Effect of milk supplementation on in-vivo bone growth and bone mineral density in pre-pubertal pigs

Brandon Batty, Angel Torres, Nina Enos, Sebastiano Busato, Katherine Swanson, Efren Plancarte, Nicolas Aguilera, Michelle Kutzler, and Massimo Bionaz
Department of Animal and Rangeland Sciences, Oregon State University, Corvallis, OR, USA

INTRODUCTION
- Osteoporosis, a degenerative bone disease, is responsible for millions of fractures and billions of dollars in healthcare costs each year (Hoss et al., 2016).
- Increased calcium, phosphorus, and vitamin D consumptions has been shown to increase total bone mass and help protect against osteoporosis (Hoss et al., 2016).
- Dairy products, especially milk, is high in these compounds and may contribute to increased peak bone mass and lower risk for osteoporosis (Pereira, 2014).
- Cows’ milk contains micro-vesicles carrying RNA which may exert an effect on bone marrow mesenchymal stem cells (BMSC) (Isommi et al., 2015).
- Understanding the effects of milk on BMSC can be critical information for osteoporosis research.

HYPOTHESIS
Milk supplementation increases bone density by affecting bone marrow stem cells.

OBJECTIVES
To determine the effect of milk supplementation on:
- Bone density during time of peak bone accrual
- Bone marrow mesenchymal stem cells osteogenesis capacity

FURTHER ANALYSES
- Biomechanical testing - bone strength
- BMSC - colony forming unit, proliferation assay, gene expression,
  and transcriptomic effects of exosome isolated from milk

LITERATURE CITED

RESULTS and DISCUSSION

Year 1
Femur had a larger (* = P<0.05) bone density in males compared to females.
Females tended (# = P=0.11) to have smaller femurs compared to males, as expected.

These data indicated that the difference between males and females is already evident prior to puberty.

Year 1 & 2
The only difference observed was a lower bone density in the mandible of pigs receiving milk compared to control pigs.

All other analyses for BMD, BMC, and bone area for the humerus, radius, 10th rib, and tibia and fibula were not affected by feeding milk.

CONCLUSIONS
Of all the measurements taken, only the bone density of the mandible was significantly lower in piglets receiving milk. This was surprising and the reason for the observed difference is still unknown.

It was expected that bones between males and female were different, but the observation that only the femur was different awaits an explanation. The lack of increase in bone density by feeding the USDA recommended 3 cups of milk/day was somewhat unexpected; however, this is a short term experiment that prevents making conclusions about long-term effects. More analyses are underway (see left).

ACKNOWLEDGMENTS
The care of the animals was provided by the Swine crew lead by Matthew Kennedy. The work was supported by the USDA AFRI, NIFA Foundational Program: Exploratory Grant to M. Bionaz and M. Kutzler.