Targeted and untargeted profiling of biological fluids to screen for anabolic practices in cattle

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This review deals with the potential of profiling approaches as valuable tools for combating the illegal use of growth promoters in cattle breeding. Detection of illegal practices classically relies on residue monitoring in a targeted approach and methods based on gas or liquid chromatography coupled to (tandem) mass spectrometry are considered state of the art. However, these strategies fail when faced with new xenobiotic growth-promoting agents or new ways of application, such as administration of low-dose cocktails. In this context, screening strategies allowing detection of the physiological response resulting from administration of anabolic compounds are promising approaches to detect misuse. Profiling biological matrices to reveal biological effects of a drug can be performed by targeting a particular class of compounds or in an untargeted way using global strategies, such as transcriptomics, proteomics or metabolomics. These emerging tactics are promising ways to highlight candidate biomarkers to tackle illegal practices.

Keywords: Anabolic compound; Growth promoter; Metabolomics; Proteomics; Residue monitoring; Screening; Steroid; Targeted profiling; Transcriptomics; Untargeted profiling

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1. Introduction

Growth-promoting practices are still encountered within the European Union (EU), despite Directive 88/146/EC [1] published in the late 1980s that banned the use of growth promoters in livestock production [2]. At around the same time, the Joint Expert Committee on Food Additives (JECFA) of the Food and Agricultural Organization/World Health Organization (FAO/WHO) stated that the use of steroids in cattle for such purposes was not an issue when conducted under good farming practices. As a consequence, hormones are still legally used in some countries around the world.

To comply with the ban, mandatory monitoring and surveillance programs, based on screening and confirmatory processes, have been implemented at national levels in Europe [3]. Besides the classical anabolic practices using particularly powerful classes of compounds [e.g., steroids, β-agonists or protein hormones (e.g., nandrolone, clenbuterol, recombinant

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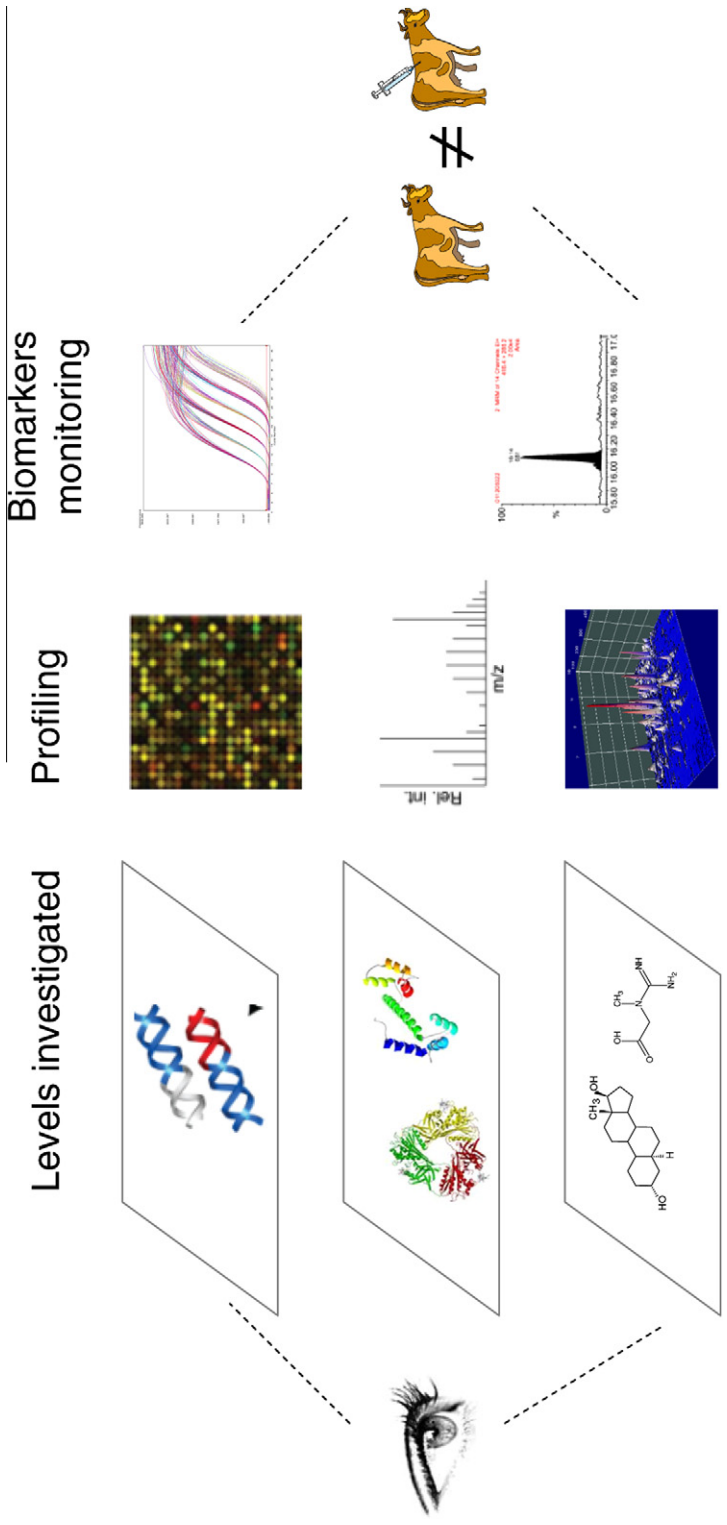

Figure 1. The three "omic" levels of investigation and associated profilings to identify biomarkers allowing screening for the anabolic practices in livestock productions.

growth hormone (GH)], for which effective methods have been developed, allowing efficient monitoring [4], some other and more emerging practices remain difficult to handle from a control point of view. In particular, the use of natural hormones (e.g., estradiol and testosterone), designer drugs or low-dose cocktails, for which the classical and current mass spectrometry (MS)-based approaches fail, as these focus on known compounds only.