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Pre- and postnatal development of adipose depots in meat animals with a specific focus on the pig (#36)

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Short Abstract

Introduction

The control of body fat content and distribution is a topic of great interest in meat producing animals. The lean to fat ratio determines commercial grading scales for carcasses in different species with greater body fatness decreasing the payments granted to producers and increasing the costs of carcass trimming in slaughtering and packing plants. On the other hand, the lipid content and the fatty acid composition of adipose depots influence the technological, nutritional and sensory properties of meat and processed products [1]. In pigs, the adiposity of carcasses has decreased significantly over the past decades, due to substantial progress in the fields of genetics, animal nutrition and husbandry. Pig production has thus succeeded in satisfying the increasing market demand for inexpensive, lean pork. However, this has led to a standardization of pig production and to difficulties in satisfying certain market segments for high quality meat. These recent changes in consumer expectations have resulted in a renewed interest in fat and the desire to move towards greater diversification of carcasses and meat products. Altogether, there is a need to better control adipose tissue deposition in the different anatomical locations to optimize the volume of meat produced while maintaining high quality and diversity of meat products. The purpose of this review is to provide an update on pre- and postnatal development of adipose depots in meat animals with a specific focus on the pig. The factors influencing animal adiposity, in terms of quantity, distribution and composition, are also drawn up.

There are two main types of adipose tissue with differences in morphology and functions in mammals: brown (BAT) and white (WAT) adipose tissues [2]. Both tissues are recognized to be differently involved in energy metabolism. Brown adipose tissue is a specialized site for energy dissipation and thermoregulation. It has been originally described in hibernating animals, and has been found in neonates of large mammalian species and more recently in adults including cow and sheep. The pig with its lack of BAT represents an exception among mammals. White adipose tissue plays a key role in the regulation of energy balance. It is also recognized to secrete a variety of factors called adipokines that are involved in a wide range of physiological and metabolic functions. White adipose depots are found throughout the body with some under the skin (subcutaneous depots), some in the abdominal cavity (generally surrounding viscera such as mesenteric and perirenal fat depots, around epididymis, etc.), and some within the musculature (inter- and intra-muscular depots). These depots exhibit large differences in size and their relative quantitative importance depends on species, age, genetics and nutrition [3]. Unlike other tissues, WAT mass has a large capacity to expand and can be seen as a dynamic tissue able to adapt to a variety of factors.

Adipose tissue development is basically triggered by variations in the number and in the size of adipocytes. In contrast to other tissues, the embryonic origin of adipose cells remains the subject of debate. The increase in cell number results from recruitment of multipotent stem cells/progenitors resident in tissues [2]. After commitment to the adipocyte lineage, progenitors undergo large changes in the expression of many genes involved in cell cycle arrest, lipid accumulation and secretory functions, and differentiate into adipocytes. The chronologies of appearance of WAT and BAT vary according to species and their anatomical locations. The first groups of adipocytes are detected during the fetal period in mammals of large size like pigs and cattle. They are located subcutaneously in pigs whereas in cattle they are located around the kidney (perirenal fat depot). Intramuscular fat appears after birth in both species, so that intramuscular fat is generally regarded as the last developing adipose tissue in all species. Altogether, a better knowledge of the cellular and molecular basis of adipose tissue development in meat animals should help us to develop new strategies to optimize the body lean-to-fat ratio and the intramuscular lipid content, and thereby better control carcass and meat quality in livestock.

References

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