



ELSEVIER

Contents lists available at ScienceDirect

Journal of Pharmaceutical and Biomedical Analysis

journal homepage: www.elsevier.com/locate/jpba

Development of a new liquid chromatography-tandem mass spectrometry method for the determination of hormones in bovine muscle

Samia Mokh^{a,*}, Fadl Moussa^{b,c}, Engie E.L. Khoury^b, Rania Nassar^b, Nicola Bernabò^c, Mohamad Al Iskandarani^{a,b,*}^a National Council for Scientific Research (CNRS) - Lebanese Atomic Energy Commission (LAEC) - Laboratory for Analysis of Organic Compound (LACO), Beirut, Lebanon^b Faculty of Public Health I - Lebanese University, Hadath, Lebanon^c Faculty of Bioscience and Technology for Food, Agriculture, and Environment, University of Teramo, Italy

ARTICLE INFO

Article history:

Received 20 May 2020

Received in revised form 6 August 2020

Accepted 7 August 2020

Available online 17 August 2020

1. Introduction

Steroid hormones are a group of lipophilic, low-molecular-weight, and biologically active compounds [1]. The main compound from which all steroids are derived is cholesterol [2]. Natural and synthetic hormones have been widely used for many decades in animal husbandry to improve the rate of growth and the efficiency of feed conversion [3]. Nonetheless, some hormones might have a carcinogenic effect leading to breast cancer, ovarian cancer, and prostate cancer [4]. Moreover, some synthetic growth promoters have potential endocrine-disrupting properties causing behavioral disorders, decreased fertility, and birth malformations [5]. Consequently, the European Union's Scientific Committee on Veterinary Measures has banned the use of natural and artificial hormones in meat and meat production through the Council Directive 96/22/EC.

However, the evolution of the "black market" was limiting the efficiency of control of the residues of these substances in foods of animal origin. To ensure consumer's safety, and to detect their presence at very low levels in the food matrices, the development of sensitive, specific, and multi-residue analytical methods has become necessary and of great significance. For a long time, researchers used to work with gas chromatography (GC) as a technique for hormone analysis [6], but since hormones possess poor thermal stability and volatility, so a derivatization step, is required before GC analysis. Derivatization is a chemical reaction aiming to modify the compound's polarity and ionization by producing new derivatives easier to be analyzed by GC-MS. Despite that, the pre-derivatization processes are time-consuming [7], and difficult to be applied for all compound [8,9]. Indeed, liquid chromatography-tandem mass spectrometry (LC-MS/MS) has gained popularity over the last decades for the detection of growth promoters in biological matrices [10]. Moreover, matrix complexity and the presence of hormones at an often low level, make residue analysis of animal matrices challenging. To detect residue low levels, sample pre-concentration is needed aiming to decrease the interfering matrix contaminants. Thus, the extraction of analytes of interest is a very crucial step to be considered when working with complex samples containing very low concentrations of organic compounds [11]. Different extraction techniques have been used for veterinary drug analysis such as QuEChERS [12], Solid Phase Extraction (SPE) [13], Supercritical Fluid Extraction (SFE) [14], and Accelerated Solvent extraction (ASE) [15]. In this context, QuEChERS was the most applied technique used for the extraction of organic contaminants from animal tissues [16]. The major advantages that encouraged researchers to focus on this extraction method are related to its simplicity, its quick extraction, its high sample throughput, as well as the possibility of using small solvent volume.

In Lebanon, no restrictions were implemented yet to control the use of these hormones in animal husbandry. Until now, no data have been provided about the contamination level with hor-

* Corresponding authors at: National Council for Scientific Research (CNRS) - Lebanese Atomic Energy Commission (LAEC) - Laboratory for Analysis of Organic Compound (LACO), Beirut, Lebanon

E-mail addresses: s.mokh@laec-cnrs.gov.lb (S. Mokh), mohamada@ul.edu.lb (M. Al Iskandarani).