



Supplementary files: PCA-Based Multiple-Trait GWAS Analysis: A Powerful Model for Exploring Pleiotropy

Wengang Zhang ^{1,†}, Xue Gao ^{1,†}, Xinping Shi ^{1,2}, Bo Zhu ¹, Zezhao Wang ¹, Huijiang Gao ¹, Lingyang Xu ¹, Lupei Zhang ¹, Junya Li ^{1,*} and Yan Chen ^{1,*}

¹ Cattle Genetics and Breeding Group, Institute of Animal Science (IAS), Chinese Academy of Agricultural Sciences (CAAS), Beijing 100193, China; zhangwengang_19@sina.com (W.Z.); gaouxue76@126.com (X.G.); sxp18811727129@163.com (X.S.); zhubo525@126.com (B.Z.); wangzezhao1@163.com (Z.W.); gaohj111@sina.com (H.G.); xulingyang@caas.cn (L.X.); zhanglupei@caas.cn (L.Z.)

² College of Animal Science and Technology, Hebei Agricultural University, Baoding 071000, China

* Correspondence: lijunya@caas.cn (J.L.); chenyan0204@163.com (Y.C.);
Tel.: +86-138-1156-8766 (J.L.); +86-134-3967-4745 (Y.C.)

† These authors contributed equally to this work.

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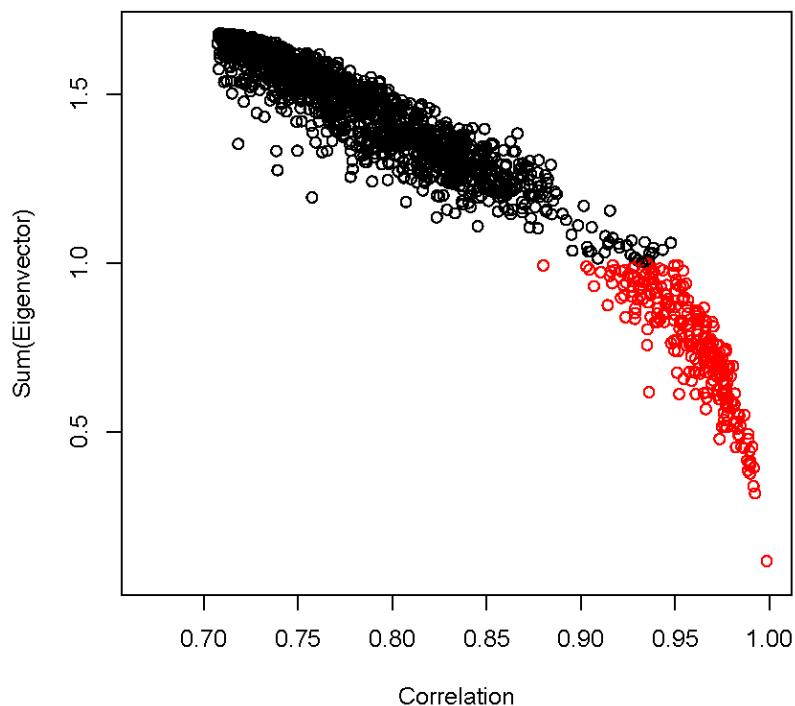


Figure S1. Summation of eigenvectors at different correlation levels based on summated data. Red plots represent that the summation of the eigenvector is lower than 1.

Table S1. Component matrix and total variance explained by each principal component.

Trait	Principal Component		
	I	II	III
Clod weight	0.915	0.395	0.084
Heel muscle shank weight	0.928	−0.279	0.247
Fore shank weight	0.939	−0.109	−0.326
Total variance explained	86.0%	8.2%	5.8%



Table S2. Significant SNPs and candidate genes associated with three traits in single-trait GWAS.

BTA	SNP name	Position	p-Value	Annotated gene	Trait ₁
6	BovineHD0600010958	40003884	1.60 × 10 ⁻⁷		HMS
6	BovineHD0600010960	40006739	1.60 × 10 ⁻⁷		HMS
5	BovineHD0500008693	29684213	5.27 × 10 ⁻⁷	LARP4 FAM186A	HMS
6	BovineHD0600010961	40007899	6.15 × 10 ⁻⁷		HMS
6	BovineHD4100004580	38852093	6.56 × 10 ⁻⁷	DCAF16 NCAPG LCORL	HMS
6	BovineHD0600011236	41498235	9.31 × 10 ⁻⁷	SLIT2	HMS
6	BTA-75902-no-rs	42155077	1.22 × 10 ⁻⁶	KCNIP4	HMS
6	BovineHD0600011439	42167429	2.17 × 10 ⁻⁶	KCNIP4	HMS
6	BovineHD0600011438	42162209	2.21 × 10 ⁻⁶	KCNIP4	HMS
6	BovineHD0600011442	42175002	2.49 × 10 ⁻⁶	KCNIP4	HMS
6	BovineHD0600011441	42169746	2.64 × 10 ⁻⁶	KCNIP4	HMS
6	BovineHD0600010952	39990876	2.78 × 10 ⁻⁶		HMS
6	BovineHD0600011435	42154344	3.37 × 10 ⁻⁶	KCNIP4	HMS
6	BovineHD0600010660	38549807	4.61 × 10 ⁻⁶	LAP3 MED28 FAM184B	HMS
6	BovineHD0600010950	39988294	4.83 × 10 ⁻⁶		HMS
6	BovineHD0600010951	39989868	5.06 × 10 ⁻⁶		HMS
6	BovineHD0600010956	39997880	5.26 × 10 ⁻⁶		HMS
15	BovineHD1500010212	37272475	5.90 × 10 ⁻⁶		HMS
6	BovineHD0600010953	39991818	6.08 × 10 ⁻⁶		HMS
6	BovineHD0600010827	39372172	6.27 × 10 ⁻⁶		HMS
6	BovineHD0600011437	42158231	7.45 × 10 ⁻⁶	KCNIP4	HMS
6	BovineHD0600011436	42156523	7.47 × 10 ⁻⁶	KCNIP4	HMS
6	Hapmap26308-BTC-057761	38576012	9.41 × 10 ⁻⁶	LAP3 MED28 FAM184B	HMS
6	BovineHD0600011226	41457949	9.75 × 10 ⁻⁶	SLIT2	HMS
4	BovineHD0400013305	48381566	3.64 × 10 ⁻¹⁰	PIK3CG PRKAR2B	CW
4	BovineHD0400013305	48381566	3.64 × 10 ⁻⁶	PIK3CG PRKAR2B	FS
1	BovineHD0100020542	71613561	8.25 × 10 ⁻⁶	TCTEX1D2 UBXN7 SMCO1 WDR53 FBXO45	FS

Note: ¹ HMS, heel muscle weight; CW, clod weight. BTA, *Bos taurus* autosome. SNP, single nucleotide polymorphism.

Table S3. Significant SNPs and candidate genes associated with three traits in PCA-based multiple-trait GWAS.

BTA	SNP name	Position	p-Value	Gene	PCA
4	BovineHD0400013305	48381566	1.39 × 10 ⁻¹¹		PC2
9	BovineHD0900013932	50518738	3.28 × 10 ⁻⁶	MCHR2	PC2
9	BovineHD0900013931	50517026	5.06 × 10 ⁻⁶	MCHR2	PC2
14	BovineHD4100010732	5888713	7.85 × 10 ⁻⁶		PC2
14	BovineHD4100010731	5887202	8.17 × 10 ⁻⁶		PC2
6	BovineHD4100004565	38471732	7.55 × 10 ⁻⁸	LAP3	PC3
6	BovineHD4100004566	38477781	1.12 × 10 ⁻⁷	LAP3	PC3
6	Hapmap30134-BTC-034283	38464203	1.29 × 10 ⁻⁷		PC3
6	BovineHD0600010958	40003884	1.56 × 10 ⁻⁷		PC3
6	BovineHD0600010960	40006739	1.56 × 10 ⁻⁷		PC3
6	BovineHD0600010647	38469930	3.23 × 10 ⁻⁷		PC3
6	BovineHD0600010660	38549807	3.43 × 10 ⁻⁷		PC3
6	BovineHD0600010961	40007899	5.34 × 10 ⁻⁷		PC3
6	BovineHD0600010666	38574125	9.28 × 10 ⁻⁷	LAP3 MED28 FAM184B	PC3
6	BovineHD0600010669	38583783	9.28 × 10 ⁻⁷	LAP3 MED28 FAM184B	PC3
6	BovineHD0600010676	38595246	1.32 × 10 ⁻⁶	LAP3 MED28 FAM184B	PC3
6	BovineHD0600010668	38581382	1.66 × 10 ⁻⁶	LAP3 MED28 FAM184B	PC3
6	BovineHD0600010648	38471181	2.07 × 10 ⁻⁶	LAP3 MED28 FAM184B	PC3
6	BovineHD0600010649	38474338	2.15 × 10 ⁻⁶		PC3
6	BovineHD0600010952	39990876	2.50 × 10 ⁻⁶		PC3
6	BovineHD0600010950	39988294	2.88 × 10 ⁻⁶		PC3



6	BovineHD0600010951	39989868	3.10×10^{-6}		PC3
6	BovineHD0600010953	39991818	3.22×10^{-6}		PC3
5	BovineHD0500008693	29684213	3.42×10^{-6}	LARP4 FAM186A	PC3
6	BovineHD0600010956	39997880	3.98×10^{-6}		PC3
6	BovineHD4100004570	38494379	4.19×10^{-6}		PC3
6	BovineHD0600010653	38495361	4.53×10^{-6}	LAP3 MED28 FAM184B	PC3
6	BovineHD0600010665	38571977	4.54×10^{-6}	LAP3 MED28 FAM184B	PC3
6	BovineHD0600010686	38618402	4.85×10^{-6}	LAP3 MED28 FAM184B	PC3
6	BovineHD4100004580	38852093	5.04×10^{-6}	NCAPG LCORL DCAF16	PC3
6	BovineHD4100004568	38487018	5.29×10^{-6}	LAP3	PC3
6	BTA-75902-no-rs	42155077	6.02×10^{-6}	KCNIP4	PC3
6	BovineHD0600010824	39356766	6.26×10^{-6}		PC3
6	BovineHD0600010957	40000025	9.01×10^{-6}		PC3
6	BovineHD0600011439	42167429	9.57×10^{-6}	KCNIP4	PC3
6	BovineHD0600011438	42162209	9.75×10^{-6}	KCNIP4	PC3
6	BovineHD0600010684	38614787	9.76×10^{-6}	LAP3 MED28 FAM184B	PC3

Note: BTA, *Bos taurus* autosome. SNP, single nucleotide polymorphism. PCA, principal component analysis.