



Ss. CYRIL AND METHODIUS UNIVERSITY IN SKOPJE  
FACULTY OF VETERINARY MEDICINE - SKOPJE

# BOOK OF ABSTRACTS

**“Days Of Veterinary Medicine”  
10<sup>th</sup> International Scientific Meeting  
and  
2<sup>nd</sup> European Conference on  
Veterinary and Medical Education 2024**

22-25 September 2024,  
Republic of North Macedonia

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**Published by:**

Faculty of Veterinary Medicine – Skopje,  
Lazar Pop Trajkov 5/7, 1000 Skopje  
Tel: ++389 2 3240 700 Fax: ++ 389 2 3114 619  
www.fvm.ukim.edu.mk



CIP - Каталогизација во публикација  
Национална и универзитетска библиотека "Св. Климент Охридски", Скопје

636.09(062)(048.3)

INTERNATIONAL Scientific Meeting Days of Veterinary Medicine (10 ; 2024)

Book of abstracts [Електронски извор] / 10th International Scientific Meeting Days of Veterinary Medicine – 2024 and 2nd European Conference on Veterinary and Medical Education 22-25 September 2024, Ohrid ; [editors Miroslav Kjosevski ... и др.]. - Skopje : Faculty of Veterinary medicine, 2024

Начин на пристапување (URL):

[https://dvm2024.mk/wp-content/uploads/2024/09/dvm-ecvme-2024\\_book\\_of\\_abstracts.pdf](https://dvm2024.mk/wp-content/uploads/2024/09/dvm-ecvme-2024_book_of_abstracts.pdf).

- Текст во ПДФ формат, 154 стр. - Наслов преземен од екранот. - Опис на изворот на ден 18.09.2024. - Регистар

ISBN 978-9989-774-43-0

1. European Conference on Veterinary and Medical Education (2 ; 2024)

а) Ветеринарна медицина -- Зборници -- Апстракти

COBISS.MK-ID 64439045

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**P28****A STUDY ON THE PRESENCE OF SOME HEAVY METALS AS FEED ADDITIVES IN ANIMAL NUTRITION IN THE REPUBLIC OF NORTH MACEDONIA**

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Essential heavy metals Mn, Co, Cu, and Zn are important in livestock production in trace amounts due to their physiological functions such as hormone synthesis, oxygen and electron transportation, fertility, antioxidant defense, and immunity. However, their presence beyond a certain limit in the biological system potentiates toxicity and provokes adverse effects in animals. These metals are administered by feed, where they are added in the form of chelates or organic compounds. In the European Union, Mn, Co, Cu, and Zn utilization in animal nutrition is ruled by Regulation (EC) No. 1831/2003. So far, there is no data on the presence of metals as feed additives in the nutrition of livestock in North Macedonia. As a result, this study aimed to determine the levels of Mn, Co, Cu, and Zn in complete feeds and evaluate their amounts relative to the maximum permitted levels under the legislation mentioned above. Between May 2023 and April 2024, we collected 109 complete feed samples, including 37 for cattle, 33 for pork, and 39 for poultry, from farms and feed distributors in North Macedonia. Samples were analyzed according to EN 15763:2009 with inductively coupled plasma-mass spectrometry (ICP-MS), after microwave-assisted mineralization. We performed the method validation following the ICH Q2 Guideline. The average determined levels of Mn, Co, Cu, and Zn are 0.440, 0.367, 1.648, and 0.524 mg/kg, respectively. The maximum determined amounts are 0.969 mg/kg for Mn, 0.698 mg/kg for Co, 7.160 mg/kg for Cu, and 3.562 mg/kg for Zn. We observe no violation of the maximum permitted levels; however, we must consider some precautions regarding the Co content, as the average concentration hovers around 37%, and the maximum 70% of the permitted level sat at 1 mg/kg. Regarding Mn, Cu, and Zn, the determined average and maximal concentrations are far below the maximum permitted levels. In conclusion, the determined levels of Mn, Co, Cu, and Zn within this study pose no risk to the health of the food-producing animals. Moreover, the presence of the aforementioned metals in animal nutrition is not of concern for the environment, provided that their maximum permitted levels are respected.

**Keywords:** metals, feed additives, determination, ICP-MS

**Acknowledgement:** We gratefully acknowledge the support provided by the Faculty of Veterinary Medicine - Skopje, Ss Cyril and Methodius University in Skopje, under the project FVMS-IPR-7, grant No. 0202-359/14.