Quantification of Oxytetracycline Residues in
Samples of Beef from the Municipality of
Arjona-Bolivar (Colombia)

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Abstract

The objective of this research was to quantify oxytetracycline residues in 60
muscle samples of bovines from a municipal benefit plant in Arjona-Bolivar
(Colombia), differentiating samples between males and females. The samples
were labeled and transported to the laboratory for analysis. The detection of
oxytetracycline was performed using high efficiency liquid chromatography
(HPLC). The Maximum Residue Limit (MRL) of Colombia (MRL > 200 μg / Kg)
was used. It was found that only 10 samples exceeded the MRL and these samples
that exceeded the MRL all came from females. There was a statistically
significant difference (p <0.05) between males and females.

Keywords: LMR, veterinary drugs, HPLC, muscle, standards

1. Introduction

Livestock activity in Colombia is of great importance in the national economy
sector. In the country of the 51 million hectares destined to the agricultural sector,
approximately 57% of this land is used for the sowing of pasture for livestock [1]. The production of beef in Colombia for the year 2017 was 905,582 tons, being the third producer in South America behind Brazil and Argentina with 2,600,000 tons and 9,600,000 tons, respectively. In this same year, meat consumption in Colombia was 18 kg per inhabitant [2]. Great demand and consumption of products of animal origin by the human population has led to the increase of agricultural production systems, in particular livestock production. This context has led to the animals being exposed to the increase of diseases of different nature, which in turn leads to greater use of veterinary drugs such as antimicrobials, pesticides and antiparasitic, growth promoters and the active ingredients of these leave residues in food of agricultural or livestock origin [3], [4].

Antibiotic residues reach the consumer through the food chain, producing consumer allergic reactions, bacterial resistance, alteration of the intestinal bacterial flora and causing problems of commercialization due to noncompliance with the standards established in different countries [5], [6].

All this problem, plus the need to preserve public health, has led health authorities to establish maximum residue limits (MRL) in different tissues and species of edible animals, whose standard aims to establish minimum tolerance levels for food safety. The MRL is the acceptable concentration of a substance in the edible tissues of an animal, in honey and eggs, and when it is ingested by humans, it does not put their health at risk. This is established for each animal species their respective tissues. The values of the MRLs in the different tissues should reflect the depletion kinetics taking into account all the food sources, the conditions of use of the drug, the feasibility of the derived waiting times and the availability of adequate analytical methods for its determination [6], [7], [8], [9], [4], [10], [11]. The objective of this research was to quantify the residues of oxytetracycline in samples of beef from the municipality of Arjona-Bolivar (Colombia).

2. Methodology

2.1 Sampling

Samples were taken in triplicate from 60 bovines of both sexes of the municipal benefit plant of Arjona-Bolivar (Colombia), these came from the diaphragm zone, free of fat and aponeurosis from freshly slaughtered animals. The samples were stored in ziploc bags, labeled and refrigerated at 2°C, transported to laboratories for further analysis.

2.2 Sample preparation and applied method

Sample preparation was done according to method 995.09 of the AOAC.
2.3 HPLC conditions

The separations were developed on a Phenomenex Synergi Polar-RP Column 250X4.6 mm column (Phenomenex, USA). The mobile phase consisted of a mixture of 85% sodium monobasic phosphate (NaH$_2$PO$_4$) 20 mM, 15% acetonitrile (ACN) at a flow of 1.5 mL / min and a detection wavelength of 210nm. The injection volume of the sample was 20 µL. The equipment used was a liquid chromatograph (BAS SS60) equipped with a ternary pump and manual injection and a UV-VIS detector (BAS) of variable wavelength.

2.4 Statistic analysis

The statistical analysis of the data was carried out with the STATGRAPHICS centurion XVI.I program through tests of variance (ANOVA), with a confidence interval of 95%. All tests were carried out all trials in triplicate.

3. Results

The results obtained in this investigation showed that of the 60 animals evaluated, 100% had oxytetracycline residues, but only 6% of these animals (all females) exceeded the MRL allowed by the Colombian norm for the evaluated drug [12]. The mean concentration of oxytetracycline in the females was higher than the mean of the males, and a statistically significant difference was found (p <0.05).

<table>
<thead>
<tr>
<th>Genus</th>
<th>Positive Samples</th>
<th>Concentrations Mean ± SD</th>
<th>MRL</th>
<th>Number of samples that exceed the MRL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rank</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>30/30</td>
<td>100.3 a</td>
<td>165.09 ± 57.35$^a$</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>308.13</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>30/30</td>
<td>99.8 a 164.8</td>
<td>127.16 ± 20.13$^b$</td>
<td>200</td>
</tr>
</tbody>
</table>

The percentage of positive samples that exceeded the MRL imposed by Colombian standards in this work, were lower than that reported by Acosta et al., [13], who evaluated the presence of this same antibiotic in beef from the department of Antioquia (Colombia) and obtained 16.43% of the samples analyzed (12 samples) exceeded the MRL imposed by the European Union (EU) which is 100 µg / Kg. A higher percentage of positive samples was also found in the research done by Franco et al., [14], where they found that 61.5% of the samples (70 samples) exceeded the EU MRL and 23.7% of the samples (27 samples) exceeded the MRL imposed by the Codex Alimentarius (200 µg / Kg), for beef in both cases. Another case where residues of this drug were found was in...
the research done by Nchima et al., [15], where approximately 45.5% and 76.6% of the beef samples from 4 provinces of Zambia exceeded MRL of Codex Alimentarius and the EU, respectively. Another similar study was done by Kimera et al., [16] in Tanzania where they found that 68.3% of the samples exceeded the MRL imposed by the FAO / WHO for muscle, liver and kidney samples of beef. On the contrary, in another investigation made by Negrete et al., [17] the percentage obtained from positive samples was 6%, in beef from the department of Córdoba (Colombia) and no sample exceeded the EU MRL.

This detection of residues above the MRL allowed by MINSALUD [12] for oxytetracycline may be due to the following cases: to the free sale of the drug, to the unauthorized use of this antimicrobial, to the lack of implementation of good livestock practices, to the application techniques used, to the use of this drug in prolonged periods of time that have made the developed muscular deposits in animals, to the primary production systems are not fulfilling the good practices in the administration of medicines, to which the plants of benefit they do not have a meat health inspection system based on the risk analysis, the non-application of the instructions on the label, the inadequate waiting time before the slaughter of the animals, the failure to consult a veterinarian before use of antimicrobials or lack of prior training in animal husbandry [14], [18], [19], [20]. To reduce the presence of these residues, the following considerations can be put into practice: observation of the period of antimicrobial suspension, non-prolonged use of the antimicrobial, application of existing legislation, and the proper application of the safety surveillance plans of the antimicrobial food, have treatment records [15].

An interesting aspect in this investigation is the observed trend that identified that the genus of the slaughtered animals influenced the presence of oxytetracycline, finding that the females had greater residues of this drug compared to the males, similar results were presented in investigations made by Acosta et al., [13] (2014) and Alvarado et al., [21] this may be due to the fact that these cows could suffer diseases such as mastitis, reproductive infections or had recently hatched and then they are sent to the slaughterhouse without complying with the established withdrawal time [13], [21], [22].

4. Conclusions

The presence of oxytetracycline residues was detected in all bovine muscle samples evaluated from both males and females, from the municipal benefit plant of Arjona-Bolivar (Colombia), but only 6% exceeded the MRL imposed by Colombian standards, these results were lower than those found by other researchers in Colombia. To reduce the presence of these residues, veterinary drug surveillance and control programs should be strengthened, as well as the training of livestock farmers.
References


J. Franco, M. Romero, G. Taborda. Determinación de niveles residuales de tetraciclina en canales bovinas por la técnica de ELISA en el frigorífico Friogan (La Dorada), Biosalud: *Revista de Ciencias Básicas*, **7** (2008), no. 1, 47-55.


C. Negrete, E. Segura, M. Torres, J. Badel. Identificación de Residuales Químicos de Oxitetraciclina, OTC, en la Carne Fresca Bovina obtenida en
Quantification of oxytetracycline residues


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