NSA
Obesity: Does it Matter?

Fatness in production animals: using genetic and environmental levers to meet consumer demand

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Background - Humans have consumed animal protein and fat for at least 10 millennia and evidence suggests that animal foods, and perhaps the process of hunting food animals, have contributed to our success as a species. Animal protein continues to be an important component of western-style diets, and recommendations against over-consumption of animal fats are well supported. Animal fats have been an important source of dietary energy for human populations, particularly when higher quality nutrients were unavailable. In the modern developed world, people are confronted with a myriad of options and opportunities to consume energy, so much so that the environment has been termed "obesogenic", reflecting the implications of over-consumption.[1] Booth and others[2] have suggested that it is the lack of physical activity, as much as the excessive energy intake that has contributed to increased prevalence of Syndrome X in our communities.

Animal productionists have worked over hundreds of years to increase growth of muscle relative to fat. Genetic, nutritional and environmental factors have been quantified in terms of their impact on carcass fatness. Several major genes have been defined that significantly contribute to carcass fatness, with or without effects on musculoskeletal growth (myostatin; somatotrophin; leptin and leptin receptor). Physical activity is likely to have the largest environmental effect, accounting to some extent for lotfed cattle being fatter than pasture fed cattle.[2] Recently, epigenetic effects on muscle growth and development have been exemplified in *Callipyge* sheep.[3] Consumerism has played a significant role in determination of the research priorities for animal productionists in the last four decades. Meat has been transformed from a staple product with occasional excellence, to a defined gourmet food ingredient with specified and reproducible attributes. The science underlying this transformation has opened a range of new opportunities to tailor the products of animal development to human taste and preference, though many in the community cannot support unfettered application of genetic modification to food animals. Consumer sentiment is not always logically consistent, and consumer demands for flavour in meat, tend to conflict with demands for whole-someness and low fat. Marbling is the appearance of flecks and streaks of adipose tissue within the connective tissue seams of ruminant skeletal muscle. It is a particularly important trait in beef cattle, because it is linked in some consumers' minds, with more intense flavour and tenderness. Marbling is linked to value in the Japanese beef market, and hence it is high on the research agenda for an export-oriented cattle-producing nation like Australia.

Review - This paper will review studies of the genetic, nutritional, environmental and epigenetic determinants of fatness and fat distribution in production animals. It will draw particularly on recently published, cross- and straight-breeding programs aimed at identifying genes contributing to population variation in the expression of fatness traits like marbling. Drawing on studies in other species, the paper will identify genes and genome regions that are likely to influence development of fat in the major meat production species: cow, sheep, pig, and goat. Interesting examples are the 'TG5' thyroglobulin gene polymorphism, an IGF2 polymorphism, and unexpectedly MMP12. The paper will discuss several nutritional factors that influence the extent and distribution of fat deposition, independently of total energy. Examples include vitamin A.[4] Fat develops in concert with muscle and bone, and it is artificial to separate development into individual cell and tissue types when seeking to understand the whole animal. The paper will also discuss the interactions between muscle and fat development at the physiological level, by highlighting developmental differences between breeds of cattle that are extreme in terms of fatness, muscularity or energetic efficiency. Good examples include the Tajima strain of Wagyu cattle, and Limousin cattle.[5]

References

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