Applied Genetics and Genomics in other Species of Economic Interest

Organised by a Standing Committee: YES

Meeting information

Date: **Tuesday, July 22**
Time: **1:30 PM - 6:00 PM**
Number of participants: 55

Chair

Name: Amparo Martínez Martínez
Affiliation: University of Cordoba, Spain
Contact email: ib2mamaa@uco.es

Co-Chair (optional)

Name: Emiliano Lasagna
Affiliation: Universitá degli Studi di Perugia, Italy
Contact email: emiliano.lasagna@unipg.it

ISAG INTERNATIONAL SOCIETY FOR ANIMAL GENETICS

Agenda

- 1:30 PM **Welcoming remarks.**
- 1:35 PM **Pig CT Discussion.**
- 1:55 PM **Dromedary CT Discussion.**
- 2:15 PM **Alpaca/Llama CT Discussion.**
- 2:35 PM **Pigeon CT Discussion.**
- 2:55 PM **Goat CT Discussion (STR)**
- 3:10 PM **Sheep CT Discussion (SNP Trial).**

- 3:30 PM **Coffee Break.**

- 4:00 PM **Sheep CT Discussion.**
- 4:30 PM **Election of committee and any other business.**

- 4:40 PM **Exploring the genetics of coat color and fleece type in alpacas using the improved VicPac4 reference genome.** A. Letko*[1], M. Mendoza Cerna[2], G. Lühken[3], T. Raudsepp[2], B. W. Davis[2], and C. Drögemüller[1], [1]*Institute of Genetics, University of Bern*, *Bern, Switzerland*, [2]*College of Veterinary Medicine and Biomedical Sciences, Texas A&M University*, *College Station, TX, USA*, [3]*Institute for Animal Breeding and Genetics, Justus Liebig University Giessen*, *Giessen, Germany*.
- 5:00 PM **Allele sequencing of microsatellite markers for parentage verification in sheep.** Agnieszka Szumiec, Agata Piestrzynska-Kajtoch*, and Anna Radko, *National Research Institute of Animal Production, Department of Animal Molecular Biology*, *Balice, Poland*.
- 5:20 PM **Impact of garlic-infused mineral supplements on the rumen microbiome and resistome of feedlot cattle.** O. N. Durunna*[1], N. Malmuthuge[2], D. B. Holman[3], T. A. McAllister[4], I. Cheang-Deis[5], C. Vandenberg[1], O. Oyedeji[6], E. Gonzalez[7], and H. A. Lardner[8], [1]*Lakeland College*, *Vermilion, Alberta, Canada*, [2]*University of Calgary*, *Calgary, Alberta, Canada*, [3]*Agriculture and Agri-Food Canada*, *Lacombe, Alberta, Canada*, [4]*Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*, [5]*Cenovus Energy*, *Lloydminster, Alberta, Canada*, [6]*Agriculture and Irrigation, Government of Alberta*, *Edmonton, Alberta, Canada*, [7]*McGill University*, *Montreal, Quebec, Canada*, [8]*University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*.

Summary of the meeting

1. Welcoming Remarks

One hundred twenty-one laboratories have participated in the STR CTs organised by the Standing Committee (4 in alpaca/llama CT, 9 in dromedary CT, 31 in goat CT, 22 in pig CT, 14 in pigeon CT and 41 in sheep CT). Thirteen laboratories have reported results for the first trial of the SNP Sheep CT. In total, 15 laboratories fewer than in the 2021-2023 round participate in all the STR CTs.

2. Pig CT Discussion

Duty Lab Responsible person: Emiliano Lasagna, University of Perugia, Italy.
Results presented by Emiliano Lasagna.

The Genetic Biotechnologies Laboratory – Department of Agricultural, Food and Environmental Sciences, University of Perugia (Italy) – served as the Duty Lab. Twenty-five (25) laboratories from 13 different countries requested samples, and 22 of them submitted results. A total of 22 samples, including two reference samples, were distributed to all participants. Only two laboratories requested a second shipment of samples. The genotypes of the reference samples were confirmed by two laboratories before the results were shared with all participants. DNA was extracted from whole blood collected from six breeds, and purification was carried out using salting-out methods. Twenty-two laboratories submitted results for some or all of the markers included in the Core Panel (15 markers: S0005, S0090, S0101, S0155, S0227, S0228, S0355, S0386, SW24, SW240, SW72, SW857, SW911, SW936, and SW951) and the Additional Panel (7 markers: IGF1, S0002, S0026, S0215, S0225, S0226, and SW632 – reported by 12 laboratories). Only the Core Panel markers were considered in the ranking system. Overall marker concordance among laboratories was very high, ranging from a minimum of 96.19% (S0005) to a maximum of 100.00% (S0090, S0155, S0355, SW240, SW72, and SW936). A discrepancy of 2 base pairs (277–279) was observed among some laboratories for marker S0005. Additionally, some laboratories did not detect allele 277 for this marker. All laboratories answered both parentage questions correctly. Clerical errors, such as reporting 162/162 instead of 162/ or 210/200 instead of 200/210, were not considered mistakes in the ranking system. However, laboratories are encouraged to pay close attention to nomenclature, as correcting such errors requires significant additional work.

3. Dromedary CT Discussion

Duty Lab Responsible person: Robert Grahn. Veterinary Genetics Laboratory, Davis, USA
Results presented by Robert Grahn.

The Veterinary Genetics Laboratory (VGL UC Davis) was the Duty lab. Twelve labs requested samples, and nine labs reported results (75%). Twenty-two samples (including two reference samples) were submitted to all participants. Sample concentration ranged from 41-74 ng/ul. Aside from one lost set of import permits, there were no shipping issues. Core marker accuracy ranged from a 93.13% (LCA37 and YWLL44) to a maximum of 100.0% (LCA65, LCA66, LCA8 and YWLL29). Marker LCA19 of the core panel was mono-allelic as it was in the 22-23 CT. In the backup panel, markers (LCA24, LCA77, YWLL36 and VOLP59) were also mono-allelic again, consistent with results from the 22-23 CT. This was also the case in several previous comparison tests. All nine labs answered the first parentage question correctly, and the second one was answered correctly by eight of nine labs. It must be noted that the lab missing the second question answered according to ISAG recommendations using qualification of the core panel thus the use of the backup panel was not warranted. This underscores resolution issues with the current panels and because of the low PE, changes in the current core and backup ISAG panels were recommended. The Veterinary Genetics Laboratory (VGL UC Davis) presented the panels used in their laboratory for camel parentage and recommended the ISAG dromedary CT participants work together to establish more robust parentage panels.

4. Alpaca/Llama CT Discussion

Duty Lab Responsible person: Angelika Mąsior. National Research Institute of Animal Production, Poland
Results presented by Angelika Mąsior.

The duty lab was the National Research Institute of Animal Production (Poland). Six laboratories requested samples, and four reported results. Twenty-two samples (1 llama sample and 21 alpaca samples, including two reference samples) were submitted to all participants. The relative overall marker concordance among laboratories was very high, ranging from a minimum of 97.5% for LCA66 and 98.75% for YWLL44 to a maximum of 100% for 12 out of 14 markers. Three loci were problematic for some participants.
In the ACT6 sample, an atypical heterozygote 229/230 was observed at the LCA66 locus and was omitted from one participant's report. In the ACT15 sample at the LCA66 locus, one laboratory labelled allele 231 as allele 230. Additionally, in the ACT18 sample at the YWLL44 locus, one laboratory incorrectly recorded a homozygote 122 instead of the correct heterozygote 120/122.
All participants answered both parentage questions correctly.

5. Pigeon CT Discussion

Duty Lab Responsible person: Angelika Mąsior. National Research Institute of Animal Production, Poland
Results presented by Angelika Mąsior.

The duty lab was the National Research Institute of Animal Production (Poland). Sixteen laboratories requested samples, and two did not submit results. Twenty-one samples (including one reference sample) were distributed to all participants. The relative overall marker concordance among laboratories was good, ranging from 78.78% (CliμT43) to a maximum of 87.14% (CliμD16).
There were no disputed loci in the core panel in this PCT round, and only minor errors occurred in individual laboratories. Two laboratories reported all loci in all samples; however, most of their results were inconsistent with ISAG nomenclature.
The first parentage question was answered correctly by all laboratories, while the second parentage question was answered correctly by thirteen out of fourteen.

6. Goat CT Discussion

Duty Lab Responsible person: Amparo Martínez. University of Cordoba, Spain.
Results presented by Amparo Martínez.

The Duty lab was the University of Córdoba (Spain). Thirty-six labs requested samples. Thirty-one labs reported results. Twenty samples, including one reference sample (GCT17), were submitted to all participants. There were many problems with the shipment of the samples. 21 Labs required an additional set of samples, and four Brazilian laboratories requested a third set. The issues reported by the participant

Labs were a poor quantity of DNA and some difficulties with customs clearance. One Lab from Brazil didn't receive the third set of samples, which was returned to the Duty Lab. Three laboratories reported poor results, primarily due to the poor quality of the DNA, as indicated in their comments on the reporting form. Maybe due to these results, any marker achieved a relative accuracy of 100%. The absolute and relative genotyping accuracy of all labs ranged between 100% and 85% in both cases, except for four labs. Looking at the ranks, concerning absolute accuracy, 77.42% of the labs are in Rank 1. All the labs answered the parentage questions correctly; two labs failed, and one lab did not respond. In this round, any genotype was problematic, and the errors were attributed to the laboratories, i.e., typo mistakes, incorrect bin sets, or missing alleles.

7. Sheep STR CT Discussion

Duty Lab Responsible person: Agata Piestrzyńska-Kajtoch. National Research Institute of Animal Production, Poland
Results presented by Agata Piestrzyńska-Kajtoch.

The Duty lab was the Laboratory of Molecular Genetics from National Research Institute of Animal Production (Poland). Forty-seven labs requested samples. Twenty-two samples (including 2 reference sample) were submitted to all participants. The samples were sent between 3rd February and 14th March and the results reporting deadline was postpone to 30th May. Ale the sample sets were delivered, however there were some problems with the delivery. None of the Labs requested additional sample set. Forty-one labs reported results. The relative overall marker concordance among labs was very good, ranging from 98,29% (OARFCB20) to MAF065 (100%). The genotype of the samples OCT11 in marker OARFCB20 was discussed. Five labs reported these samples as 91/ homozygotes instead of 89/91 heterozygotes. The correct genotype the samples is 89/91. This issue was also discussed during the previous ISAG CT 2020-2021 and 2022-2023 (it was sequenced than). What is more, due to previous problems with that genotype, one of the reference samples (OCT-REF2) had the genotype 89/91 in that locus. The mistakes in OARFCB20 will be counted as errors in the ranking. For sample OCT20 in marker MAF214 five different genotypes were reported (131/261 – 36 Labs; 229/261 – 2 Labs; 233/261 - 1 Lab, 230/261 – 1 Lab, 231/233 – 1 Lab). The correct genotype of this sample is 231/261. Parentage questions were answered correctly by all 41 labs. It was suggested to use two reference samples in the next CT round.

8. Sheep SNP CT Discussion

Duty Lab Responsible person: Agata Piestrzyńska-Kajtoch. National Research Institute of Animal Production, Poland
Results presented by Agata Piestrzyńska-Kajtoch.

The Duty lab was the Laboratory of Molecular Genetics from National Research Institute of Animal Production (Poland). It was the first trial sheep SNP CT. Eighteen labs requested samples, and 13 Labs reported results. Twenty-two samples (including 2 reference sample) – same as for sheep STR CT - were submitted to all participants. Ale the sample sets were delivered. None of the Labs requested additional sample set.
During ISAG Conference in 2023 in Cape Town (South Africa) the Community have chosen SNP panel proposed by Neogen GeneSeek Operations (201 SNPs, proposed by Ryan Ferretti in 2023 as extended panel firstly proposed by International Sheep Genomics Consortium (ISGC) in 2012 during 33rd ISAG Conference in Cairns, Australia). In May 2024, after the discussions, the Committee decided to use

combined panels from Neogen and Thermo Fisher Scientific (Eureka Ovine Parentage Panel, proposed in 2014 by Heaton et al. (PloS one 9.4 (2014): e94851) and after that by Brenda Murdoch in 2019 during 37th ISAG Conference in Lleida (Spain)). Finally, the panel contained 242 SNPs.
There were several problems with the markers. At the beginning of April 2025 few labs noticed discrepancies between reference samples SNP genotypes and differences in SNP flanking sequences between those provided with template results file (v. 2025/02/11) and Illumina files. It was officially confirmed by Thermo Fisher Scientific, that while developing the ovine panel, for 29 markers incorrect flanking sequencing were used (= incorrect SNP positions for the primer design for the IonTorrent technology) what had impact on the ISAG scoring for the Labs which used this technology. There were also problems with reference and alternative alleles formats and with the mapping to the different genome versions. The results template file was corrected and the new version (2025/05/14) was sent to the Labs. The reference samples were genotyped by two labs using IonTorrent technology (LGM and Stephane Daly from AgriGenomics & Animal Health Genetic Sciences Laboratory, ThermoFisher Scientific). For markers, for which the primers in IonTorrent technology were not properly designed, the results for the reference samples in Illumina technology were provided by Jiansheng Qiu (Neogen).
Three different platforms were used for genotyping: Illumina iScan, Ion Gene Studio (IonTorrent; Thermo Fisher Scientific) and GeneTitan MC Instrument (Thermo Fisher Scientific). Due to all above mentioned problems, only 76,45% of markers (185) had the relative accuracy above 95%, 14,46% of markers had the relative accuracy below 80% and four markers (DU194639_560.1_1, DU352764_273.1_1, DU480434_533.1_1, DU500816_390.1) had relative accuracy 0%.
All the 13 labs correctly answered parentage questions.
Marker issues: mistakes in the template file, 29 officially incorrectly designed primers for Ion Torrent Technology, 3 markers on the list for unexisting SNPs, SNP reporting format issues, differences in genotyping between platforms used. The first trial sheep SNP Comparison test was not officially ranked.
During the discussion, despite all problems mentioned above, the Community decide to organize the next sheep SNP Comparison Test as officially ranked ISAG CT, with 238 markers (4 markers with 0% relative accuracy were excluded), with two reference samples. It was decided to use TOP format for the results reporting in the future sheep SNP CTs.

9. Election of committee and any other business

New Committee chair

Chair: Agata Piestrzyńska-Kajtoch
Term of service (*add years of first and second term of service*): 2025-2029
Affiliation: National Research Institute of Animal Production, POLAND.
E-mail address: agata.kajtoch@iz.edu.pl

New Committee co-chair (optional)

Chair: Rosina Fossati
Term of service (*add years of first and second term of service*): First term 2023-2027
Affiliation: Genexa. URUGUAY.
E-mail address: fossati@genexa.com.uy

Note: One term runs for two bi-annual conferences (i.e. four years)

New Committee members

Other committee members	**Affiliation**	**First term of service**	**Second term of service**	**Email address**
Foluke Eunice Sola-Oja	Faculty of Agriculture, University of Ilorin, Kwara State, NIGERIA.	2019-2023	2023-2027	solaojo.fe@unilorin.edu.ng
Angelika Mąsior	National Research Institute of Animal Production, POLAND.	2021-2025	2025-2029	angelika.masior@iz.edu.pl
Jianseng Qiu	Neogen. USA.	2023-2027		JQiu@neogen.com
Lucía Borreguero Escribano	Laboratorio Central de Veterinaria. Algete, Madrid. SPAIN.	2025-2029		lborreguero@mapa.es
Luca Fontanesi	University of Bologna. ITALY.	2025-2029		luca.fontanesi@unibo.it
Avneesh Kumar	DUVASU, INDIA.	2025-2029		avneesh.kumar@upuetuniv.edo.in

ISAG INTERNATIONAL SOCIETY FOR ANIMAL GENETICS

Comparison test (2026-2027) YES

Duty Laboratories for the 2025-2027 CTs

Duty laboratory Pig

Contact person: Robert Grahn
Affiliation: Veterinary Genetics Laboratory, Davis, USA
E-mail address: ragrahn@ucdavis.edu

Duty laboratory Dromedary

Contact person:
Affiliation:
E-mail address:

Duty laboratory Alpaca/Llama

Contact person: Angelika Mąsior
Affiliation: National Research Institute of Animal Production, Poland
E-mail address: angelika.masior@iz.edu.pl

Duty laboratory Pigeon

Contact person: Angelika Mąsior
Affiliation: National Research Institute of Animal Production, Poland
E-mail address: angelika.masior@iz.edu.pl

Duty laboratory Sheep

Contact person:
Affiliation:
E-mail address:

Duty laboratory Goat

Contact person:
Affiliation:
E-mail address:

List of recommended markers with primer information

Dromedary:

ISAG STR Core Panel - Dromedary

Locus	Forward	Reverse
LCA8	GCTGAACCACAATGCAAAGA	AATGCAGATGTGCCTCAGTT
LCA37	AAACCTAATTACCTCCCCCA	CCATGTAGTTGCAGGACACG
LCA56	ATGGTGTTTACAGGGCGTTG	GCATTACTGAAAAGCCCAGG
LCA65	TTTTTCCCCTGTGGTTGAAT	AACTCAGCTGTTGTCAGGGG
LCA66	GTGCAGCGTCCAAATAGTCA	CCAGCATCGTCCAGTATTCA
YWLL29	GAAGGCAGGAGAAAAGGTAG	CAGAGGCTTAATAACTTGCAG
YWLL44	CTCAACAATGCTAGACCTTGG	GAGAACACAGGCTGGTGAATA

ISAG Additional Markers - Dromedary

Locus	Forward	Reverse
CVLR01	GAAGAGGTTGGGGCACTAC	CAGGCAGATATCCATTGAA
CVLR04	CCCTACCTCTGGACTTTG	CCTTTTTGGGTATTTTCAG
CVLR05	CCTTGGACCTCCTTGCTCTG	GCCACTGGTCCCTGTCATT
LCA99	CAGGTATCAGGAGACGGGCT	AGCATTTATCAAGGAACACCAGC
LGU49	TCTAGGTCCATCCCTGTTGC	GTGCTGGAATAGTGCCCAGT
VOLP3	AGACGGTTGGGAAGGTGGTA	CGACAGCAAGGCACAGGA
VOLP32	GTGATCGGAATGGCTTGAAA	CAGCGAGCACCTGAAAGAA
VOLP59	CCTTCCTCAGAATCCGCCACC	CCCGCGCACCAAGCAG
YWLL08	ATCAAGTTTGAGGTGCTTTCC	CCATGGCATTGTGTTGAAGAC
YWLL36	AGTCTTGGTGTGGTGGTAGAA	TGCCAGGATACTGACAGTGAT

Alpaca/Llama:

ISAG STR Core Panel - Llamas and Alpacas

Locus	Forward	Reverse
LCA5	GTGGTTTTTGCCCAAGCTC	ACCTCCAGTCTGGGGATTTC

LCA8	GCTGAACCACAATGCAAAGA	AATGCAGATGTGCCTCAGTT
LCA19	TAAGTCCAGCCCCACACTCA	GGTGAAGGGGCTTGATCTTC
LCA37	AAACCTAATTACCTCCCCCA	CCATGTAGTTGCAGGACACG
LCA56	ATGGTGTTTACAGGGCGTTG	GCATTACTGAAAAGCCCAGG
LCA65	TTTTTCCCCTGTGGTTGAAT	AACTCAGCTGTTGTCAGGGG
LCA66	GTGCAGCGTCCAAATAGTCA	CCAGCATCGTCCAGTATTCA
LCA94	GTCCATTCATCCAGCACAGG	ACATTTGGCAATCTCTGGAGAA
LCA99	CAGGTATCAGGAGACGGGCT	AGCATTTATCAAGGAACACCAGC
YWLL29	GAAGGCAGGAGAAAAGGTAG	CAGAGGCTTAATAACTTGCAG
YWLL40	CACATGACCATGTCCCCTTAT	CCAGTGACAGTGTGACTAAGA
YWLL44	CTCAACAATGCTAGACCTTGG	GAGAACACAGGCTGGTGAATA
LGU49	TCTAGGTCCATCCCTGTTGC	GTGCTGGAATAGTGCCCAGT
LGU50	CTGCTGTGCTTGTCACCCTA	AGCACCACATGCCTCTAAGT

ISAG Additional Markers - Llamas and Alpacas

Locus	Forward	Reverse
LCA24	ACTCACGGGTGACATACAGTG	GAGCAGTGTTTGGTTTGCATT
YWLL08	ATCAAGTTTGAGGTGCTTTCC	CCATGGCATTGTGTTGAAGAC
YWLL36	AGTCTTGGTGTGGTGGTAGAA	TGCCAGGATACTGACAGTGAT
YWLL43 (X-linked)	ATACCTCTCTTGCTCTCTCTC	CCTCTACAACCATGTTAGCCA
YWLL46	AAGCAGAGTGATTTAACCGTG	GGATGACTAAGACTGCTCTGA

Pigeon:

ISAG STR Core Panel - Pigeons

Locus	Forward	Reverse
CliµD11	CCAATCCCAAAGAGGATTAT	ACTGTCCTATGGCTGAAGTG
CliµT43	GGGAAAGGAAATTTGACACTG	ACTGTCGATGCCATTAAGAC
CliµD01	GATTTCTCAAGCTGTAGGACT	GTTTGATTTGGTTGGGCCATC
PIGN57	CTCTTGTATGTCCATCTGAAC	ACCCATTTACCACTCTCTAA
CliµT13	CTGTCGAGCAGTAACAGTCC	GTTTGCAAGCCCTGGTTATCTCA
CliµD16	GCAGTGATAAAGTTCTGGAACA	GTTTGCCTCACCGTGACATCA

CliμD19	CTGCCCGTTTCTTCTAATGCAC	GTTTGGATTTCTGGGAGTGTATG
CliμT02	AGTTTTAATGAAGGCACCTCT	TGTAGCATGTCAGAAATTGG
CliμD17	TCTTACACACTCTCGACAAG	GTTTCCACCCAAATGAGCAAG
CliμD35	GGGAGCTTAAGGGATTATTG	ATTCCTTGCATGCCTACTTA
CliμT17	ATGGGTTTGGAGATGTTTTG	GTTTGATGGAGTTGCTATTTTGCT
PIGN04	GGTTTTTCTGTTTCCTCACG	GGGATTCTGGGATTATTTTTTC

ISAG Additional Markers - Pigeons

Locus	Forward	Reverse
PIGN15	TTTCCTTTCATTTGCTGTGG	AACCAGGCATTGGAGTCTTT
PIGN10	TTCCACTGAATGGGTCTCAG	CTGCCAGAAGGTAAATGACAC
PIGN26	TCACTGTATTCACCAAAGTCTG	CAATGTGGGGGCGTCTATG
PIGN12	CAGATCCAGCAGTCTTGAAG	CCCATCTAATGCGATAAATCC

Pig:

ISAG STR Core Panel - Pig

Locus	Forward	Reverse
S0005	TCCTTCCCTCCTGGTAACTA	GCACTTCCTGATTCTGGGTA
S0090	CCAAGACTGCCTTGTAGGTGAATA	GCTATCAAGTATTGTACCATTAGG
S0101	GAATGCAAAGAGTTCAGTGTAGG	GTCTCCCTCACACTTACCGCAG
S0155	TGTTCTCTGTTTCTCCTCTGTTTG	AAAGTGGAAAGAGTCAATGGCTAT
S0227	GATCCATTTATAATTTTAGCACAAAGT	GCATGGTGTGATGCTATGTCAAGC
S0228	GGCATAGGCTGGCAGCAACA	AGCCCACCTCATCTTATCTACACT
S0355	TCTGGCTCCTACACTCCTTCTTGATG	TTGGGTGGGTGCTGAAAAATAGGA
S0386*	GAACTCCTGGGTCTTATTTTCTA	GTCAAAAATCTTTTTATCTCCAACAGTAT
SW24	CTTTGGGTGGAGTGTGTGC	ATCCAAATGCTGCAAGCG
SW240	AGAAATTAGTGCCTCAAATTGG	AAACCATTAAGTCCCTAGCAAA
SW72	ATCAGAACAGTGCGCCGT	TTTGAAAATGGGGTGTTTCC
SW857	TGAGAGGTCAGTTACAGAAGACC	GATCCTCCTCCAAATCCCAT
SW911	CTCAGTTCTTTGGGACTGAACC	CATCTGTGGAAAAAAAAAGCC
SW936	TCTGGAGCTAGCATAAGTGCC	GTGCAAGTACACATGCAGGG

SW951	TTTCACAACTCTGGCACCAG	GATCGTGCCCAAATGGAC

* Recommended amplification temperature: 48 ºC

ISAG Additional Markers - Pig

Locus	Forward	Reverse
IGF1	GCTTGGATGGACCATGTTG	CATATTTTTCTGCATAACTTGAACCT
S0002	GAAGCCCAAAGAGACAACTGC	GTTCTTTACCCACTGAGCCA
S0026	AACCTTCCCTTCCCAATCAC	CACAGACTGCTTTTTACTCC
S0215	TAGGCTCAGACCCTGCTGCAT	TGGGAGGCTGAAGGATTGGGT
S0225	GCTAATGCCAGAGAAATGCAGA	CAGGTGGAAAGAATGGAATGAA
S0226	GCACTTTTAACTTTCATGATACTCC	GGTTAAACTTTTNCCCCAATACA
SW632	TGGGTTGAAAGATTTCCCAA	GGAGTCAGTACTTTGGCTTGA

Sheep:

ISAG STR Core Panel - Sheep

Locus	Forward	Reverse
AMEL	CAGCCAAACCTCCCTCTGC	CCCGCTTGGTCTTGTCTGTTGC
CSRD247	GGACTTGCCAGAACTCTGCAAT	CACTGTGGTTTGTATTAGTCAGG
ETH152	TACTCGTAGGGCAGGCTGCCTG	GAGACCTCAGGGTTGGTGATCAG
INRA005	TTCAGGCATACCCTACACCACATG	AAATATTAGCCAACTGAAAACTGGG
INRA006	AGGAATATCTGTATCAACCGCAGTC	CTGAGCTGGGGTGGGAGCTATAAATA
INRA023	GAGTAGAGCTACAAGATAAACTTC	TAACTACAGGGTGTTAGATGAACTC
INRA063	GACCACAAAGGGATTTGCACAAGC	AAACCACAGAAATGCTTGGAAG
INRA172	CCAGGGCAGTAAAATGCATAACTG	GGCCTTGCTAGCCTCTGCAAAC
MAF065	AAAGGCCAGAGTATGCAATTAGGAG	CCACTCCTCCTGAGAATATAACATG
MAF214	AATGCAGGAGATCTGAGGCAGGGACG	GGGTGATCTTAGGGAGGTTTTGGAGG
McM042	CATCTTTCAAAAGAACTCCGAAAGTG	CTTGGAATCCTTCCTAACTTTCGG
McM527	GTCCATTGCCTCAAATCAATTC	AAACCACTTGACTACTCCCCAA
OarFCB20	GGAAAACCCCCATATATACCTATAC	AAATGTGTTTAAGATTCCATACATGTG

Goat:

ISAG STR Core Panel - Goat

Locus	**Forward**	**Reverse**
CSRD247	GGACTTGCCAGAACTCTGCAAT	CACTGTGGTTTGTATTAGTCAGG
ILSTS008	GAATCATGGATTTTCTGGGG	TAGCAGTGAGTGAGGTTGGC
ILSTS19	AGGGACCTCATGTAGAAGC	ACTTTTGGACCCTGTAGTGC
ILSTS87	AGCAGACATGATGACTCAGC	CTGCCTCTTTTCTTGAGAGC
INRA005	TTCAGGCATACCCTACACCACATG	AAATATTAGCCAACTGAAAACTGGG
INRA006	AGGAATATCTGTATCAACCGCAGTC	CTGAGCTGGGGTGGGAGCTATAAATA
INRA023	GAGTAGAGCTACAAGATAAACTTC	TAACTACAGGGTGTTAGATGAACTC
INRA063	GACCACAAAGGGATTTGCACAAGC	AAACCACAGAAATGCTTGGAAG
MAF65	AAAGGCCAGAGTATGCAATTAGGAG	CCACTCCTCCTGAGAATATAACATG
McM527	GTCCATTGCCTCAAATCAATTC	AAACCACTTGACTACTCCCCAA
OarFCB20	GGAAAACCCCCATATATACCTATAC	AAATGTGTTTAAGATTCCATACATGTG
SRCRSP23	TGAACGGGTAAAGATGTG	TGTTTTTAATGGCTGAGTAG
SRCRSP5	GGACTCTACCAACTGAGCTACAAG	TGAAATGAAGCTAAAGCAATGC
SRCRSP8	TGCGGTCTGGTTCTGATTTCAC	CCTGCATGAGAAAGTCGATGCTTAG

SIGNATURE

Amparo Martínez Martínez

Chair

Emiliano Lasagna

Co-chair