



FEED 2025

9th International Feed Conference
"Innovating Feed - Shaping the Future"

Book of Abstracts



Institute of Food Technology in Novi Sad

15-16 October, 2025

Novi Sad, Serbia

ISBN-978-86-7994-067-4

IX INTERNATIONAL FEED CONFERENCE “INNOVATING FEED – SHAPING THE FUTURE”, 15th -16th OCTOBER 2025, NOVI SAD, REPUBLIC OF SERBIA

Publisher

University of Novi Sad
Institute of Food Technology in Novi Sad
Bulevar cara Lazara 1
21000 Novi Sad
Republic of Serbia

Main editor

Dr Olivera Đuragić

Editors

Dr Marija Milašinović Šeremešić
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- AFOS - Feed Formulation Software
- Food and Feed Research, Journal of the Institute of Food Technology in Novi Sad, University of Novi Sad, Republic of Serbia

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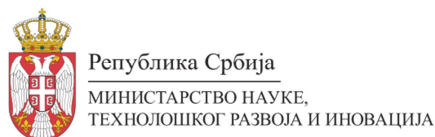
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THEOBROMINE AND CAFFEINE IN FORMER FOOD PRODUCTS INTENDED FOR ANIMAL NUTRITION

Francesca Mercoglian^{1*}, Corinne Bani¹, Marco Tretola², Luciano Pinotti³, Chiara Di Lorenzo¹

¹Department of Pharmacological and Biomolecular Sciences, Università degli Studi di Milano, 20133 Milano, Italy

² Institute for Livestock Sciences, Agroscope, 1725 Posieux, Switzerland

³ Department of Veterinary Medicine and Animal Sciences, Università degli Studi di Milano, 26900 Lodi, Italy

*Corresponding author:

E-mail address: francesca.mercoglian@unimi.it

The integration of Former Food Products (FFPs) into animal feed represents a promising circular economy strategy to reduce food waste while maintaining feed safety and animal productivity. FFPs are foodstuffs originally intended for human consumption that are excluded from the retail chain due to non-safety-related issues such as packaging defects, aesthetic imperfections or logistical oversupply. Despite their removal from the food market, FFPs retain high nutritional value. However, potential safety concerns may arise from naturally occurring compounds like methylxanthines, including theobromine and caffeine, especially when FFPs contain chocolate or cocoa-based ingredients. This study aimed to quantify theobromine and caffeine in FFPs containing various food industry products such as baked goods, pasta, confectionery, and cereals by-products. Compliance was evaluated against EU Directive 2002/32/EC, which sets maximum levels for theobromine. Caffeine is not regulated with a maximum limit in feed. However, caffeine can still have physiological effects on animals, so its presence is often monitored. An initial screening for theobromine and caffeine was performed by High-Performance Thin Layer Chromatography (HPTLC); following positive results, quantitative analysis was carried out using High-Performance Liquid Chromatography with UV detection (HPLC-UV). Results indicated that all FFPs were generally compliant with the EU maximum levels (ML) for theobromine in complete feed for ruminants (300 ppm) and pigs (200 ppm), assuming a worst-case inclusion rate of 30% of total dry matter intake. FFPs primarily composed of savoury products exhibited lower theobromine and caffeine concentrations compared to those with a higher inclusion of bakery products. These findings emphasize the need for species-specific evaluations, careful consideration of inclusion rates, and consistent compositional monitoring. Overall, this study supports the safe incorporation of FFPs into livestock diets within regulatory boundaries, highlighting their potential to improve feed sustainability and reduce environmental burdens associated with food waste.

Keywords: former food, ex-food, theobromine, alkaloids, circular economy