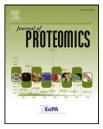
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Muscle and meat: New horizons and applications for 2 proteomics on a farm to fork perspective *3

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ABSTRACT

Meat consumption is an important part of human diet with strong implications in health, economy and culture worldwide. Meat is a proteinaceous product and therefore proteomics holds a considerable value to the study of the protein events underlying meat production and processing. In this article we will review this subject in an integrated "farm to fork" perspective, i.e. focusing on all the major levels of the meat producing chain: farm, abattoir and transformation industry. We will focus on the use, importance and applications of proteomics, providing clear examples of the most relevant studies in the field. A special attention will be given to meat production, as well as quality control. In the latter, a particular emphasis will be given to microbial safety and the detection of frauds. This article is part of a Special Issue entitled: EUPA 2012: new horizons.

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70 1. Introduction

69

Meat consumption is an important part of human culture since 7273the dawn of ages and the formation of early civilizations. 74 Indeed, in several cultures from the Inuit in Greenland to the 75 Sami of Lapland, as well as the several peoples in the 76Mediterranean basin or the great plains of North and South 77 America, meat production and consumption are key aspects defining and influencing not only local economy, but also its 78 culture and ultimately its very essence. Meat production 79 involves numerous domestic species, with several degrees of 80 popularity, depending not only on cultural and religious beliefs 81 but also on practical reasons and availability. The most popular 82 species in the industrialized world, not including fish and 83 shellfish, comprise cattle (Bos taurus, Bos indicus and hybrids), pig 84 (Sus scrofa), sheep (Ovis aries), goat (Capra hircus), rabbit 85 (Oryctolagus cuniculus), chicken (Gallus gallus), mallards and 86 ducks (respectively Anas platyrhynchos and Cairina moschata, as 87 well as their hybrids), the turkey (Meleagris gallopavo) and the 88 Japanese quail (Coturnix japonica). Less familiar species are 89 nevertheless particularly important outside of the Western 90 91 world. These include the water buffalo (Bubalus bubalis), the 92dromedary (Camelus dromedarius), reindeer (Rangifer tarandus), 93 Guinea-pigs (Cavia porcellus), geese (Anser anser), as well as ostriches (Stuthio camelus) and other ratites. Generally speaking 94production methods also vary considerably with species 95farmed, the location of the farm, availability of resources, etc. 96 In the Western world, meat production systems are usually 97 divided in two types: intensive and extensive, often with a third 98 type in between, semi-intensive; or alternatively in commercial 99 100 and subsistence farming. On a broad perspective, intensive 101 systems include most of the pig, poultry and dairy production systems whereas grazing cattle, sheep and goats are associated 102 to extensive systems. Nevertheless such boundaries are not 103clearly defined and tend to change according to the perspective 104 and above all with geographical location. Although the farm is a 105 key component of the meat production chain, there are other 106

agents with equally important roles: the transporter, the 107 abattoir, the meat processing plant, retail, regulatory agencies 108 and ultimately the final consumer. Both quality and safety of a 109 meat product is dependent on events that take place at the level 110 of at least one of such agents. Accordingly, the meat producing 111 sector is more and more often viewed in a "farm to fork" 112 perspective, i.e. a global integrated approach allowing a more 113 efficient, traceable and safe control of the chain and the 114 characteristics of the product. These aspects are particularly 115 important as a consequence of the expected rise in demand for 116 food products of animal origin that are expected to increase 117 significantly in the future particularly in emerging economies 118 [1].

Proteomics can be defined as the science that studies the 120 proteome, i.e. the study of the proteins being expressed in a 121 given cell, tissue or fluid, organ, system or population. The 122 importance of proteomics in animal science has recently 123 been described [2] and demonstrated in numerous areas of 124 animal production such as dairy products [3], foie gras [4], 125 aquaculture [5], wool [6], or the monitoring of pollutant 126 effects using shellfish [7]. We have recently reviewed, from 127 the proteomics angle, the major events involved in the 128 transformation of muscle to meat in a multi-species 129 approach [8]. Nevertheless, and as meat is essentially a 130 proteinaceous product, proteomics has necessarily a rele- 131 vant role in the study of all aspects related to the meat 132 producing chain. In this article, we aim to place proteomics 133 in the context of meat science and in a "farm to fork" 134 perspective, as schematized in Fig. 1. Accordingly, we will 135 thoroughly address all the major components of the meat 136 producing chains. In a first section we will concentrate on 137 the use of proteomics at the level of the live animals that 138 will be used in meat production. We will focus this section 139 on aspects related to breed and genotype differentiation and 140 at levels of feeding and management and handling of the 141 animals. On a second section we will address the impor- 142 tance of proteomics in the slaughtering procedure. We will 143

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