

Yong Soo Kim
College of Tropical Agriculture and Human Resources
HNFAS

FTE Distribution: 30% I; 70% R

Education

<u>Degree</u>	<u>University</u>	<u>Major</u>
Bachelors	Seoul National University, Korea	Animal Science
Masters	University of California, Davis	Animal Science
PhD	University of California, Davis	Animal Physiology

Professional Appointments

<u>Title</u>	<u>Employer</u>	<u>Dates Employed</u>
Postdoc Research Fellow	University of Melbourne	1988 -1992
Assistant Animal Scientist	University of Hawaii	1992-1997
Associate Animal Scientist	University of Hawaii	1997-2013
Animal Scientist	University of Hawaii	2013 - present

Courses Taught

Course Number and Title (credits)

- ANSC387, Animal Science Techniques Laboratory, 2 credits (15%)
- ANSC454, Meat Science and Muscle Biology, 3 credit
- ANSC454L, Meat Science and Muscle Biology Laboratory, 1 credit
- ANSC644, Growth Biology of Meat Animals, 2 credit (graduate course)
- ANSC687, Advanced Laboratory Techniques, 3 credit (graduate course, 50%)

Publications (reverse chronological order)

Book Chapters

1. Y.S. Kim. 2001. Meat production. In: Meat Science and Applications. Marcel Dekker, Inc. New York, NY p563-579.
2. Yong Soo Kim, Goo Bu Park, Dong Wook Ahn and Sang Geun Jin. 1998. Product utilization. In: Pig Production. Seon Jin Publishing Co, Seoul Korea. P463-506. (written in Korean)

Conference Proceedings

1. Yong Soo Kim, Glen Fukumoto, Matthew Stevenson, Mark Thorne, and Rajesh Jha. 2016. Carcass traits and tenderness of grass-fed beef from subtropical pastures in Hawaii. The 16th AAAP Congress Proceedings 1525-1529.
2. Glen K. Fukumoto, Yong S Kim, and Perry Kealoha. 2016. Evaluation of incorporating an improved leucanea forage for grass-fed beef production in a tropical ecosystem. The 16th AAAP Congress Proceedings 1302-1305.
3. Yong Soo Kim. 2015. Improving meat quality characteristics of grass-fed beef in Hawaii. 1st International Symposium on Beef Sciences and Industry Technology Development. Volume 1, 1-8. Yanji, China (invited speaker)
4. N. Rodriguez, D. H. Choi, S.K. Park, Y.S. Kim. 2014. Comparison of myostatin-inhibitory capacity of various myostatin-binding proteins using a luciferase gene reporter assay system.

The 16th AAAP Congress Proceedings Vol. II 2398-2401.

5. Yong Soo Kim and Glen K. Fukumoto. 2013. The 5th Korea-US International Joint Symposium Interdisciplinary Research for High Quality Beef Production. "Grass-fed beef in Hawaii: a review on carcass and meat quality characteristics.
6. Yong Soo Kim and Halina Zaleski. 2005. Proceedings of International Joint Symposium, "Current Trends and Issues in Animal Production"
7. Y. Liu, H. Ali, L. Xu, Z-D. Shi, S.D. Liang, Y.S. Kim. 2003. Cloning of Shitou Goose myostatin cDNA and construction of its recombinant protein vaccine. *Advance on Animal Genetics and Breeding Researches in China*. 495-500.
8. G.F. Fukumoto, Y.S. Kim, K.H. Kim and H.Ako. 1999. Carcass and meat quality characteristics of forage-based beef. In: *Food for Health in the Pacific Rim*. 3rd International Conference of Food Science and Technology (J.R. Whitaker, N.M. Haard, C.F. Shoemaker and R.P. Singh (ed.)). pp 12-21. Food & Nutrition Press, Inc. Trumbull, CT.

Refereed Journal Publications

1. Jun Gyo Jung, Jae Hong Kim, Jeong Hwan Kim, Yong Soo Kim, Deuk-Hee Jin and Hyung Joo Jin, 2021. Effect of Scytosiphon lomentaria Ethanol Extracts on Myostatin Activity and Zebrafish Obesity Induced by High Feeding. *Journal of Life Science* 31. No. 8. 699~709. DOI : <https://doi.org/10.5352/JLS.2021.31.8.699>.
2. Jeong Han Kim, Jae Hong Kim, Jun-Pil Jang, Jae-Hyuk Jang, Deuk-Hee Jin, Yong Soo Kim, and Hyung-Joo Jin. 2021. Identification of Molecules from Coffee Silverskin That Suppresses Myostatin Activity and Improves Muscle Mass and Strength in Mice. *Molecules* 26, 2676. <https://doi.org/10.3390/molecules26092676>
3. S. Wasti, N, Sah, D. L. Kuehu, Y.S. Kim R. Jha and B. Mishra. 2020. Expression of follistatin is associated with egg formation in the oviduct of laying hens. *Animal Science Journal* e13396.
4. Jeong Hwan Kim, Jeong Han Kim, Lisa Andriani Sutikno, Sang Beum Lee, Deuk-Hee Jin, Yong-Ki Hong, Yong Soo Kim, Hyung-Joo Jin. 2019. Identification of the minimum region of flatfish myostatin propeptide (Pep45-65) for myostatin inhibition and its potential to enhance muscle growth and performance in animals. *PLoS ONE* 14(4): e0215298. <https://doi.org/10.1371/journal.pone.0215298>.
5. Dong hyuck Choi, Jinzeng Yang, Yong soo Kim. 2019. Rapamycin suppresses postnatal muscle hypertrophy induced by myostatin-inhibition accompanied by transcriptional suppression of the Akt.mTOR pathway. *BB Reports*. 17:182-290.
6. Yusuf Mohammed Maaeni, Sang Beum Lee, Dong Hyuck Choi, Yong Soo Kim and Paul Mozdziaik. 2018. Cloning of Japanese quail (*Coturnix Japonica*) follistatin and production of bioactive quail follistatin288 in *E. coli*. *International Journal of Poultry Science*. 17(1):8-21.
7. Jackie K. Paquette, Ying Ma, Colleen Fisher, Jinze Li, Sang Beum Lee, James F. Zachary, Yong Soo Kim, Cory Teuscher, and Janis J. Weis. 2017. Genetic control of Lyme arthritis by *Borrelia burgdorferi* arthritis-associated locus 1 (*Bbaa1*) is dependent on localized differential production of IFN- β and requires upregulation of myostatin. *The Journal of Immunology*. 199(10):3525-3534.
8. C.N. Lee, G.K. Fukumoto, M.S. Thorne, M.H. Stevenson, Y.S. Kim, M. Nakahata and R.M. Ogoshi. 2017. Nutrient compositions of sugarcane forages were influenced by season and the time of harvest. *Journal of Dairy and Veterinary Sciences* 2(1):555579.

9. Sang Beum Lee, Sung Kwon Park and Yong Soo Kim. 2017. Maltose binding protein-fusion enhances the bioactivity of truncated forms of pig myostatin propeptide produced in *E. coli*. *Plos One* 12(4): e0174956.
10. Jin-Dan Kang, Seokjoong Kim, Hai-Ying Zhu, LongJin, QingGuo, Xiao-Chen Li, Yu-ChenZhang, Xiao-XuXing, Mei-Fu Xuan, Guang-Lei Zhang, Qi-Rong Luo, Yong Soo Kim, Cheng-Du Cui¹, Wen-XueLi¹, Zheng-YunCui¹, Jin-Soo Kim, and Xi-Jun Yin. 2017. Generation of cloned adult muscular pigs with myostatin gene mutation by genetic engineering. *RSC Advances* 7:12541-12549.
11. J.D. Berrocoso, R. Kilda, A.K. Singh, Y.S. Kim and R. Jha. 2017. Effect of in ovo injection of raffinose on growth performance and gut health parameters of broiler chicken. *Poultry Science* 96:1573-1580.
12. R.K. Putluru, Y.S. Kim and C.N. Lee. 2016. Differential expression of superoxide mutases (SODs) in bovine corpus luteum during estrous cycle and pregnancy. *Pacific Agriculture and Natural Resources*. *Pacific Agriculture and Natural Resources*, Vol. 1:11-20.
13. S.B. Lee, J.H. Kim, D.H. Jin, H.J. Jin and Y.S. Kim. 2016. Myostatin inhibitory region of fish (*Paralichthys olivaceus*) myostatin-1 propeptide. *Comp. Biochem. Physiol. Part B*. 194-195:65-70.
14. S.B. Lee, S.K. Park, and Y.S. Kim. 2015. Production of bioactive chicken (*Gallus gallus*) follistatin-type proteins in *E. coli*. *AMB Express* 5:58 doi 10.1186/s13568-015-0142-3
15. S.B. Lee, R. Choi, S.K. Park, and Y.S. Kim. 2014. Production of bioactive chicken follistatin315 in *Escherichia coli*. *Applied Microbiology and Biotechnology* 98:10041-10051. doi: 10.1007/s00253-014-6139-z
16. W.Y. Haq, S.K. Kang, S.B. Lee, H.C. Kang, Y.J. Choi, C.N. Lee and Y.S. Kim. 2013. High-level soluble expression of porcine myostatin propeptide in *Escherichia coli*. *Applied Microbiology and Biotechnology* 97(19):8517-27. doi:10.1007/s00253-013-5134-0.
17. Sang Beum Lee, Jeong Hwan Kim, Hyung-Joo Jin, Il Shik Shin, and Yong Soo Kim, 2013. High-yield expression and purification of bioactive flatfish (*Paralichthys olivaceus*) myostatin-1 prodomain in *Escherichia coli*, *American Journal of Biochemistry and Biotechnology* 8 (3):195-201 DOI: [10.3844/ajbbsp.2012.195.201](https://doi.org/10.3844/ajbbsp.2012.195.201)
18. Y.S. Kim, B. Fox, K.H. Kim, S.B. Lee, H. J. Jin and C.S. Tamaru. 2013. Immersion bath treatment of tilapia fry with myostatin-1 prodomain does not affect tilapia growth at market size. *Aquaculture Research* 44:1643-1648. DOI:10.1111/j.1365-2109.2012.03168.x
19. B. Funkenstein, E. Krol, E. Esterin, and Y. S. Kim, 2012. Structural and functional characterizations of activin type 2B receptor (*acvr2b*) ortholog from the marine fish *Sparus aurata*: evidence for gene duplication of *acvr2b* in fish. *Journal of Molecular Endocrinology* 49(3):175-192.
20. M. Wang, H. Yu, Y.S. Kim, C. A. Bidwell and S. Kuang. 2012. Myostatin facilitates slow and inhibits fast myosin heavy chain expression during myogenic differentiation. *Biochemical and Biophysical Research Communications* 426(1):83-8.
21. Y.S. Kim, G. Fukumoto, and S. Kim. 2012. Carcass quality and meat tenderness of Hawaii pasture-finished cattle and Hawaii-originated, mainland feedlot-finished cattle. *Tropical Animal Health and Production* 44:1411-1415.
22. Y.S. Kim, K.H. Kim and C.J. Kim. 2012. Production of bioactive extracellular domain of pig and chicken activin type IIB receptors in *Pichia pastoris*. *Process Biochemistry* 47:139-146. doi:10.1016/j.procbio.2011.10.027

23. Z. Li, F. Zeng, A Mitchell, Y.S. Kim, Z. Wu and J. Yang. 2011. Transgenic overexpression of bone morphogenetic protein 11 propeptide in skeleton enhances bone formation. *Biochemical and Biophysical Research Communications* 416:289-292.
24. S.B. Lee, M.J. Cho, J.H. Kim, Y.S. Kim, H.J. Jin. 2011. Production of bioactive rockfish (*Sebastes schlegeli*) myostatin-1 prodomain in an *Escherichia coli* system. *Protein Journal* 30:52-58.
25. K.H. Kim, Y.S. Kim and J.Z. Yang. 2011. Skeletal muscle hypertrophic effect of clenbuterol is additive to the hypertrophic effect of myostatin suppression. *Muscle & Nerve* 43:700-707.
26. J. Wang, K.H. Kim, S.K. Kim, Y.S. Kim, Q.X. Li, and S. Jun. 2010. Development of a simple quantification method of *Escherichia coli* K-12 internalized in baby spinach using Fourier Transform Infrared spectroscopy. *International Journal of Food Microbiology* 144:147-151.
27. S.B. Lee, Y.S. Kim, M.Y. Oh, I.H. Jeong, K.B. Seong and H.J. Jin. 2010. Improving rainbow trout (*Oncorhynchus mykiss*) growth by treatment with a fish (*Paralichthys olivaceus*) myostatin prodomain expressed in soluble forms in *E.coli*. 2010. *Aquaculture* 302:270-278.
28. Z.C. Li, B. Zhao, Y.S. Kim and J. Yang. 2010. Administration of a mutated myostatin propeptide to neonatal mice significantly enhances skeletal muscle growth. *Molecular Reproduction and Development* 77:76-82.
29. N.K. Bobbili, Y.S. Kim, M.A. Dunn, J. Yang and A.Ong. 2008. Effects of maternal immunization against myostatin on postnatal growth and skeletal muscle mass of offspring in mice. *Food and Agricultural Immunology* 19:93-106.
30. Y.S. Kim, N.K. Bobbili, Y.K. Lee, H.J. Jin and M. Dunn. 2007. Production of a polyclonal antibody against unprocessed chicken myostatin and the effects of in-ovo administration of the antibody on post-hatch broiler growth and muscle mass. *Poultry Science* 86:1196-1205.
31. S.B. Lee, Y.S. Kim and H.J. Jin. 2007. Characterization and expression pattern of myostatin in the rockfish, *Sebastes schlegeli*. *Journal of Fisheries Science and Technology* 10:60-67.
32. S.B. Lee, Y.S. Kim, M. Yoon, S.K. Kim, I.W. Jang, H.J. Lim and H.J. Jin. 2007. Characterization and expression pattern of the partial myostatin cDNA in shrimp, *Fenneropenaeus Chinensis*. *Journal of Marine Bioscience and Biotechnology* 2:224-229.
33. Y.S. Kim, N.K. Bobilli, K.S. Paek and H.J. Jin. 2006. Production of a monoclonal anti-myostatin antibody and the effects of in ovo administration of the antibody on post-hatch broiler growth and muscle mass. *Poultry Science* 85:1062-1071.
34. Y.S. Kim, S.W. Kim, M.A. Weaver and C.Y. Lee. 2005. Increasing the pig market weight: world trend, expected consequences and practical considerations (invited review). *Asian Australian Journal of Animal Science* 18(4):590-600.
35. H.J. Jin, M.A. Dunn, D. Borthakur and Y.S. Kim. 2004. Refolding and purification of unprocessed porcine myostatin expressed in *Escherichia coli*. *Protein Expression and Purification* 35:1-10.
36. C.Y. Lee, K.H. Baik, J.H. Jeong, S.D. Lee, J.K. Park, Y.M. Song, Y.S. Kim, and S.H. Sohn. 2002. Active immunization against adrenocorticotrophic hormone in growing-finishing barrows: an initial trial and evaluation. *Asian Australian Journal of Animal Science* 15:410-415.
37. J.Y Kim, M.L. Chung, K.K. Cho, C.D. Kim, Y.S. Kim, J.H. Woo and Y.J. Choi. 2001. Effects of active immunization against somatostatin or somatostatin analogues on male rat growth. *Food and Agricultural Immunology*. 13:141-149.

38. K.H. Kim, Y.S. Kim, Y.K. Lee, and M.G. Baik. 2000. Postmortem muscle glycolysis and meat quality characteristics of intact male Korean native (Hanwoo) cattle. *Meat Science*. 55:47-52.
39. K.H. Kim, Y.S. Kim, and S.J. Moon. 1999. Distribution of type IId fiber in various pig skeletal muscles. *Korean J. Food Sci. Ani. Resour.* 19:314-323.
40. I.G. Yi, D.S. Lim, J.Y. Kim, M.G. Chung, Y.J. Choi, Y.S. Kim, and J.D. Kim. 1999. Effects of active immunization against somatostatin or somatostatin analogues on milk production in rats. *Nutritional Res.* 19:1061-1072.
41. Y.S. Kim, K.H. Kim and Y.J. Choi. 1999. A sensitive ELISA for the measurement of anti-somatostatin antibody titer. *Food and Agricultural Immunol.* 11:269-273.
42. K.H. Kim and Y.S. Kim. 1997. The effects of sample storage and handling condition on calpain I and II and calpastatin activities in skeletal muscles. *Korean J. Anim. Sci.* 39(5):617-624.
43. Y.S. Kim, M.V. Dugies, Y.H. Kim and D.L. Vincent. 1997. Temporal pattern of cAMP and α -actin mRNA expression in skeletal muscle of cimaterol-fed rats. *Asian Australian Journal of Animal Science* 10:528-533.
44. Y.H. Kim and Y.S. Kim. 1997. Effects of active immunization against clenbuterol on growth-promoting effect of clenbuterol in rats. *J. Anim. Sci.* 75:446-453.
45. M.V. Duguies, Y.S. Kim and D.L. Vincent. 1995. Temporal pattern of cAMP concentration in skeletal muscle and heart from cimaterol-fed rats. *HITAHR Research Series* 074.
46. Y.S. Kim. 1995. Carcass characteristics and meat quality in forage-finished and grain-finished beef. *RDA J. Agri. Sci.* 37:573-582.
47. G.K. Fukumoto, Y.S. Kim, D. Okuda, H. Ako. 1995. Comparison of chemical composition and shear force in longissimus muscles between Hawaiian young beef and supermarket choice beef. *HITAHR Research Extension Series* 161.
48. Y.S. Kim, T.H. Lee and Y.J. Choi. 1995. Effect of intermittent and stepwise administration of a beta-adrenergic agonist, L644,969, on rat growth performance and skeletal muscles. *Comp. Biochem. Physiol.* 110C:127-132.
49. Y.B. Lee and Y.S. Kim. 1994. Muscle characteristics and meat tenderness of cimaterol-fed lambs. *J. Food Sci.* 59:33-37.
50. Y.S. Kim, R.D. Sainz, J. Ferlazzo and N.M. Tulloh. 1994. Effect of maternal administration of salbutamol to sows on post-natal growth and carcass characteristics in the progeny. *Aust. J. Agricul. Res.* 45:271-278.
51. F.R. Dunshea, R.H. King, R.G. Campbell, R.D. Sainz, and Y.S. Kim. 1993. Interrelationship between sex and ractopamine on protein and lipid deposition in rapidly growing pigs. *J. Anim. Sci.* 71:2919-2930.
52. R.D. Sainz, Y.S. Kim, F.R. Dunshea and R.G. Campbell. 1993. Temporal changes in growth enhancement by ractopamine in pigs: performance aspects. *Aust. J. Agric. Res.* 44:1149-1155.
53. R.D. Sainz, Y.S. Kim, F.R. Dunshea and R.G. Campbell. 1993. Effects of ractopamine in pig muscles: histology, calpains and beta-adrenergic receptors. *Aust. J. Agric. Res.* 44:1141-1148.
54. Y.S. Kim, R.D. Sainz and Y.B. Lee. 1993. Note on the comparison of calpains I, II and calpastatin activity in two different types of porcine skeletal muscles. *Comp. Biochem. Physiol.* 105A:235-237.

55. Y.S. Kim, R.D. Sainz, R.D. Summers and P. Molenaar. 1992. Cimaterol reduces beta-adrenergic receptor density in rat skeletal muscles. *J. Anim. Sci.* 70:115-122.
56. Y.S. Kim and R.D. Sainz. 1992. Beta-adrenergic agonists and hypertrophy of skeletal muscles. *Life Sci.* 50:397-407.
57. P. Molenaar, S.J. Roberts, Y.S. Kim, H.S. Park, R.D. Sainz and R.J. Summers. 1991. Localization and characterization of two propranolol resistant (-)[¹²⁵I]cyanopindolol binding sites in rat skeletal muscle. *Eur. J. Pharmacol.* 209:257-262.
58. Y.S. Kim, R.D. Sainz, P. Molenaar and R.J. Summers. 1991. Characterization of β_1 - and β_2 -adrenoceptors in rat skeletal muscles. *Biochem. Pharmacol.* 42:1783-1789.
59. Y.S. Kim and Y.B. Lee. 1990. Effect of cimaterol on growth and 3-methylhistidine excretion in rats. *AJAS.* 3:313-318.
60. Y.S. Kim, Y.B. Lee, C.R. Ashmore and I.K. Han. 1989 Effects of cimaterol on carcass and skeletal muscle characteristics under ad libitum and restricted feeding conditions in lambs. *AJAS.* 1(4):223-232.
61. Y.S. Kim, Y.B. Lee and W.N. Garrett and R.H. Dalrymple. 1989. Effect of cimaterol on nitrogen retention and energy utilization in lambs. *J. Anim. Sci.* 67:674-681.
62. Y.S. Kim, Y.B. Lee and C.R. Ashmore. 1988. Cimaterol-induced growth in rats: growth pattern and biochemical characteristics. *Growth, Development & Aging* 5(1):41-46.
63. Y.S. Kim, Y.B. Lee and R.H. Dalrymple. 1987. Effect of the repartitioning agent, cimaterol, on growth, carcass and skeletal muscle characteristics in lambs. *J. Anim. Sci.* 65:1392-1399.
64. Y.B. Lee and Y.S. Kim and C.R. Ashmore. 1986. Antioxidant property in ginger rhizome and its application to meat products. *J. Food Sci.* 51:20-30.
65. Y.B. Lee and Y.S. Kim. 1985. Effects of delayed chilling on the tenderness of beef from different carcass weight and backfat thickness. *Proc. 3rd AAAP Anim. Sci. Congress* 2:1109-1111.

Extension Publications

1. Glen K. Fukumoto, Y.S. Kim, and Perry Kealoha. 2017. Improved Leucaena (var. 'Wondergraze') for Sustainable Beef Production in Hawai'i: Study 1, Evaluation of beef cattle performance and carcass characteristics. PRM-14
2. C.N. Lee, G.K. Fukumoto, M.S. Thorne, M.H. Stevenson, Y.S. Kim, M. Nakahata and R.M. Ogoshi. December 2015. Sugarcane Crosses as Potential Forages for Ruminants: Nutrient Compositions Were Influenced by Season and Time of Harvest. (PRM)-8
3. Yong Soo Kim, Glen Fukumoto, Matthew Stevenson, Mark Thorne, and Rajesh Jha. December 2015. Carcass Traits and Tenderness of Hawaii's Grass-fed Beef (LM)-29
4. Matthew Stevenson, Yong Soo Kim, Glen Fukumoto, November 2012. Effects of Wet Aging and Age at Slaughter on Kauai Grass-Finished Ribeye Steak Tenderness (FST)-53
5. Stevenson, M., Y.S. Kim and G. Fukumoto. November 2010. Evaluation of the tenderness, size, and marbling of Kaua'i ribeye steaks. *Food Safety and Technology (FST)*-40
6. Y.S. Kim, A. Ong, N. Bobbili, M. DuPonte and G. Fukumoto. June 2007. Evaluation of meat tenderness of forage-finished cattle produced in Hawaii and factors affecting the tenderness. *Food Safety and Technology (FST)*-27
7. G.K. Fukumoto and Y.S. Kim. March 2007. Carcass characteristics of forage-finished cattle produced in Hawaii. *Food Safety and Technology (FST)*-25
8. G.K. Fukumoto and Y.S. Kim. Jan 2007. Improving tenderness of forage-finished beef using a mechanical tenderizer. *Food Safety and Technology (FST)*-23

9. Y.S. Kim, C.N. Lee, M.W. DuPont and G. Fukumoto. Jan 2007. Improving tenderness of forage-finished beef using a low-voltage electrical stimulator. Food Safety and Technology (FST)-22

Leadership Roles (Committees, Boards, Advisory, etc.)

Member of University Research Council (2002- 2005)

CTAHR Educational Improvement Fund Screening Committee (2000)

UH Radiation Safety Committee (August, 1995 – 2001)

Graduate Students

<u>Category</u>	<u>Current Number of Students</u>	<u>Number Graduated (Career)</u>
<i>Chair of Master's</i> Committees	0	15
<i>Chair of PhD Committees</i>	1	2
Member of Master's Committees	1	34
Member of PhD Committees	0	12

Grant Support

As a PI

UH CTAHR Supplement Funding, FY2019 (2 year) “Maternal immunization against myostatin to enhance post-hatch broiler growth and muscle mass”, \$76,316

UH CTAHR Supplement Funding, FY2016 (2 year), “Potentials of anti-MSTN proteins to enhance skeletal muscle growth of animals”, \$58,938

UH CTAHR Supplement Funding, FY2014, “Molecular mechanisms regulating skeletal muscle growth and differentiation”, \$20,000

NIAS, RDA, Korea, (May, 2013 – December, 2015), “Improving the efficiency of pig production by enhancing muscle satellite cell proliferation using myostatin-based biotechnology”, \$150,000

USDA SARE grant, (August, 2013 – July, 2016), “Enhancing the sustainability of grass-fed beef production in Hawaii via carcass and meat quality improvement”, \$50,000

UH CTAHR Supplement Funding, FY2013-FY2014, “Molecular mechanisms regulating skeletal muscle growth and differentiation”, \$10,000

UH CTAHR Supplement Funding, FY2012, “Molecular mechanisms regulating skeletal muscle growth and differentiation”, \$14,000

UH CTAHR Capacity Improvement Funding, FY2012, “Repairing and upgrading teaching Lab for HNFAS/MBBE programs”, \$31,000

Hawaii Community Foundation, 2011, 1 years (May18, 2011-November 18, 2012) “A novel approach of using myostatin prodomain to treat age-associated sarcopenia”, \$47, 980

USDA NIFA (T-STAR), 2 Years (Sep 2010 – Aug, 2012), “Myostatin Inhibition and Improvement of Skeletal Muscle Growth of Broilers”, \$122, 351

USDA T-STAR, 2005 2 years (August 15, 2005 – August 14, 2007), “Investigation of Molecular Mechanisms regulating skeletal muscle growth using microarray analysis”, \$88,335

CTAHR Beef Initiative Program, 2 year (January 1, 2005 – December, 2006), “Meat quality of forage-finished beef”, \$55,000

USDA T-STAR, 2 years (October, 2003 – September, 2005), “Improving skeletal muscle growth by active immunization against myostatin”, \$109,020

University Research Council Seed Grant, 2001, “Expression of myostatin in muscle cell culture system”, \$4,500.

USDA NRICGP, 2000, 2 years (September, 2000 – August, 2002), “Production of monoclonal antibodies against porcine myostatin”, \$50,000.

USDA NRICGP, 2000, “Acquisition of FPLC (Fast Protein Liquid Chromatography) system”, \$23,700.

USDA T-STAR, 1999, 3 years (July, 1999 – June, 2003), “Improving skeletal muscle growth by immunomodulation of myostatin bioactivity”, \$110,869.

Faculty Opportunity Fund, 1999, “A preparative electrophoresis system for lab course (ANSC 687)”, \$4,800.

Hawaiian Electric Company Research Grant, 1998, 1 year, “Improving carcass and meat quality characteristics of forage-fed beef using electrical stimulation technology”, \$17,800.

HITAHR Mini Grant Program, 1995, 2 years, “Immunological approaches to improve animal production”, \$20,000.

Hatch Project, 1995, 3 year (1995 – 1998), “Immunological approaches to improve animal production: use of beta-agonist anti-idiotypic antibody”, \$12,000.

Seed Grant, Office of Research Administration, U.H., 1994, “Effects of beta-adrenergic agonists on the expression of muscle-specific mRNAs and second messenger molecules in the rat”, \$6,800.

Hatch Project, 1992, 4 years (1992-1996), “Regulation of skeletal muscle growth by beta-adrenoceptors”, \$16,000.

As a Co-PI

NIH RO1, 2020-2024, “Molecular Genetics of Lyme Arthritis”, total grant \$2,271, 260 (UH allocation, \$451,046). PI: Dr. Janis Weiss, School of Medicine, University of Utah

CATHR NIFA Animal Health Grant, 2015. “Potential Probiotic Bacteria for Poultry Production from Fermented Cooked Taro Peel” 10/01/2015-9/30/2017, \$12,000/year, *PI: C.N. Lee*

CTAHR Catalyst Funding, 2011, “Maximization of grass-finishing efficiency as determined by calf immune function, growth performance, and carcass quality determination”, April, 2011 – June 2012, \$103,668, *PI: Ashley Stokes*

Western SARE Grant, 2011, “Training livestock to eat weeds in the tropical Pacific and evaluation of the effects on meat quality” \$42,490, *PI: Stevenson MH*

Kauai beef quality assessment. County of Kauai Office of Economic Development (awarded to Kauai Cattlemen’s Association), *PI: Stevenson, M.H.*

Hawaii Community Foundation, 2009, “Recombinant oligomeric antimicrobial peptides with enhanced activities”, \$50,000 (1 year), *PI: Wei Wen Su*

USDA/HATCH “Improving health through the establishment of a relative iron-bioavailability database” Funded for 3 years for a total of \$60,000. Start/end dates: 10/01/2008 - 9/30/2011, *PI: Dr. Michael Dunn*

Allen Foundation, 2005, “Establishing an Iron-Bioavailability Database”, July 1, 2005 – June 30, 2006, \$79,718., *PI: Michael Dunn*

USDA T-STAR, 2003, “Role of myostatin (GDF-8) prodomain in promoting animal growth”,

3 years (October, 2003 – September, 2006), \$202,300. *Principal investigators, Jinzeng Yang, Yong Soo Kim and Michael Dunn (HNFAS, UH).*

Hawaii County, 2003, “Organoleptic evaluation of meat products”, 1 year (September 2003 – August, 2003), \$10,000, *Principal investigators, Michael DuPonte and Yong Soo Kim (HNFAS, UH).*

Faculty Opportunity Fund, 2001, “Instrument automation for MBBE/HNFAS687” 1 year (2001), \$5,000. *Principal investigators, Qing Li (MBBE, UH) and Yong Soo Kim.*

USDA Higher Education Challenge Grants Program, 1997, “An internet-based multimedia laboratory manual for biological engineering”, 3 years (September, 1997 – August, 2000), \$80,000. *Principal investigators, Winston Su (MBBE, UH) and Yong Soo Kim*

Korean Ministry of Agriculture Research Grant, 1996, “Investigation of genes related to lipid metabolism in order to improve genetic potentials of Korean native cattle in producing high quality meat”, 5 years (1996- 2001), \$312,500, *Principal Investigators, M.G. Baik and Y.S. Kim.*

National Livestock Research Institute, 1996, “The effects of somatostatin autoimmunization on the muscle growth in rat, Korea”, 2 years (1996- 1998), \$85,200, *Principal Investigators: Y.J. Choi, Y.S. Kim, and S.S. Sun.*

Private Company Fund, Pacmar Inc., 1995, “Mushy Tuna Project”, 1 year, \$ 25,000. *Principal Investigators, Drs. H. Ako and Y.S. Kim*

Department of Research and Development, County of Hawaii, 1994, “Compositional and shear force characteristics of Hawaii forage based beef”, 1 year (1994), \$ 5,500, *Principal Investigators: G.K. Fukumoto and Y.S. Kim.*

Abstracts, and Conference, and Invited Presentations

1. Yong Soo Kim, Sangbeum Lee, and Arthur Wong. 2021. Production of recombinant myostatin propeptide, an inhibitor of myostatin, in E. coli. ISIBio 2021 (Virtual meeting), November 15-17. Bogor Indonesia. (invited guest speaker)
2. Rajeev Kumar Mishra, Rajesh Jha, Birendra Mishra, Yong-Soo Kim. 2020. Effects of maternal immunization against myostatin on the post-hatch growth performance of their chicks. 2020 PSA Virtual Annual Meeting, July 20-22
3. S. Yadav, Y. Li, Y.S. Kim, C.N. Lee and R. Jha. 2018. Effect of feeding lactic acid bacteria isolated from taro (*Colocasia esculenta*) skins on growth performance, gut microbiota and muscle growth of broiler chickens. 2018 Annual Meeting for Poultry Science Association July 23-26, San Antoni, TX
4. M. Oshiro, M. S. Thorne, Ph.D., C. N. Lee, Ph.D., Dr. Y. S. Kim, Ph. D., G.K. Fukumoto. 2018. Effects of Animal Behavior and Core-Body Temperature on Production Efficiency of Grass-Finished Cattle. 2018 Conference for The Society for Range Management, Sparks, NV. Jan 28-Feb 2, 2018.
5. Yong Soo Kim, Glen Fukumoto, Matthew Stevenson, Mark Thorne, and Rajesh Jha. 2016. Carcass traits and tenderness of grass-fed beef from subtropical pastures in Hawaii. 17th Asian Australian Animal Production Animal Science Congress. August 22-25, 2016, Fukuoka, Japan.
6. Glen K. Fukumoto, Yong S Kim, and Perry Kealoha. 2016. Evaluation of incorporating an improved leucanea forage for grass-fed beef production in a tropical ecosystem. 17th Asian

- Australian Animal Production Animal Science Congress. August 22-25, 2016, Fukuoka, Japan.
7. Julio D. Berrococo, Ryosuke Kida, Amit K. Singh, Yong soo Kim, Rajesh Jha. 2016. In-ovo inoculation of raffinose (as a prebiotic) improves hatchability rate and gut health, but not growth performance of broiler chickens. The XXV World's Poultry Congress. September 5-9, 2016 Beijing, China. 2015,
 8. The 1st International Symposium on Beef Sciences and Industry Technology Development. October 10-11, 2015 Yanji, China. Invited speaker, *Title of presentation: Improving meat quality characteristics of grass-fed beef in Hawaii*
 9. The 16th Asian-Australian Association of Animal Production Societies Congress, 2014, November 10-14, *Title of presentation: "Comparison of myostatin-inhibitory capacity of various myostatin-binding proteins using a luciferase gene reporter assay system"*
 10. Sungkwon Park, Yongdae Jeong, Sangbeum Lee and Yongsoo Kim. 2015. Porcine myostatin propeptide promotes the proliferation of satellite cells isolated from porcine skeletal muscle. International Conference of the Korean Society for Molecular and Cellular Biology. Sep 21-23. Seoul, Korea.
 11. Yong Soo Kim, Sang Beum Lee, Sung Kwon Park, and Hyung-Joo Jin. 2015. Production of bioactive myostatin propeptide of various animal species in E. coli. 7th Asia-Pacific Biotech Congress. J. Biotechnol. Biomater Vol 5, Issue 2:29.
 12. Awat N Yousif, Yong S. Kim, Douglas L Vincent, and Jinzeng Yang. 2015. Transgenic expression of myostatin propeptide prevents muscle loss and fat accumulation in old ages. The Endocrine Society's 97 Annual Meeting & Expo. March 5-8, San Diego.
 13. Mark Thorne, Glen Fukumoto, Yong Soo Kim, Chin N. Lee, Matthew Stevenson, and Melelani Abran. Forage quality and weaning weight influences grass-finished cattle performance and meat quality. 2015. Society for Range Management 68th Annual Meeting, Jan 31- Feb 6, Sacramento.
 14. Glen Fukumoto, Yong soo Kim, and Perry Kealoha. 2015. Evaluation of incorporating an improved leucaena forage for grass-fed beef production in Hawaii. Society for Range Management 68th Annual Meeting, Jan 31- Feb 6, Sacramento.
 15. Mark Thorne, Glen Fukumoto, Yong Soo Kim, Chin N. Lee, Matthew Stevenson, and Melelani Abran. 2015. Grazing management for tropical grass-finished beef production. Society for Range Management 68th Annual Meeting, Jan 31- Feb 6, Sacramento.
 16. N. Rodriguez, D. H. Choi, S.K. Park, Y.S. Kim. 2014. Comparison of myostatin-inhibitory capacity of various myostatin-binding proteins using a luciferase gene reporter assay system. The 16th AAAP Congress Proceedings Vol. II Abstract:662. (2014 AAAP meeting, November 10-14, 2014, Indonesia)
 17. Rocky Choi, Sang Beum Lee, Sung Kwon Park and Yong Soo Kim. 2014. Production of bioactive chicken follistatin315 in Escherichia coli. 4th Asia Pacific-Korea Conference on Science and Technology (12/20-12/22. Sydney, Australia) (Abstract).
 18. S.B. Lee, S.K. Park, and Y.S. Kim. 2014. Production of bioactive porcine mutant myostatin propeptide/Fc fusion protein in Escherichia coli. J. Anim. Sci. 92 (suppl. 2): 581.
 19. D. Choi, J. Yang, S.K. Park, and Y.S. Kim. 2014. Muscle hypertrophy induced by myostatin inhibition is suppressed by rapamycin administration. J. Anim. Sci. 92 (suppl. 2): 588.
 20. The 5th Korea-US International Joint Symposium Interdisciplinary Research for High Quality Beef Production. October 28, 2013, *Title of presentation: "Grass-fed beef in Hawaii: a review on carcass and meat quality characteristics. Honolulu, Hawaii*

21. R. Choi and Y.S. Kim. 2012. Soluble expression of chicken follistatin proteins in *Escherichia coli*. FASEB J 26:545.1 (Abstract)
22. W.Y. Haq, H.C. Kang, S.K. Kang, J.A. Park, Y.J. Choi, C.N. Lee and Y.S. Kim. 2011. Soluble expression of porcine myostatin propeptide in an *Escherichia coli* expression system. Asian Congress on Biotechnology 2011, May 11-15, Shanghai, China.
23. S. Yarlagadda, C.N. Lee, Y.S. Kim, J.Y. Yang and W.Y. Ho. 2011. Effect of transgenic myostatin depression on reproductive parameters and placental superoxide dismutases in mice. 2011 Joint ADSA and ASAS Annual Meeting.
24. Stevenson, M.H., Y. Kim, and G. Fukumoto. 2011. Evaluation of the tenderness, size and marbling of forage-finished ribeye steaks produced in Kauai County, Hawaii. Society for Range Management (SRM) 64th Annual Meeting, February 6-1-. Billings, Montana.
25. Tamaru, C.S., B. Fox, T. Radovich, Y. S. Kim, S. Khanal, H. Ako, J. Sugano, K. McGovern-Hopkins and R. Klinger-Bowen. 2010. Aquaponics at the College of Tropical Agriculture and Human Resources (CTAHR). Zero Emissions Conference. The World Congress on Zero Emissions Initiatives. September 13-17, 2010. Honolulu, Hawaii.
26. K.H. Kim and Y.S. Kim. 2009. Skeletal muscle hypertrophic effect of clenbuterol is additive to the hypertrophic effect of myostatin suppression. FASEB J 23:600.26 (Abstract)
27. Y.S. Kim, K.H. Kim and J.Z. Yang. Experimental Biology Annual Meeting, San Diego, California, April 5-10 2008. Overexpression of myofibrillar protein and metallothionein 3 genes in transgenic mice overexpressing myostatin prodomain. FASEB J 22:1b143 (Abstract)
28. S.B. Lee, O M. Young, K.J. Hwan, H.Y. Dong, K.H. Woong, K.J. Ho, C.P. Lee, Y.S. Kim, and H.Y. Jin. 2008. The 3rd International Symposium on the Marine Biotechnology and Advanced Materials p215.
29. S.B. Lee, Y.J. Park, K.S. Lee, Y.S. Kim, M Yoon, and H.Y. Jin. 2008. Characterization of a partial myostatin gene from *Stichopus japonicus*. Annual meeting of the Japanese Society of Fisheries Science. Abstract #1429
30. S.J. Jun, Y.S. Kim, L Cox and A. Huang. 2007. Potentials of retort pouches for adding value to less desirable cuts of beef. FoodSmart: Institute of Food Technologists annual meeting and Food Expo, Chicago IL 096-42.
31. Y.S. Kim, A. Ong, N. Bobbili, M. DuPont, G.K. Fukumoto and C.N. Lee. 2007. Evaluation of meat tenderness of forage-finished cattle produced in Hawaii and factors affecting the tenderness. J. Anim. Sci. 85 (suppl. 1):492.
32. S.B. Lee, Y.S. Kim and H.Y. Jin. 2007. Characterization and protein expression of myostatin in *Paralichthys olivaceus*. The 3rd International Symposium on Advanced Materials, Natural Products and Marine Biotechnology: p38.
33. S.B. Lee, Y.S. Kim and H.Y. Jin. 2007. Comparison and analysis of the myostatin in *Paralichthys olivaceus*, *Sebastes schegeli* and *Fenneropenaeus chinensis*. The 3rd International Symposium on Advanced Materials, Natural Products and Marine Biotechnology: p28
34. 2007, September 18, Kalamazoo MI, Invited speaker for the “Poultry Performance Workshop” hosted by Pfizer Animal Health and Embrex. Title of presentation: “Immunoneutralization of myostatin to improve poultry meat production” Contact: Dr. Richard Wardley (richard.c.wardley@pfizer.com, 269-760-1567).
35. 2006, June 9, Jinju, Korea, invited speaker for a joint symposium between the Regional animal Industry Research Center, Jinju National University and University of Hawaii and

- Texas Tech University, Invited speaker Title of presentation: “Meat quality characteristics of grain- forage-finished beef” Contact: Dr. Dr. Chul Young Lee (cylee@jinju.ac.kr, 82-55-751-3285)
36. S.B. Lee, Y.S. Kim and H.J. Jin. 2006. Characterization and expression pattern of myostatin in *Sebastes schlegeli*. 2nd International Conference on Marine Biotechnology: p79.
 37. N.K. Bobbili, Y.K. Lee and Y.S. Kim. 2006. Production of a polyclonal antibody against unprocessed chicken myostatin and the effects of in-ovo administration of the antibody on post-hatch broiler growth and muscle mass. J. Anim. Sci. 84(suppl. 1):30
 38. Y.S. Kim, Y.C. Huh and C.J. Kim. 2006. Maternal immunization against myostatin enhances post-hatch broiler growth and muscle mass. J. Anim. Sci. 84(suppl. 1):30
 39. Y.S. Kim and H.J. Jin. 2005. Effects of in-ovo administration of monoclonal anti-myostatin antibody on post-hatch chicken growth and muscle mass. J. Anim. Sci. 83(suppl. 1):26.
 40. R.K. Putlulu, C.N. Lee and Y.S. Kim. 2005. Differential expression of superoxide dismutase (SODs) in bovine corpus luteum during estrous cycle and pregnancy. J. Anim. Sci. 83(suppl. 1):119.
 41. M. DuPonte, J. Dobbs, H.M. Zaleski and Y.S. Kim. 2005. Eating quality of forage-finished beef produced in Hawaii as compared to the imported mainland beef. J. Anim. Sci. 83(suppl. 1):159.
 42. J. Yang, Y.S. Kim, R.J. Wall. 2004. Myostatin and its prodomain transgene expression. Plant and Animal Genome XII Conference, p293.
 43. H.J. Jin, Y.S. Kim and M.A. Dunn. 2003. Refolding and purification of unprocessed porcine myostatin expressed in *E. coli*. J. Anim. Sci. 81 (suppl. 1):305.
 44. Y.S. Kim, Y.K. Lee, and M.A. Dunn. 2002. Polyclonal antibodies recognize only the latent peptide of myostatin but not the active form of myostatin. J. Anim. Sci. 80 (suppl. 1):211.
 45. Y.S. Kim, K.S. Baek, and M.A. Dunn. 2001. Solubilization and purification of a recombinant chicken myostatin expressed as inclusion bodies in *E. coli*. J. Anim. Sci. 79 (suppl. 1):431.
 46. K.S. Baek, Y.S. Kim and C.N. Lee. 2001. *Comparison of total protein, DNA and RNA contents in corpus luteum of various stages of the estrous cycle and pregnancy*. Korean Soc. of Animal Production Proceedings, Seoul, Korea.
 47. K.S. Baek, C.N. Lee and Y.S. Kim. 2001. *The site of administration of PGF2a and the subsequent pregnancy rates*. Korean Soc. of Animal Production Proceedings, Seoul, Korea
 48. Y.K. Lee, K.H. Kim, Y.S. Kim, S.S. Kim, and M.G. Kim. 2001. Meat quality characteristics of loin eye and tenderloin muscles of native Korean (Hanwoo) steers. Anim. Sci. 78 (suppl. 1):318
 49. Y.S. Kim, K.S. Baek, M.A. Dunn, and D. Borthakur. 2000. PCR cloning and expression of chicken myostatin cDNA in *E. coli*. J. Anim. Sci. 78 (suppl. 2):104
 50. K.H. Kim, Y.S. Kim, Y.K. Lee and M.G. Baik. Meat quality characteristics of loin eye and tenderloin muscle of male Korean native cattle. 1998. J. Anim. Sci. 76 (suppl. 1):141
 51. 1999, March 21-26, Invited workshop at the University of Guam on “Pig Carcass Evaluation” Contact: Dr. Manuel Dugies
 52. Y.S. Kim, K.H. Kim and Y.J. Choi. 1998. Conjugation methods affect anti-somatostatin antibody production, but do not affect growth response during active immunization against somatostatin in rats. J. Anim. Sci. 76 (suppl. 1):126.
 53. 1996, Invited speaker as an honorary scientist in the Rural Development Administration of the Republic of Korea, June 23 - 29. Presented series of lectures about ‘pig meat quality’

54. Y.S. Kim, K.H. Kim, Y.H. Kim and Y.J. Choi. 1996. Effects of active immunization against various forms of somatostatin on growth rate in rats. *J. Anim. Sci.* 74 (suppl.1): 156.
55. K.H. Kim, Y.S. Kim, and H. Zaleski. 1996. Effects of age and muscle type on calpainI, calpain II, and calpastatin in pig skeletal muscles. *J. Anim. Sci.* 74 (suppl. 1):165.
56. M.V. Duguies and Y.S. Kim. 1995. Temporal pattern of muscle cAMP concentration in cimaterol-fed rats. *J. Anim. Sci.* 73 (suppl. 1):149.
57. Y.H. Kim and Y.S. Kim. 1995. Active-immunization against clenbuterol does not inhibit the growth-promoting effect of clenbuterol in rats. *J. Anim. Sci.* 73 (suppl. 1):149. 1994, Korean Cooperative Research Proceedings, Suwon, Korea, September 9-19. Invited speaker as an honorary scientist in the Rural Development Administration of the Republic of Korea, Title of presentation: Beta-adrenergic agonists and hypertrophy of skeletal muscles
58. Y.S. Kim, Y.J. Choi and T.H. Lee. 1994. Effect of intermittent and stepwise administration of beta-adrenergic agonist, L644,969, on rat growth performance and skeletal muscle growth. *J. Anim. Sci.* 72 (suppl. 1):261
59. Y.S. Kim. 1994. Carcass characteristics and meat quality in forage finished and grain finished beef. Proceedings of the Hawaiian Home Lands Livestock Education and Assistance Symposium and Field Day: 52-56.
60. Y.S. Kim and Y.H. Kim. 1995. Immunological approaches to improve animal growth efficiency. Proceedings of Hawaii Agriculture: Positioning for Growth: 146.
61. Y.S. Kim, R.D. Sainz and Y.B. Lee. 1992. Comparison of calpains I and II and calpastatin activity in two different types of porcine skeletal muscles. *J. Anim. Sci.* 70 (suppl. 1):219.
62. Y.S. Kim, R.D. Sainz, F. Dunshea and R.G. Campbell. 1991. Skeletal muscle fiber type characteristics in ractopamine-fed pigs. *Proc. Nutr. Soc. Australia.* 16.
63. Y.S. Kim, R.D. Sainz, R.D. Warner, R.H. King and R.G. Campbell. 1991. Effect of porcine growth hormone administration on muscle fiber characteristics. *Proc. Nutr. Soc. Australia.* 16.
64. Y.S. Kim and R.D. Sainz. 1990. Skeletal muscle beta-adrenoceptors are reduced by chronic administration of the beta-agonist, cimaterol. *J. Anim. Sci.* 68 (suppl.1):317.
65. Y.S. Kim and R.D. Sainz. 1990. Characterization of beta-adrenoceptors in rat skeletal muscles. *J. Anim. Sci.* 68 (suppl. 1):285.
66. Y.S. Kim and Y.B. Lee. 1990. Effect of cimaterol on growth and 3-methylhistidine excretion in rats. *J. Anim. Sci.* 68 (suppl. 1):317.
67. Y.B. Lee, H. Jung, Y.S. Kim and R.H. Dalrymple. 1988. Effects of cimaterol (CL 263,780) on meat quality in lambs. *J. Anim. Sci.* 66 (suppl. 1):279.
68. Y.S. Kim, Y.B. Lee, C.R. Ashmore and R.H. Dalrymple. 1987. Effect of cimaterol on skeletal muscle characteristics of lambs. *J. Anim. Sci.* 65 (suppl.1):278.
69. Y.S. Kim, Y.B. Lee and C.R. Ashmore. 1987. Cimaterol-induced growth in rats: growth pattern and biochemical characteristics. *J. Anim. Sci.* 65 (suppl.1):251.
70. Y.S. Kim, Y.B. Lee, W.N. Garrett and R.H. Dalrymple. 1987. Effect of cimaterol on nitrogen retention and energy utilization in lambs. *J. Anim. Sci.* 65 (suppl.1):277.
71. Y.S. Kim, Y.B. Lee, C.R. Ashmore and R.H. Dalrymple. 1986. Effect of repartitioning agent, cimaterol (CL 263,780), on growth, carcass characteristics and skeletal muscle cellularity of lambs. *J. Anim. Sci.* 63 (suppl.1):221.
72. Y.B. Lee, M. Shafer, Y.S. Kim and C.R. Ashmore. 1984. Antioxidant property of ginger rhizome and its application to meat products. *J. Anim. Sci.* 59 (suppl.1): 233.