaggccaagggggaagggcaggtgctctggagggcaagggcagacctgca
4506 gaccaccctggggagcagggactgacccccgtccctgccccatagTCAGGACCCCGGAGGTGGACAACGAGGCCCTGGAGAAATT
4591 CGACAAAGCCCTCAAGGCCCTGCCCATGCACATCCGGCTTGCCTTCAACCCGACCCAGCTGGAGGgtgagcacccaggccccgcc
4676 cttccccagggcaggagccacccggccccgggacgacctcctcccatggtgacccccagctccccaggcctcccaggaggaaggg
4761 gtggggtgcagcaccccgtgggggcccctccccacccccctgccaggcctctcttcccgaggtgtccagtcccatcctgaccccc
4846 ccatgactctccctccccacagGGCAGTGCCACGTCTAGGTGAGCCCCTGCCGGTGCCTCTGGGgtaagctgcctgccctgccc
4931 cacgtcctgggcacacacatggggtagggggtcttggtggggcctgggaccccacatcaggccctggggtccccccctgtgagaat
5016 ggctggaagctggggtccctcctggcgactgcagagctggctggccgcgtgccactcttgtgggtgacctgtgtcctggcctcac
5101 acactgacctcctccagctccttccagcagagctaaggctaagtgagccagaatggtacctaaggggaggctagcggtccttctc
5186 ccgaggaggggctgtcctggaaccaccagccatggagaggctggcaagggtctggcaggtgccccaggaatcacagggggggcccc
5271 atgtccatttcagGGCCCGGGAGCCTTGGACTCCTCTGGGGACAGACGACGTCACCACCGCCCCCCCCCCATCAGGGGGACTAGA
5356 AGGGACCAGGACTGCAGTCACCCTTCCTGGGACCCAGGCCCCTCCAGGCCCCTCCTGGGGCTCCTGCTCTGGGCAGCTTCTCCTT
5441 CACCAATAAAGGCATAAACCTGTgctctcccttctgagtctttgctggacgacgggcagggggtggagaagtggtggggagggag
5526 tctggctcagaggatgacagcggggctgggatccagggcgtctgcatcacagtcttgtgacaactgggggcccacacacatcact
5611 gcggctctttgaaactttcaggaaccagggagggactcggcagagacatctgccagttcacttggagtgttcagtcaacacccaa
5696 actcgacaaaggacagaaagtggaaaatggctgtctcttagtctaataaatattgatatgaaactcaagttgctcatggatcaat
5781 atgcctttatgatccagccagccactactgtcgtatcaactcatgtacccaaacgcactgatctgtctggctaatgatgagagat
5866 tcccagtagagagctggcaagaggtcacagtgagaactgtctgcacacacagcagagtccaccagtcatcctaaggagatcagtc
5951 ctggtgttcattggaggactgatgttgaagctgaaactccaatgctttggccacctgatgtgaagagctgactcatttgaaaaga
6036 ccctgatgctgggaaagattgagggcaggaggagaaggggacgacagaggatgagatggttggatggcatcaccaacacaatgga
6121 catgggtttgggtggactccaggagttggtgatggacagggaggcctggcgtgctacggaagcggtttatggggtcacaaagact
6206 gagtgactgaactgagctgaactgaatggaaatgaggtatacagcaaagtggggatttttagataataagaatatacacataac
6291 atagtgtatactcatatttttatgcatacctgaatgctcagtcactcagtcgtatctgactctgtgacctatggaccgtagcctt
6376 ccaggtttcttctgtccacagaattctccaaggcaagaatactggagtgggtagccatttcctcctccaggggatcctcccgacc
6461 cagggattgaaccggcatctcctgtattggcaggtggattctttaccactgtgccaccagggaagcccgtgttactctctatgtc
6546 ccacttaattaccaaagctgctccaagaaaaagcccctgtgccctctgagcttcccggcctgcagagggtggtgggggtagactg
6631 tgacctgggaacaccctcccgcttcaggactcccgggccacgtgacccacagtcctgcagacagccgggtagctctgctcttcaa
6716 ggctcattatctttaaaaaaaactgaggtctattttgtgacttcgctgccgtaacttctgaacatccagtgcgatggacaggacc
6801 tcctccccaggcctcaggggcttcagggagccagccttcacctatgagtcaccagacactcgggggtggccccgccttcagggtg
6886 ctcacagtcttcccatcgtcctgatcaaagagcaagaccaatgacttcttaggagcaagcagacacccacaggacactgaggttc
6971 accagagctgagctgtccttttgaacctaaagacacacagctctcgaaggttttctctttaatctggatttaaggcctacttgcc
7056 cctcaagagggaagacagtcctgcatgtccccaggacagccactcggtggcatccgaggccacttagtattatctgaccgcaccc
7141 tggaattaatcggtccaaactggacaaaaaccttggtgggaagtttcatcccagaggcctcaaccatcctgctttgaccaccctg
7226 catctttttttcttttatgtgtatgcatgtatatatatatatatatttttttttttttcatttttttggctgtgctggctgttcgt
7311 tgcagttcggtgcgcaggcttctctctagtttctctctagtcttctcttatcacagagcagtctctaga 7379

Fig 1. The 7379bp of genomic sequence encompassing the ovine BLG gene. Upper case sequence corresponds to the transcribed exons that comprise the mature message (3,6). Underlined at 5938-6231 and 6328-6444 are sequences with homology to previously described artiodactyl Alu-like repeat sequences (7,8 respectively).

References

1. Jenness, R. (1982) In Fox, P.F. (ed), Developments in Dairy Chemistry, Applied Sciences Publishers, London and New York, Vol. I, pp 83-114.
2. Pervaiz, S and Brew, K. (1985) Science 228, 335-337.
3. Ali, S. and Clark, A.J. (1988) J. Mol. Biol. 199, 415-426.
4. Simons, J.P. McClenaghan, M. and Clark, A.J. (1987) Nature 328, 530-532.
5. Harris, S. et al. in preparation.
6. Gaye, P. Hue-Delahaie, D. Mercier, J-C. Soulier, S. Vilotte, J-L. and Furet, J-P. (1986) Biochimie 68, 1097-1107.
7. Duncan, C.H. (1987) Nucl. Acids. Res. 15, 1340.
8. Watanabe, Y. Tsukada, T. Notake, M. Nakanishi, S. and Numa S. (1982) Nucl. Acids. Res. 10, 1459-1469.