INHERITANCE OF THE "RAT-TAIL" SYNDROME [1]

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Summary

A form of congenital hypotrichosis, commonly known as rat-tail, is characterized by the colored hair anywhere on the body being short, curly, malformed, and sometimes sparse and an abnormal tail switch.

The "rat-tail" syndrome is controlled by interaction between two loci. Cattle that express this syndrome must have at least one gene for black color and be heterozygous at the other locus involved.

(Key Words: Rat-Tail Syndrome, Genetics, Breeds.)

Introduction

When black breeds of cattle (such as Angus and Holstein) are crossed with Continental European breeds, a small percentage of the calves will have a form of congenital hypotrichosis, which is commonly known as "rat-tail" syndrome. The condition is characterized by the colored hair anywhere on the body being short, curly, malformed, and sometimes sparse and an abnormal tail switch. The condition does not exist in red or white cattle. In an earlier study (1992 Cattlemen's Day Report), we reported that "rat-tail" calves had a lower rate of gain during the winter months, probably because of the poor insulation value of the hair. The objective of the current study was to determine the mode of inheritance of the "rat-tail" syndrome.

Experimental Procedures

Because purebred black Angus and red Simmental do not show the "rat-tail" condition, but approximately 13% of the offspring from crossing these two breeds do, we assumed that at least two loci were involved in the inheritance of this trait. The F_1 "rat-tail" cattle would be expected to be heterozygous at these loci, and segregation should be observed in the F_2 generation.

Six females and four males that were "rat-tails" produced from mating purebred black Angus cows to purebred dark red Simmental bulls were produced in 1991. In addition, two mature "rat-tail" cows from similar matings were transferred from a project at the Southeast Agricultural Research Center to be used in this study. Semen was collected from two of the bulls by KABSU[1] and used to breed the six females. Cross Country Genetics[2] superovulated, flushed, and froze embryos produced by the mating of F_1 bulls to F_1 females. The embryos were transferred by Cross Country Genetics into cows owned and cared for by ECCO Ranch at Buffalo, KS. A total of 64 F_2 calves was produced during 1993-94.

All calves were evaluated visually and designated as being a "rat-tail" or not. In addition, all calves were photographed by 2 months of age and reevaluated at weaning

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[2]7101 Anderson Avenue, Manhattan, Kansas 66502.

(approximately 7 months). Minerals, especially copper, are involved in pigment formation, and some evidence indicates that Continental breeds are less efficient in either copper absorption or transport. Therefore, blood samples were obtained from all calves at weaning, and liver biopsies and hair samples were taken from 30 calves born in the fall of 1994. Liver and plasma levels of copper, iron, zinc, manganese, molybdenum, and cobalt as well as ceruloplasmin were determined for the 30 calves.

Results and Discussion

Results of the "rat-tail" classification and the expected number of individuals are given in Table 1. Two loci are involved in the inheritance of this syndrome. The alleles at one locus are the dominant gene for black (R^b) and the recessive allele for red (R) color. (Note: The allele for white, present in some Shorthorn cattle also can occupy this locus; however, we have no indications that it is involved in the "rat-tail" syndrome.) The other locus has incomplete dominance between the two alleles "C" and "c". An interaction occurs between the genes at the "R" locus and the genes at the "C" locus to produce the colors shown in Table 1.

The dominant dilution gene that can occupy another locus is not involved in the production of the "rat-tail" syndrome. The cattle used in this study were homozygous for the nondilution gene. We assumed that "rat-tail" cattle that have the dominant dilution gene would be lighter in color than the ones in this study.

No significant relationship was found between "rat-tail" syndrome and mineral contents of either serum or liver.

Table 1. Genotypes and Number of Calves Observed and Expected in Each Phenotype

		Number of Calves	
Genotypes	Phenotypes	Observed	Expected
R^bR^bCC R^bR CC	Light to medium gray with fine hair	15	12
R^bR^bCc R^bR Cc	Charcoal colored with rat-tail syndrome	21	24
R^bR^bcc R^bR cc	Normal black hair	12	12
R R CC R R Cc R R cc	Normal red color	16	16