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Professional paper

ASSESSMENT OF ANTIMICROBIAL RESIDUES IN PRODUCTS OF ANIMAL ORIGIN AND LEGAL ACTS FOR THEIR MANAGEMENT

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Abstract

Antimicrobial products, when used for the prevention, treatment of diseases, and stimulation of growth of food-producing animals, can leave residues in their products such as meat, milk, eggs, and honey. Veterinary residues in animal products may originate from antiparasitics, antibiotics, sulfonamides, additives and hormones, growth and development promoters, which are necessary to ensure the welfare and protect the health of agricultural and companion animals.

The indiscriminate use of antimicrobials in production animals enables the inevitable creation of residues in animal products, in the form of metabolites or original products, and when they are above the permitted limits, they can be harmful not only to the health of the animals, but also to the consumers who use these products.

Based on the information received from production farms, it has been proven that minimal amounts of veterinary products or their metabolites can be found in tissues and products intended for human consumption, such as meat, milk, eggs, and honey, which should be considered as health risk factors.

The purpose of this paper is to evaluate veterinary residues in foods of animal origin, based on veterinary legislation and technical and professional instruments, in accordance with national and European standards.

Keywords: veterinary residues, chromatography method, AuroFlow™ BT Combo Strip Test,

1. Introduction

Monitoring residues in products of animal origin is a global problem, due to the negative effect on consumer health, as proven in many scientific studies. Referring to the European Union and the European Medicines Agency, residues are "pharmacologically active substances and their metabolites, which remain in products of animals, treated with the PMVs in question"

Veterinary product residues include binding components as well as their metabolite residues in edible parts of products of animal origin, which are one of the sources of contamination of animal foods, and with risk for the consumer.

Under normal physiological conditions, most drugs are metabolized, thus facilitating their elimination, detoxification, and excretion through urine and to a lesser extent through feces [17]

However, it is not excluded that these substances can be found in milk, eggs and meat. Therefore, rationally, no product with animal origin, which comes from a treated animal, can be consumed if the medication used has not been eliminated.

Global population growth has also led to a continuous increase in demand for foods of animal origin, meat, milk, eggs and by-products, accompanied by an increase in the use of antimicrobials and biostimulants in production animals [4]

Antimicrobial agents are widely used in production animals for prophylactic and therapeutic purposes. Although the use of these drugs has significantly improved the health and increased the efficiency of food-producing animals, misuse, inappropriate administration or errors by farmers and veterinarians and failure to observe withdrawal periods can result in the creation of residues in animal products [8]. Regarding the increasing trend of residues in animal

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products and the creation of problems in human health due to the increase in microbial resistance, the European Union has set maximum residue limits (MRLs) for pharmacologically active substances in animal foods for human consumption. [15]

Recognizing antimicrobial products, which are most frequently used in dairy, meat, egg and honey farms and selecting appropriate tests for the detection, assessment and control of residues in animal products, remains an important part of veterinary and human services.

European Regulation 178/2002/EU states that in the EU the primary legal responsibility for food safety lies with food business operators [23]

According to scientific studies, the consumption of animal products with veterinary residues in the consumer can cause side effects such as acute toxicity, allergic reactions, bacterial resistance, flora imbalance, carcinogenic processes, teratogenicity and mutagenicity.

In addition to the health risk, residues in animal products can jeopardize international trade under the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures, which supports the globalization of markets.[1]

2. Materials and Methods

The study aims to identify the most common antimicrobials used in production animals, identify possible pathways for residue formation in milk, meat, eggs and honey, and assess them in relation to the maximum residue limits (MRL). Part of the study's objective was also to verify veterinary legislation and administrative instruments supporting veterinary activity for monitoring and minimizing veterinary residues in animal products, according to EU standards [4]

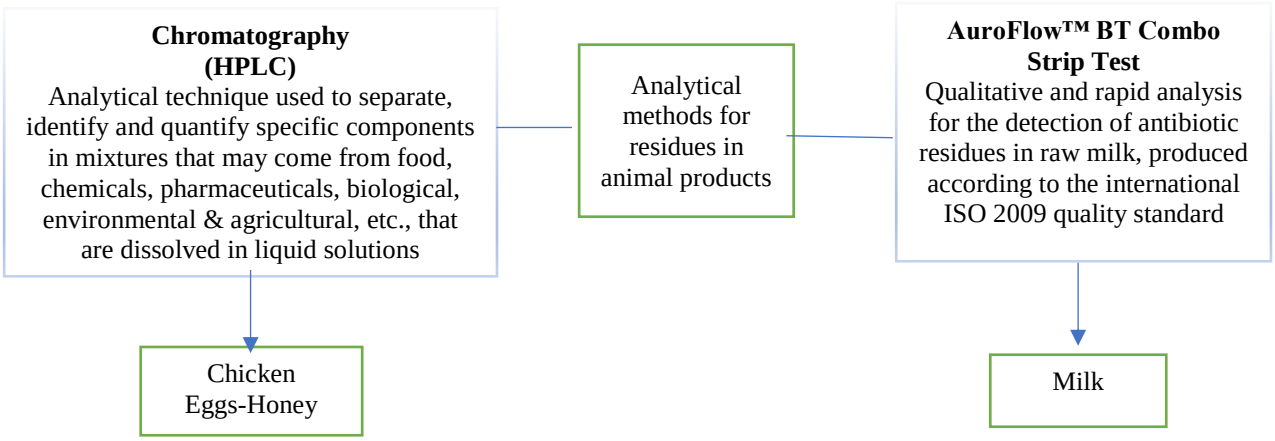
There are many analytical methods for residues, but in the study evaluating meat, egg and honey samples, the liquid chromatography method was used, a high-performance liquid chromatography (HPLC) technique that serves to separate, identify and determine the amount of specific components that can be chemicals and pharmaceutical, biological, environmental, agricultural products, dissolved in liquid solutions. [22]

Identification and evaluation of residues in raw milk samples was performed with AuroFlow™ BT Combo Strip Test, a qualitative analysis, which enables the detection of residues of up to 14 beta-lactam antibiotics, 3 tetracyclines [12]. The use of this test, produced according to the international standard ISO 9001, takes on practical value especially for farmers, the processing industry and milk transport companies, without the need for a special complex laboratory infrastructure. [2]

Based on the study methodology, with the consent of the farmers, information was obtained from the farm register on the types and frequency of antimicrobial products used during farm visits for a one-year period. The frequency of the antimicrobial agent for each farm was determined based on the number of animals treated, in relation to the days of treatment.

To determine the magnitude of residues detected in milk, meat, eggs and honey, data from routine official controls carried out during 2024 were used, while for milk, data from the dairy processing industry were also used. The number of farms, samples taken, analytical methods and the level of residue magnitude are presented in the table below.

Fig. no. 1: Analytical methods for the evaluation of residues in animal products



3. Results

The results presented in Table no 1 are based on the analytical indicators of 480 samples taken from 7 farms, namely: 100 samples from two dairy farms, with a total of about 100 cows, 110 samples from two poultry farms for meat production, with a total of about 100 thousand heads, 150 samples from three poultry farms for egg production, with a total of about 150 thousand heads, 120 from two bee parks, with a total of about 100 hives.

Referring to the analytical indicators, it resulted that out of 480 samples in total, 24 samples, or 5%, were above the norm, and respectively according to the types of products they are: 5 milk samples or 5%, 4 chicken samples, or 3.63%, 7 egg samples or 4.66%, 8 honey samples, or 6.66%

Tab. no.1- Number of monitored heads and companions above the norm, 2024

No.	Samples	Farms/Parks	Tot heads/Hives	No. samples	Above the norm	In %
1.	**Milk**	2	100	100	5	5,00
2.	**Chicken**	2	100,000	110	4	3,63
3.	**Eggs**	3	300,000	150	7	4,66
4.	**Honey**	2	100	120	8	6,66
Total				**480**	**24**	**5,00**

An important aspect of the findings in the study was the identification of the types of antimicrobials used in production farms, as well as their percentage above the norm in milk, chicken, egg and honey samples (Table no. 2)

Tab. no. 2- Samples above the norm and MRL value (in %)

Sample type	Samples		Medicines their derivatives	Value above the norm (%)
	Total	Above the norm		
Milk	100	1	Amoxicillinë	20
		1	Ampicillinë	20
		1	Cephquinome	25
		1	Oxacillinë,	30
		1	Chloxacilinë	30
Total		5	-	-
		1	Penicillinë G	10

Chicken	110	1	Oxacillinë	20
		1	Enrophloxacinë	20
		1	Sulphamethoxazole	10
Total		**4**	-	-
Eggs	150	1	Dinitrocarbanilide,	10
		1	Dihydrostreptomycinë	10
		1	Tilmicosine/Salinomycine	20
		1	Sulphamethoxazole/Amprolium	10
		1	Dimetrazol	20
		1	Enrophloksinë	10
		1	Florphenikol	20
Total		**7**	-	-
Honey	**120**	1	Penicillinë G	30
		1	Cephalonium	10
		1	Dicloxacillinë	10
		1	Nefcillinë	20
		1	Cefazolinë	10
		1	Enrophloxacinë	10
		1	Enrophloxacinë	20
		1	Oxitetraciklinë	10
Total		**8**	-	-

Referring to the above data, although it is now proven that the use of antimicrobials in animals has the potential to generate residues in animals and animal products and pose a risk to consumer health, they remain part of daily veterinary practice.

4. Discussion

The findings in the study show that the use of antimicrobials during 2024 in dairy, meat, egg farms, and bee parks is not only diverse,[8] but also an important part of veterinary activity for the protection of animal health. To address the causes, sources and routes of waste generation, the study also used data from the farmers' registry, which shows that during 2024, a total of 45 veterinary products with around 27 active substances identified according to commercial indicators were used as part of veterinary prophylaxis and therapy.

According to evidence from dairy farms, of the most used antibiotics, antibiotics occupy the main place, due to the control of various infectious diseases, breast diseases, etc. [7]

But although the creation of antibiotic residues in dairy farms is generally rare, in 5 milk samples amoxicillin, ampicillin, cephquinome, oxacillin, chloxacillin were found,

From the case-by-case evaluation of samples above the norm, antibiotic residues in milk can be related to their intramammary use, and to other factors such as: failure to respect the withdrawal period or failure to separate the milk of treated cows. [6]

The possibility of their entry into the milk supply chain can be prevented if every milk shipment for processing is tested for the presence of antibiotics and sulfonamides, etc., as well as informing farmers about the care of production animals from the misuse of antibiotics and protecting milk from residues. [1]

In poultry farms for meat production, a product that ranks second most consumed globally, the most commonly used products for prophylactic, therapeutic and growth promotion purposes are antibiotics, antiparasitics and anticoccidials [21] which can inevitably leave residues in consumable tissues,

Referring to the values found in the 4 above-standard chicken meat samples, the following products were identified: penicillin G, sulphamethoxazole, oxacillin, enrofloxacin, whose presence is related to technical and professional factors such as the determination of dosimetry, frequency and routes of use during the implementation of the prophylaxis and therapy calendar, the withdrawal time before slaughtering the birds, etc. [16]

In poultry farms for egg production, it has been proven that the use of antimicrobials for prophylactic and therapeutic purposes, they or their metabolites, after circulating through the blood, are distributed throughout the body, especially in the ovary with growing follicles and in the ovary, where the egg white is formed and secreted, creating opportunities for an increase in the incidence of residues above the norm in eggs. Due to the permanent presence of coccidiosis and some other stable infections, anticoccidials such as: salinomycin, monensin, narasin, toltrazuril, robenid, nicarbazin, dinitrocarbanilid, dimetridazole, decoquinate and lasalocid have had a special role in egg farms, some of which are used through food.

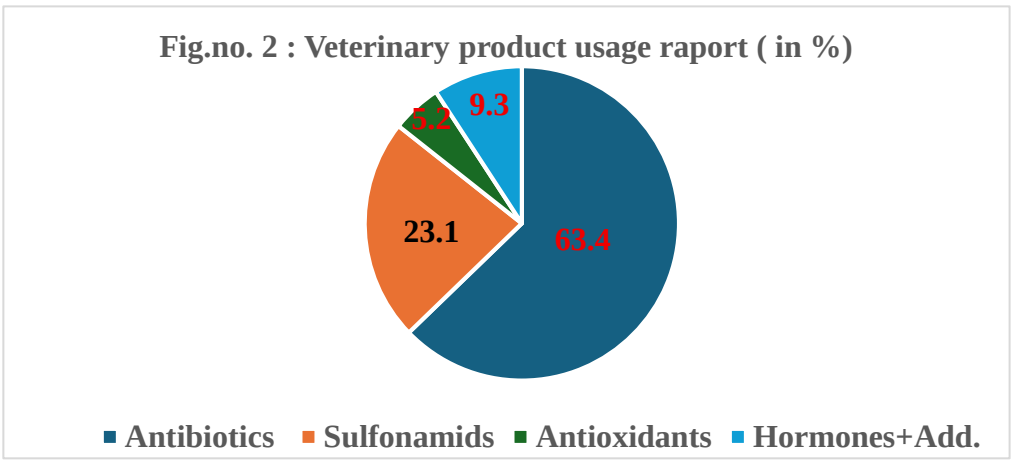
The findings in 7 egg samples above the norm of dinitrocarbanilide, dihydrostreptomycin, enrofloxacin, tilmicosin/salinomycin, sulphamethoxazole/amprolium, dimetridazole, florphenicol, indicate that eggs, due to their complex composition and high content of phospholipids, proteins, cholesterol and other nutrients, require care regarding dosimetry, frequency of use during the implementation of the prophylaxis and therapy calendar on the farm, as well as the suspension time of the use of some antibiotics in production chickens. [3]

In bee parks, the study has identified that the main place in veterinary activity is occupied by products such as: penicillin, cephalonium, dicloxacillin, nefcillin, streptomycin, sulfonamide and chloramphenicol, while their use by beekeepers in relatively high doses is done in cases of treatment of infections and in low doses as "growth promoters". [25]

The findings of the study of above-normal residue values in 7 honey samples have been identified: penicillin, cephalonium, dicloxacillin, cefazolin, enrofloxacin, oxytetracycline and nafcillin, this is due to protection from several very damaging diseases present in recent years in beekeeping [9] . A source of residues in animal products are also hormones and anabolic steroids, which are diverse and are used to promote growth and increase meat yield, as well as medicated foods with a very wide use on production farms. Even additives, which have been widely used in animal feed in recent years to improve the performance of health parameters and profitability of nutrients, remain a potential source of residues in animal products. [20]

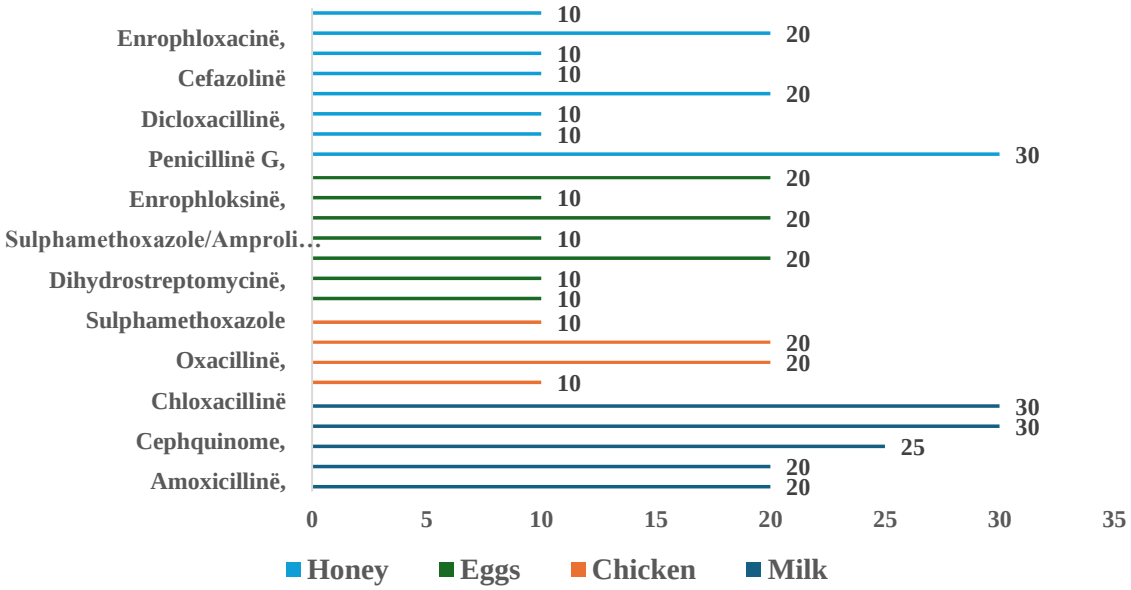
The pharmacological groups (Fig. 2) used for prophylactic and therapeutic purposes in all farms were: 63.4% antibiotics, 23.1% sulfonamides, 5.2% antacids, 9.3% hormone products / medicated feeds.

Fig.no. 2 : Veterinary product usage raport (in %)



The report of the pharmacological groups is also in line with the findings of the report of the European Medicines Agency (Citation: www.ema, 31/03/2025) which identifies that of the total antimicrobials used in food-producing animals in EU countries and beyond, about 65% of them are in category D, which includes antibiotics such as penicillin, tetracycline, etc., and sulfonamides.

Fig.no. 3: Value above the norm (in %)



The findings of the study (Fig. no.3) show that the above-normal size of the analyzed samples results from 10-30%, where the highest values come from antioxidants used in the poultry industry and then antibiotics used in beekeeping and dairy farms, and their correction is achieved through the control of their administration on farms.

Of interest to veterinary and food safety sciences remains the conduct of further studies to determine the size of antimicrobial residues and the determination of their maximum limits (MRL) for foods produced from animals treated with VMPs [10] although it is known that their range is much wider and for some animal products that MRL is missing, generally for its assessment it is carried out according to the standards of the Codex Alimentarius.

Referring to the mission of the veterinary service for the protection of animal health and food safety for the protection of consumer health, the monitoring and control of residues in animals and animal products is based on the requirements of Law 10465/2011: On the Veterinary Service in the Republic of Albania and on the sub-legal acts drafted by the Ministry of Agriculture, regarding the implementation of sampling procedures, and official control of substances authorized as VMPs or as additives of animal feed and their residues, as well as the implementation of rules for suspicious cases or non-conformity with applicable national rules.

The veterinary documentation package on the implementation of the traceability system, drafted in accordance with EU Regulation: 2017/625, EU Regulation: 2019/2090 and EU Regulation: 2022/1644, as well as the instruments created by the relevant law enforcement authorities, constitute a complete legal and regulatory framework, supporting the veterinarian for the monitoring of residues in the production, processing and distribution chain of animal products.

5. Conclusions

1) Monitoring residues in animal products has brought about the need to approximate national veterinary legislation with that of the EU to strengthen control instruments in the use of VMPs in animals
2) Since VMPs have the potential to generate residues in animals and animal products, but their minimization is achieved through the implementation of the traceability system,
3) Mismanagement and abuse of VMPs, especially of antibiotics in production animals, create premises for residues throughout the food chain,
4) In monitoring residues, priority is given to the implementation of the withdrawal period and the period of their elimination from treated animals.
5) Cooperation and awareness of farmers to recognize the routes of residue creation, including the method of use, group medication, use of medicated foods, sources and possible routes for the creation of residues in production animals and animal products for human consumption.
6) Administration of VMPs only through the use of veterinary prescription,
7) Evaluation of veterinary residues, as part of biochemical and pharmacological sciences requires better knowledge of the basic concepts on risk analysis of animal health and animal products, based on the Alimentary Codex on MRL and national and European legislation, which are quite broad and specified.

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