

Table S1. Description of whole-genome and some suggestive* SNPs associated with fat content and fatty acids in the milk of Karachai goats

CHR	SNP	Position	P
TS			
2	snp18646-scaffold1882-539299	111 052 769	1.41E-06
3	snp11864-scaffold144-984620	46 725 075	9.00E-06
8	snp28090-scaffold300-3913146	39 751 214	9.65E-06
10	snp24669-scaffold251-1625913	56 089 166	6.55E-06
25	snp16908-scaffold1766-616140	1 861 790	7.79E-07
MSNF			
2	snp8325-scaffold130-2860751	6 443 953	1.47E-07
21	snp6514-scaffold1230-1489811	31 913 916	5.18E-06
PT			
2	snp8326-scaffold130-2909971	6394722	2.13E-07
2	snp8325-scaffold130-2860751	6443953	2.88E-06
8	snp997-scaffold1026-378556	70684382	1.34E-06
PC			
1	snp19495-scaffold197-240248	15 704 998	1.51E-06
2	snp8325-scaffold130-2860751	6 443 953	1.47E-07
8	snp43684-scaffold585-2375977	78 374 813	6.26E-06
8	snp43681-scaffold585-2255525	78 496 104	3.69E-07
8	snp997-scaffold1026-378556	70 684 382	9.99E-07
24	snp40879-scaffold526-1360443	44 527 159	7.88E-06
Cas. β			
2	snp8326-scaffold130-2909971	6 394 722	4.54E-08
2	snp8325-scaffold130-2860751	6 443 953	8.00E-07
Fat			
8	snp33285-scaffold391-913110	6 144 247	4.04E-06
25	snp16908-scaffold1766-616140	1 861 790	3.35E-06
Saturated fatty acids (SFA)			
2	snp18646-scaffold1882-539299	111 052 769	1.41E-06
3	snp10469-scaffold1373-2167084	52 769 710	9.19E-06
8	snp33285-scaffold391-913110	6 144 247	9.68E-06
13	snp8522-scaffold1308-1729010*	75 367 491	2.21E-05
16	snp50562-scaffold727-524836*	37 286 538	1.11E-05
23	snp10273-scaffold1368-2701834*	6 904 785	9.35E-05
Monounsaturated fatty acids (MUFA)			
1	snp27412-scaffold292-177570*	141 051 692	9.19E-05
13	snp8522-scaffold1308-1729010*	75 367 491	2.21E-05
25	snp16908-scaffold1766-616140*	1 861 790	1.23E-05
Polyunsaturated fat (Polyunsaturated fatty acids - PUFA)			
8	snp47195-scaffold66-1841919*	47 780 184	2.68E-05
16	snp18361-scaffold186-251734*	68 374 935	7.96E-05

23	snp10273-scaffold1368-2701834*	6 904 785	9.35E-05
Long-chain fatty acid (LCFA)			
4	snp1935-scaffold1053-1528396*	2 746 300	1.96E-05
8	snp33285-scaffold391-913110	6 144 247	9.68E-06
10	snp1441-scaffold104-780285*	25 486 826	5.54E-05
16	snp3754-scaffold112-3973504	63 371 269	5.51E-06
25	snp16908-scaffold1766-616140	1 861 790	7.79E-07
Medium chain fatty acid (MCFA)			
2	snp18646-scaffold1882-539299	111 052 769	1.41E-06
3	snp10469-scaffold1373-2167084	52 769 710	9.19E-06
10	snp24669-scaffold251-1625913	56 089 166	6.55E-06
16	snp50562-scaffold727-524836*	37 286 538	1.11E-05
23	snp10273-scaffold1368-2701834*	6 904 785	9.35E-05
25	snp16908-scaffold1766-616140	1 861 790	7.79E-07
Short-chain fatty acid (SCFA)			
2	snp18646-scaffold1882-539299	111 052 769	1.41E-06
3	snp10469-scaffold1373-2167084	52 769 710	9.19E-06
8	snp33285-scaffold391-913110	6 144 247	9.68E-06
23	snp10273-scaffold1368-2701834*	6 904 785	9.35E-05
25	snp16908-scaffold1766-616140	1 861 790	7.79E-07
Myristic C14:0			
2	snp18646-scaffold1882-539299	111 052 769	1.41E-06
3	snp10469-scaffold1373-2167084	52 769 710	9.19E-06
8	snp28090-scaffold300-3913146	39 751 214	9.65E-06
16	snp50562-scaffold727-524836*	37 286 538	1.11E-05
23	snp10273-scaffold1368-2701834*	6 904 785	9.35E-05
Palmitic C16:0			
2	snp18646-scaffold1882-539299	111 052 769	1.41E-06
3	snp10469-scaffold1373-2167084	52 769 710	9.19E-06
23	snp10273-scaffold1368-2701834*	6 904 785	9.35E-05
25	snp16908-scaffold1766-616140	1 861 790	7.79E-07
Oleic C18:1			
4	snp1935-scaffold1053-1528396*	2 746 300	1.96E-05
8	snp33285-scaffold391-913110	6 144 247	9.68E-06
10	snp1441-scaffold104-780285*	25 486 826	5.54E-05
13	snp8522-scaffold1308-1729010*	75 367 491	2.21E-05
16	snp3754-scaffold112-3973504	63 371 269	5.51E-06
25	snp16908-scaffold1766-616140	1 861 790	7.79E-07
Trans-isomers fatty acid			
8	snp47195-scaffold66-1841919*	47 780 184	2.68E-05
25	snp16908-scaffold1766-616140	1 861 790	7.79E-07
Lactose			
1	snp19495-scaffold197-240248	15 704 998	1.51E-06
1	snp23385-scaffold234-683659	25 509 749	2.58E-06

6	snp30534-scaffold337-667566	24 057 337	2.49E-06
8	snp997-scaffold1026-378556	70 684 382	9.99E-07
8	snp43685-scaffold585-2415660	78 335 071	5.99E-07
8	snp43681-scaffold585-2255525	78 496 104	3.69E-07
Acetone			
3	snp22179-scaffold219-771742	8 177 011	5.47E-06
7	snp21549-scaffold210-2243912	3 581 422	1.35E-06
9	snp43765-scaffold588-1398750	14 534 276	4.51E-06
27	snp51892-scaffold762-2837282	3 674 006	2.12E-06
Beta hydroxybutyrate (BHB)			
2	snp2511-scaffold1071-129957	14 902 755	9.44E-07
Urea			
2	snp25937-scaffold2682-105434	614 121	1.84E-06
3	snp11864-scaffold144-984620	46 725 075	9.00E-06
Feeding point depression (FPD)			
1	snp19495-scaffold197-240248	15 704 998	1.51E-06
1	snp23385-scaffold234-683659	25 509 749	2.58E-06
Acidity			
1	snp19495-scaffold197-240248	15 704 998	1.51E-06
1	snp23385-scaffold234-683659	25 509 749	2.58E-06
8	snp43684-scaffold585-2375977	78 374 813	6.26E-06
8	snp43681-scaffold585-2255525	78 496 104	3.69E-07

Table S2. Annotation of the identified candidate genes for the component composition of milk of Karachai goats

CHR	SNP±200 kb	No SNP – serial number of SNP in Figure 1	Trait	Gene	Biological function
1	snp27412-scaffold292-177570 141251692...140851692	1	MUFA	<i>MX2</i> ^{141193475..141232778}	protective response to the virus
2	snp18646-scaffold1882-539299111252769...110852769	3	TS, MCFA, SFA C14, C16, SCFA	<i>METTL8</i> ^{111185392..111270066}	development of skeletal muscle tissue, differentiation of fat cells
2	snp9402-scaffold1341-2132092114722555...114322555	4	BHB, Acetone	<i>ATF2</i> ^{114518050..114597771}	development of skeletal muscle tissue, differentiation of fat cells
2	snp8314-scaffold130-	5	TS	<i>LUZP1</i> ^{6185376..6286457}	development of the interventricular septum, bending

	2382340 ^{7122494...67} 22494				of neural folds, development of arteries
2	snp8322-scaffold130-2738985 ^{6766020...} 6566020	6	TFA	<i>HTR1D</i> ^{6305115..6} 307862	smooth muscle contraction, chemical synaptic transmission, regulation of locomotion, vasoconstriction, regulation of behavior
2	snp25937-scaffold2682-105434 ^{814121...41412} 1	7	Urea, TS	<i>NECAP2</i> ^{486514..} 500217	endocytosis
2	snp8314-scaffold130-2382340 ^{7122494...67} 22494	8	TS	<i>ID3</i> ^{6650387..6652141}	development of the central nervous system, development of the heart
				<i>HMGCL</i> ^{6836125..} 6855444	lipid metabolism, mitochondrial organization, process of biosynthesis of ketone bodies
2	snp2511-scaffold1071-129957 ^{15102755...147} 02755	9	BHB	<i>HPCA</i> ^{14931533..14} 940116	development of the inner ear, cellular response to calcium ions, regulation of the activity of voltage-gated calcium channels
				<i>FNDC5</i> ^{14907902..} 14915966	response to muscle activity, positive regulation of brown fat cell differentiation
2	snp47697-scaffold670-1960487 ^{9886517...} 9486517	10	MSNF	<i>SLC9A</i> 9830831..9883473	cellular sodium ion homeostasis, pH regulation, response to muscle distribution, cellular response to acidic pH, cellular response to adrenaline stimulus, regulation of heart rate strength via cardiac conduction
3	snp22179-scaffold219-771742 ^{8377011...7977} 011	11	Acetone	<i>NEU2</i> ^{8043799..8057} 992	catabolic process of glycoproteins, catabolic process of gangliosides, catabolic process of cellular oligosaccharides
				<i>GIGYF2</i> ^{8226338..8} 358229	feeding behavior, locomotor behavior of adults, postembryonic development, growth of a multicellular organism, metabolic process of cellular protein, balance of neuromuscular processes
				<i>INPP5D</i> ^{7877943..} 8015888	immune system process, longevity
3	snp48374-scaffold687-	12	TS	<i>PGM1</i> ^{38942586..39} 008777	glucose metabolic process

	1302080 ^{38979227...3} 8579227				
3	snp55013- scaffold841- 1661526 ^{105681913...} 105281913	13	pH	<i>ARHGEF2</i> ¹⁰⁵³⁰ 3668..105353888	cell morphogenesis, nervous system development, innate immune response
				<i>LMNA</i> ^{105450088..} 105478581	development of ventricular cardiac muscle cells
4	snp1935- scaffold1053- 1528396 ^{2946300...} 2546300	14	PUFA, LCFA, C18:1	<i>INSIG1</i> ^{12747017..27} 57803	triglyceride metabolic process, cholesterol biosynthesis process, cholesterol metabolism process, cholesterol homeostasis, negative regulation of fat cell differentiation, negative regulation of fatty acid biosynthesis process, palate development, cranial suture morphogenesis
				<i>EN2</i> 2659430..2666542	midbrain development, hindbrain development, neuronal development, embryonic brain development
				<i>PAXIP1</i> ^{2922811..2} 963751	development of adipose tissue, chorion development
4	snp38614- scaffold49- 1209913 ^{110877395...} 110477395	15	Acetone	<i>CDK6</i> ^{110413189..11} 0678573	response to the virus
5	snp47348- scaffold666- 528999 ^{97220952...} 96820952	16	Acetone	<i>ETV6</i> ^{96570433..9685} 7059	vitellogenesis, neurogenesis
5	snp12158- scaffold1450- 249468 ^{107408739...} 107008739	17	Acetone	<i>CACNA1C</i> ¹⁰⁷³² 8368..107719644	immune system development, heart development
8	snp10589- scaffold1376- 2594525 ^{73806016...} 3406016	18	PC	<i>DPYSL2</i> ^{73547764.} .73663711	brain development
				<i>ADRA1A</i> ⁷³⁷⁴⁷³⁹ 7..73862840	negative regulation of heart rate involved in baroreceptor response to increased systemic blood pressure, adult cardiac development, multicellular aging, regulation of cardiac muscle, fractional cells, cell growth in cardiac muscle cell development

8	snp43637-scaffold585-317127 ^{80644212...80244212}	19	pH	<i>DAPK1</i> ^{80466314..80672849}	protective response to tumor cells, innate immune response, cellular response to organic matter
8	snp43681-scaffold585-2255525 ^{78696104...78296104}	20	pH, Lactose, PC, β-κз	<i>AGTPBP1</i> ^{78600749..78791306}	neuromuscular process
8	snp47195-scaffold66-1841919 ^{47980184...47580184}	21	TFA, PUFA	<i>CEMIP2</i> ^{47675207..47756816}	metabolic process
8	snp997-scaffold1026-378556 ^{70884382...70484382}	22	PC, Lactose, Cas. β, pH	<i>NKX3-1</i> ^{70600953..70606837}	development of the heart, development of the dorsal aorta, development of the pharyngeal system
				<i>NKX2-6</i> ^{70639383..70643794}	development of the hypothalamus, development of the embryonic heart tube, development of the tongue, development of the guiding tract, development of the cardiac muscle cells of the atria, development of the cardiac muscle cells of the ventricles, development of the pharyngeal system
				<i>STC1</i> ^{70791218..70806076}	regulation of cardiac muscle, positive regulation of import and sources, negative regulation of renal phosphate excretion
8	snp34748-scaffold412-871719 ^{91227795...90827795}	23	FAT	<i>BAAT</i> ^{90845022..90861305}	bile acid conjugation, glycine metabolic process, fatty acid metabolic process, bile acid biosynthesis process
				<i>PLPPR1</i> ^{90695441..90835782}	process of phospholipid metabolism, development of the nervous system
8	snp28090-scaffold300-3913146 ^{39951214...39551214}	24	TS, PUFA, C14	<i>SLC1A</i> ^{39770036..39845247}	behavioral response insurance, brain development, memory, sexual behavior, neurogenesis, adult behavior, morphogenesis of blood vessels
10	snp1441-scaffold104-	25	LCFA, C18	<i>FUT8</i> ^{25310706..25629694}	left gas exchange

	780285 ^{25686826...252} 86826				
10	snp24669- scaffold251- 1625913 ^{56289166...5} 5889166	26	TS, PUFA, MCFA	TPM1	morphogenesis of cardiac muscle tissue of the ventricles, contraction of cardiac muscle
				LACTB	regulation of lipid metabolism
13	snp5221- scaffold1180- 236240 ^{36057527...356} 57527	27	PC, β -ka3	ODAD2 ^{35971967..} 36143096	heart development, development of the ventricular system
13	snp8522- scaffold1308- 1729010 ^{75567491...7} 5167491	28	MUFA, C18, SFA	EYA2 ^{75025156..752} 83017	development of striated muscle tissue
16	snp18361- scaffold186- 251734 ^{68574935...681} 74935	29	PUFA	PROX1 ^{68179003..} 68234777	determination of cell development/death, kidney development
16	snp50562- scaffold727- 524836 ^{37486538...} 37086538	30	TS, SFA, MCFA, C14	FMO2 ^{37286455..37} 330116	acid determination metabolic process, toxin metabolic process, oxygen metabolic process
				FMO1 ^{37336303..37} 376884	metabolic process of acid determination, metabolic process of xenobiotics, metabolic process of toxins
16	snp3754- scaffold112- 3973504 ^{63571269...6} 3171269	31	LCFA, C18, MUFA	NCF2 ^{63224955..632} 63716	phagocytosis, “oxygen explosion”, trophy of neutral leukocytes in the pathogenesis of the inflammatory process
16	snp8683- scaffold131- 4589642 ^{54997494...5} 4597494	32	FAT, PT	TNN ^{54831011..5490} 3426	regulation of bone development
18	snp18289- scaffold1857- 308667 ^{56470790...560} 70790	33	Urea	SULT2B1 ⁵⁶²³⁹⁵⁴ 7..56275810	cholesterol metabolic process
				GRIN2D ⁵⁶¹¹⁷⁰⁴⁷ ..56151568	reaction to fear, motor behavior of adults, regulation of sensory perception of pain
				SPHK2 ^{56292056..5} 6299987	blood vessel development, brain development
				NTN5 ^{56321271..563} 26460	neurogenesis
				IZUMO1 ⁵⁶³⁹³⁸⁹ 9..56396881	fusion of sperm with the plasma membrane of the egg, sperm-egg recognition

				<i>FUT1</i> ^{56399123...56402123}	metabolic process, protein glycosylation
21	snp6484-scaffold1230-240156 ^{33359659...32959659}	34	MSNF	<i>MPI</i> ^{33246409...33253730}	metabolic process of carbohydrates
23	snp10273-scaffold1368-2701834 ^{7104785...6704785}	35	TS, C14, C16, MCFA, PUFA, SFA, SCFA	<i>PHACTR1</i> ^{6556030...7073500}	development of the cerebral cortex
23	snp48737-scaffold692-158314 ^{45730320...45330320}	36	PC	<i>BAG2</i> ^{45658115...45668381}	chemical protein process
25	snp16907-scaffold1766-582489 ^{2027754...1627754} snp16908-scaffold1766-616140 ^{2061790...1661790}	37	TS, SFA, PUFA, MUFA, MCFA, C16, C18:1, LCFA, C14, SCFA, TFA	<i>ECI1</i> ^{1672290...1685556}	beta-oxidation of fatty acids
				<i>PGP</i> ^{1649864...1652731}	glycerol biosynthesis process
		38		<i>ABCA3</i> ^{1701870...1743075}	positive regulation of cholesterol efflux, lung development, phosphatidylcholine metabolic process, phosphatidylglycerol metabolic process, lipid biosynthesis regulation process, phospholipid homeostasis
				<i>AMDHD2</i> ^{1915270...1921956}	metabolic process of carbohydrates
				<i>PDPK1</i> ^{1932902...1996678}	pancreatic type B cell development, cellular response to epidermal growth factor stimulus
26	snp18573-scaffold1878-337881 ^{14293322...13893322}	39	Cas. β	<i>PDZD8</i> ^{14290884...14368219}	pancreatic type B cell development, cellular response to epidermal growth factor stimulus
26	snp41130-scaffold532-1727870 ^{30209081...29809081}	40	SCFA	<i>SEMA4G</i> ^{29853719...29867663}	maintenance of the nervous system, cell differentiation
26	snp47577-scaffold67-3351554 ^{17989628...17589628}	41	Cas. β , PC	<i>CASP7</i> ^{17808414...17850585}	heart development
				<i>NRAP</i> ^{32471325...32547298}	tendon joint of the thigh
				<i>HABP2</i> ^{17935249...17970574}	blood clotting

27	snp51881-scaffold762-2349319 ^{4343759...3943759}	42	Acetone	<i>THRB</i> ^{3763978..4201001}	positive regulation of thyroid hormone-mediated signaling pathway, sensory sound perception, negative regulation of female receptivity
27	snp55772-scaffold864-4012988 ^{20994598...20594598}	43	MSNF, Cas. β	<i>MFHAS1</i> ^{20648690..20757838}	reaction to an inflammatory process in the body

Note*: CHR – chromosome, SNP – single nucleotide polymorphism; genes located within SNPs are highlighted in bold.

Fat – fat content; PT – true protein content; PC – crude protein content; Lactose – lactose; MSNF – milk solids not fat ; TS – total solids; Cas. β – casein; BHB - hydroxy-butyrate; C14:0 – myristic FA; C16:0 – palmitic FA; C18:1 – oleic FA; LCFA – long chain fatty acids; MCFA – medium chain fatty acids; MCFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; SFA – saturated fatty acids; SCFA – short chain fatty acids; TFA – trans-isomers of fatty acids.