

Genes for Skeletal Strength in Poultry

A. S. Leaflet R1935

Susan J. Lamont, Professor of Animal Science,
Nader Deeb, Postdoctoral Research Associate,
Huaijun Zhou, Postdoctoral Research Associate

Summary and Implications

A unique resource population was used to determine that variation in a gene of the bone morphogenetic protein (BMP) family is associated with shank measurements in poultry. Knowledge of genetic variation and associations with traits related to skeletal integrity will enable genetic selection of poultry populations for stronger bones, thus reducing bone breakage in the live animal and on the processing line.

Introduction

Improvements in egg production or growth rate in poultry have created a situation wherein the early development and long-term integrity of the skeleton are sometimes not sufficient to support the weight and long-term metabolic demands of the birds or the typical processing procedures. Discovering genetic associations between genes and bone-related traits will lead to development of molecular markers that can be used to improve skeletal integrity, thus reducing leg problems and bone breakage in poultry production and processing.

Materials and Methods

A unique resource population, the Iowa Growth and Composition Resource Population (IGCRP), was established by crossing broiler sires with dams from two unrelated highly inbred lines (Leghorn and Fayoumi). At 8

weeks of age, 720 F₂ birds were euthanized and the shank length, shank weight, tibia length (TBL), tibia weight, bone mineral content (BMC) were measured. Shank weight to length ratio, tibia weight to length ratio, and bone mineral density (BMD) were also calculated. Candidate genes, with variation originating from the broiler, Leghorn and Fayoumi lines, were investigated to uncover the genetic control of skeletal integrity traits.

Primers were designed from database sequences for genes in the bone morphogenetic protein (BMP) family: BMP2, 4, 5 and 7. In other species, these genes are reported to influence development of the skeletal structure. Gene fragments were amplified and sequenced. Then molecular diagnostics were developed to screen the population.

Results and Discussion

No genetic variation was detected for BMP2 and BMP4 genes in the parental lines of the resource population. Variations between broiler and Fayoumi lines were detected by DNA sequencing in BMP5 and BMP7. There were associations of the BMP7 gene with % shank weight to length ratio ($p = 0.07$) and with % shank weight ($P = 0.03$, Table 1).

Acknowledgements

This study is a collaboration with Dr. Christopher Ashwell, formerly at the USDA-ARS in Beltsville and now at North Carolina State University. Bone mineral traits were measured by Dr. A. Mitchell, USDA-ARS. The research is partly supported by a grant from the Midwest Poultry Research Program. Live animal and carcass measurements were done at the Iowa State University Poultry Research Center.

Table 1. Effects (*P* values) of BMP5 and 7 gene variation on chicken skeletal traits.

Gene	Shank length	Shank weight	% Shank weight to length ratio	% Shank weight
BMP 5	0.15	NS	NS	NS
BMP 7	NS	NS	0.07	0.03