Aflatoxin M1 in Milk in Poland: Regulatory Framework, Official Control, Occurrence Data and Recommendations

Polish Country Chapter prepared for the MILKCHECK V4 Comparative Report 7 May 2026

Prepared for:

MILKCHECK Project Consortium
MTKI / Hungarian Dairy Research Institute

Project title:

MILKCHECK — Establishing a V4 Dairy Research Network and Addressing Challenges in the Dairy Sector

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1. Introduction

Milk and dairy products are an important component of the human diet, providing high-quality proteins, fats, vitamins and minerals, including calcium, potassium and fat-soluble vitamins. Due to their nutritional value and widespread consumption, particularly among children, ensuring the safety of milk and milk-based products remains an important public health priority (Pereira 2014; De Lamas et al. 2019; Rizzoli 2022).

One of the chemical hazards relevant to the dairy chain is aflatoxin M1 (AFM1), a hydroxylated metabolite of aflatoxin B1 (AFB1). AFB1 may occur in contaminated feed materials, particularly maize, maize silage and other feed components. After ingestion by dairy cows, AFB1 is metabolised mainly in the liver and excreted into milk as AFM1. Therefore, the level of AFM1 in milk is closely linked to feed quality, storage conditions, feeding practices, animal metabolism and climatic factors (Min et al. 2021; Zentai et al. 2023).

This issue is particularly relevant because AFM1 is relatively stable during standard milk processing. Contamination present in raw milk may therefore persist in processed dairy products, while dehydration and spray-drying may contribute to a concentration effect in milk powder (Iqbal et al. 2015; Nguyen et al. 2020). In the European Union, the maximum level for AFM1 is set at 0.050 µg/kg for raw milk, heat-treated milk and milk intended for the manufacture of milk-based products (Commission Regulation (EU) 2023/915).

In Poland, as in other EU Member States, no separate national maximum level for AFM1 in milk is established. The applicable limits are those laid down in EU legislation. Poland is one of the important milk-producing countries in Central Europe; therefore, the monitoring of AFM1 is relevant both from the perspective of national food safety and the broader V4 dairy sector. The main preventive focus should be placed on the feed chain,

because AFM1 contamination in milk is primarily a consequence of AFB1 contamination in feed for dairy cows (Min et al. 2021; Zentai et al. 2023).

Available evidence from Europe indicates that AFM1 occurrence in milk is strongly influenced by geographical region, climate, feed contamination pressure and farm management practices. In temperate regions of Europe, the risk is generally lower than in warmer regions; however, climate change may increase the probability of aflatoxin contamination in crops and feed materials, including maize grown in areas previously considered to be at relatively low risk (Battilani et al. 2016; Van der Fels-Klerx et al. 2019). This is particularly relevant for Central Europe, where the dairy sector relies on both locally produced and imported feed components.

In Poland, available monitoring and research data suggest that AFM1 contamination of raw milk is generally low and that exceedances of the EU maximum level are uncommon. Nevertheless, the risk cannot be ignored, especially in the context of feed storage, maize silage quality, imported feed materials and changing climatic conditions. For this reason, continued monitoring of AFM1 in milk and AFB1 in feed, together with good agricultural, storage and feed management practices, remains essential.

This country chapter summarises the Polish regulatory framework, competent authorities, available occurrence data, and previous research findings.

2. Legal and regulatory framework

2.1. General overview

In Poland, the legal framework concerning aflatoxin M1 (AFM1) in milk is based primarily on European Union legislation. As an EU Member State, Poland directly applies binding EU provisions concerning food safety, contaminants in food, food hygiene, hygiene of food of animal origin, official controls, and feed hygiene. Consequently, Poland does not establish a separate national maximum level for AFM1 in milk. The maximum levels applicable in Poland are those laid down in EU legislation, while national law mainly defines the organisation, competences and enforcement mechanisms of the Polish control system.

The regulatory approach to AFM1 in milk should be considered in the context of two parts of the dairy chain. The first is the food safety framework for milk and dairy products, in which AFM1 is regulated as a food contaminant. The second is the feed safety framework, since AFM1 in milk is formed mainly as a result of the biotransformation of aflatoxin B1 (AFB1) ingested by dairy cows with contaminated feed. Therefore, effective legal control of AFM1 in milk depends not only on milk testing, but also on the prevention and control of AFB1 contamination in feed materials and compound feed intended for dairy animals.

2.2. Applicable EU Food Law

In Poland, the basis of general EU food law is Regulation (EC) No 178/2002, which lays down the general principles and requirements of food law, establishes the European Food Safety Authority, and sets out procedures in matters of food safety. This Regulation introduces key principles relevant to the dairy chain, including the responsibility of food business operators, traceability, risk analysis, and the requirement that unsafe food must not be placed on the market (Regulation (EC) No 178/2002).

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With regard to food hygiene, Regulation (EC) No 852/2004 establishes general hygiene requirements for food business operators. These requirements include the obligation to implement procedures based on HACCP principles, maintain hygienic production conditions, and ensure the protection of food against contamination throughout production, processing and distribution (Regulation (EC) No 852/2004).

Milk and dairy products are also subject to Regulation (EC) No 853/2004, which lays down specific hygiene rules for food of animal origin. This Regulation supplements the general hygiene requirements and includes specific provisions for raw milk and dairy products, including requirements concerning production, processing and the approval of establishments handling products of animal origin (Regulation (EC) No 853/2004).

Official controls are regulated by Regulation (EU) 2017/625. This Regulation establishes the general framework for official controls and other official activities carried out to ensure the application of food and feed law, as well as rules on animal health and welfare, plant health and plant protection products. In the context of AFM1, it provides the basis for official sampling, inspections, enforcement measures and coordination between competent authorities (Regulation (EU) 2017/625).

2.3. Maximum Levels of AFM1 in Milk

Maximum levels for AFM1 in food are currently laid down in Commission Regulation (EU) 2023/915 on maximum levels for certain contaminants in food. This Regulation replaced the previous Commission Regulation (EC) No 1881/2006 and is directly applicable in Poland (Commission Regulation (EU) 2023/915). For milk, the key regulatory value is the EU maximum level of 0.050 µg/kg for AFM1 in raw milk, heat-treated milk and milk intended for the manufacture of milk-based products. A more stringent level applies to infant formula, follow-on formula and foods intended for infants and young children, reflecting the greater sensitivity of this consumer group. In practice, milk exceeding the maximum level for AFM1 cannot be placed on the market as food. Since AFM1 is relatively stable during milk processing, compliance should be ensured primarily at the raw milk level and through the prevention of AFB1 contamination in feed.

2.4. Sampling and Analysis Requirements

The control of mycotoxins in food requires appropriate sampling and the use of validated analytical methods. Commission Implementing Regulation (EU) 2023/2782 lays down the methods of sampling and analysis for the control of mycotoxin levels in food and repeals Regulation (EC) No 401/2006. This Regulation is relevant to the official control of AFM1 in milk and dairy products, because the reliability of the result depends not only on the analytical method, but also on representative sampling (Commission Implementing Regulation (EU) 2023/2782). For AFM1, analytical methods used in official control should meet the relevant performance criteria, including appropriate limits of quantification, recovery and precision. In practice, screening methods such as ELISA may be used for rapid control, whereas chromatographic methods, for example HPLC-FLD or LC-MS/MS, are usually applied for confirmatory purposes.

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2.5. Feed Regulations Relevant to AFM1 in Milk

Although AFM1 is regulated in milk as a food contaminant, its main source is AFB1 in feed. Therefore, feed legislation is of key importance for prevention. Directive 2002/32/EC on undesirable substances in animal feed establishes maximum permitted levels of undesirable substances in products intended for animal feed, including AFB1. Under this legal framework, products intended for feed may contain undesirable substances only under the conditions laid down in the Directive, and feed exceeding the applicable maximum levels must not be used for animal nutrition (Directive 2002/32/EC). In the case of dairy animals, the prevention of AFB1 contamination in feed is particularly important, because AFB1 is metabolised by lactating cows and excreted into milk as AFM1. Therefore, feed materials such as maize, maize silage and compound feed should be controlled with particular attention to storage conditions, moisture content, fungal growth and the origin of feed ingredients. Feed hygiene is regulated by Regulation (EC) No 183/2005, which lays down requirements for feed hygiene, feed traceability, and the registration or approval of feed businesses. These provisions apply to all stages of feed production, storage, transport and use, including farms producing or using feed for dairy cows (Regulation (EC) No 183/2005).

2.6. Polish National Legal Framework

Polish national legislation does not establish a separate maximum level for AFM1 in milk. Instead, it provides the institutional and procedural framework for the application and enforcement of EU food and feed law.The Act of 25 August 2006 on Food and Nutrition Safety regulates issues related to food safety in Poland and supports the implementation of EU food law at the national level. It is relevant to the general protection of consumer health, supervision over food safety, and the functioning of competent authorities within the food chain (Act on Food and Nutrition Safety of 2006). The Act of 16 December 2005 on Products of Animal Origin regulates matters concerning products of animal origin, including milk and dairy products. It is relevant to the organisation of veterinary supervision over the production and placing on the market of products of animal origin (Act on Products of Animal Origin of 2005). The Act of 29 January 2004 on the Veterinary Inspection defines the tasks, organisation and operating principles of the Veterinary Inspection. This Act is particularly important for AFM1 control, because the Veterinary Inspection is a key competent authority responsible for the control of raw milk, dairy establishments and feed for food-producing animals (Act on the Veterinary Inspection of 2004). The Act of 22 July 2006 on Feed regulates the national legal framework for feed, including the application of EU feed law, supervision over feed production and the placing of feed on the market. It is relevant in the context of AFM1, because the prevention of milk contamination depends on the control of AFB1 in feed for dairy cows (Act on Feed of 2006).

From a practical point of view, the Polish legal framework for AFM1 in milk can be summarised as follows: Poland applies the EU maximum level of 0.050 µg/kg for AFM1 in raw milk, heat-treated milk and milk intended for the manufacture of milk-based products. No separate national limit has been established. The national system focuses on implementation, official control, sampling, laboratory testing and enforcement. The key preventive measure is

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the control of AFB1 in feed for dairy cows. This includes compliance with feed safety legislation, feed hygiene requirements, traceability, good storage practices and appropriate control of feed materials that may be susceptible to aflatoxin contamination, particularly maize-based feeds and silages. The most relevant competent authority for milk and feed in this context is the Veterinary Inspection, while the State Sanitary Inspection and other authorities may also be involved, depending on the stage of the food chain, the product category and the market context. This institutional division is discussed in the next section.

3. Competent authorities and official control system

3.1. General Organisation of the Control System

The official control system is divided among several competent authorities responsible for food safety, feed safety, veterinary supervision, public health, commercial quality and laboratory support. In the context of AFM1, the Veterinary Inspection plays the most important role, because AFM1 in milk is directly related both to milk as food of animal origin and to the safety of feed used in dairy cattle production. The Polish control system should therefore be interpreted as a chain-based system. The control of AFM1 in milk includes not only the testing of milk and dairy products, but also the prevention of aflatoxin B1 (AFB1) contamination in feed materials and compound feed.

3.2. Ministry of Agriculture and Rural Development

The Ministry of Agriculture and Rural Development is the main governmental authority responsible for agricultural production, the dairy sector, feed, food of animal origin and veterinary supervision. In practice, the Ministry is responsible for the national policy framework in these areas and supervises the Veterinary Inspection. Its role is mainly legislative, organisational and supervisory. It provides the political and administrative framework within which the Veterinary Inspection and other competent authorities operate.

3.3. Veterinary Inspection

The Veterinary Inspection is the key competent authority for the control of AFM1 in milk in Poland. It performs tasks related to animal health, feed safety and the safety of food of animal origin. Its responsibilities include supervision over products of animal origin, dairy establishments, feed production, the placing of feed on the market, and the use of feed in animal production. The tasks of the Veterinary Inspection include supervision over food of animal origin and over the production, placing on the market and use of feed and feed additives. The Veterinary Inspection is relevant at several stages of the dairy chain: dairy farms producing raw milk, the collection and processing of raw milk, dairy processing establishments, feed production and trade, the use of feed on farms, sampling and control activities, and enforcement measures in cases of non-compliance. The Veterinary Inspection also publishes information concerning food of animal origin, including lists of approved establishments and official control activities. In the area of feed, the Veterinary Inspection provides information on registers of feed businesses, feed monitoring and other feed-related

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control resources. The structure of the Veterinary Inspection is hierarchical and operates at central, regional, local and border levels.

3.4. Feed Control as a Preventive Element

Feed quality control is a central element in preventing the presence of AFM1 in milk. Since AFM1 in milk originates from AFB1 in contaminated feed, the control of feed materials, compound feed and on-farm feed storage facilities is essential. Particular attention should be paid to maize, maize silage and other feed materials that are susceptible to fungal contamination under improper storage conditions. The Veterinary Inspection is responsible for feed supervision, including registers of feed business operators and control activities related to feed monitoring. In the context of AFM1, this means that effective prevention should begin before milk production, through appropriate control of feed quality, storage conditions and the traceability of feed materials.

3.5. State Sanitary Inspection

The State Sanitary Inspection is responsible for public health protection and sanitary supervision. In the food chain, its tasks include the control of food production, transport, storage and sale, as well as supervision over mass catering establishments and collective nutrition facilities. Official information from sanitary inspection units describes these tasks as including the control of conditions of food production, transport, storage and sale, and supervision over collective catering. In the context of AFM1 in milk, the State Sanitary Inspection may be relevant mainly at the following stages: retail trade, gastronomy and catering, consumer products, food intended for vulnerable groups, communication on public health risks, and participation in food safety alert systems. The State Sanitary Inspection also plays an important role in the RASFF system. According to official information, the Chief Sanitary Inspector acts as the National Contact Point for the Rapid Alert System for Food and Feed in Poland. This is relevant in cases where AFM1 contamination in dairy products or AFB1 contamination in feed may require rapid exchange of information between authorities and EU Member States.

3.6. Agricultural and Food Quality Inspection

The Agricultural and Food Quality Inspection is not the main authority responsible for assessing the health risk associated with the presence of AFM1 in milk, but it plays an important complementary role in the control of commercial quality, labelling and authenticity of agri-food products. Its official tasks include supervision over the commercial quality of agri-food products in production and trade, including products exported abroad and imported from other countries. With regard to milk and dairy products, this authority may be competent in the area of commercial quality requirements, labelling control, verification of declared product characteristics, detection of irregularities and food adulteration, and control of storage and transport conditions for agri-food products. The tasks of the Inspection also include the control of storage and transport conditions for agri-food products. Although these activities are not directly related to the issue of AFM1 presence in milk, appropriate storage and

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transport conditions form part of the broader framework ensuring food quality and compliance with market regulations.

3.7. Official and Reference Laboratories

Laboratory testing is an important element of the official control system. In the case of AFM1, testing may include both screening and confirmatory methods, depending on the purpose of the control and the analytical context. Official samples may be analysed in laboratories operating within, or on behalf of, the competent authorities, including veterinary and sanitary laboratories. The National Veterinary Research Institute — National Research Institute in Puławy provides scientific and diagnostic support in the field of veterinary medicine. It is one of the key national expert institutions dealing with animal health, feed safety and food of animal origin.

3.8. Practical Scheme for AFM1 Control in Poland

AFM1 control in Poland can be summarised as a preventive and reactive system. At the preventive stage, the main emphasis is placed on feed safety. Feed materials and compound feed should comply with EU and national feed safety requirements, while dairy farms should apply good feed storage and feeding practices. The Veterinary Inspection is the most important authority in this chain. At the stage of milk production and processing, raw milk-producing holdings and dairy establishments are primarily subject to veterinary supervision. If AFM1 is detected above the permitted limit, the competent authority may require corrective actions, restrict or prevent the product from being placed on the market, investigate the source of contamination and verify the feed used on the farm. At the market stage, depending on the type of product, place of sale, consumer risk and the nature of the non-compliance, other authorities may also be involved, including the State Sanitary Inspection and the Agricultural and Food Quality Inspection.

4. National occurrence data and trends

4.1. Availability of National Occurrence Data on AFM1 in Milk

Publicly available national data on the occurrence of aflatoxin M1 (AFM1) in milk in Poland are limited. AFM1 is included in official control and monitoring activities, but the available summaries usually provide general information, such as the number of samples analysed and the number of non-compliant results, rather than full concentration distributions. Therefore, the available data are useful for determining whether non-compliances occurred, but they are less suitable for detailed statistical analysis of long-term trends, seasonal patterns or regional variability. In Poland, the most relevant sources of information on the occurrence of AFM1 in milk are: official monitoring and control data published by the Veterinary Inspection, notifications in the Rapid Alert System for Food and Feed (RASFF), and scientific publications.

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4.2. Official Monitoring Data

The Veterinary Inspection carries out official control and monitoring activities concerning residues and contaminants in food of animal origin. AFM1 has been included in the official monitoring system under the group “other substances and contaminants”. Publicly indexed files of the General Veterinary Inspectorate indicate that AFM1 was monitored in milk over several years. For example, monitoring documents of the General Veterinary Inspectorate from 2016 and 2017 report 40 analysed samples and no non-compliant results in each of these years. A similar entry is visible in indexed monitoring data from later years. A careful summary of the available official data indicates that, among 120 raw milk samples, all samples met the compliance criteria (General Veterinary Inspectorate 2016, 2017, 2020).

RASFF does not provide representative national occurrence data on AFM1 in milk in Poland. It is an incident-based rapid alert system; therefore, it can only be used as a supplementary source of information on specific food or feed safety events. The absence, or low number, of RASFF notifications does not mean that AFM1 is absent from the national dairy chain, and the presence of notifications does not allow the frequency of occurrence to be estimated.

4.3. Previous research and scientific evidence in Poland

Scientific data on the occurrence of AFM1 in milk and dairy products in Poland are relatively limited. The available studies indicate that AFM1 has been detected in Polish milk or dairy products, but usually at low concentrations and mostly below the maximum level established in the European Union. One of the earlier studies was conducted by Domagała et al. (1997), who analysed 187 milk samples collected in Poland in 1993/1994 using the ELISA method. AFM1 was detected in approximately 20% of farm milk samples and in 23.6% of bulk milk samples from dairies. The reported concentrations were low, and none of the analysed milk samples exceeded the EU permitted level of 50 ng/kg (Domagała et al. 1997). A subsequent Polish study focused on milk powder and infant formulas. Domagała (1998) analysed 50 samples of milk powder and infant formulas obtained from various domestic producers and production batches. AFM1 was detected in 10 samples at concentrations ranging from 3.1 to 8.6 ng/kg. The author also noted that some ELISA results in infant milk formulas containing starch may have been affected by false-positive reactions, which is important for the interpretation of historical data generated using immunoenzymatic methods (Domagała 1998).

The most recent data on the occurrence of aflatoxins in milk come from research conducted at the Institute of Agricultural and Food Biotechnology — National Research Institute in Warsaw (Bryła et al. 2026), financed by the Ministry of Agriculture and Rural Development. This study concerned the monitoring of AFM1 and AFM2 occurrence in Polish raw milk and selected milk powder samples. The study included 284 raw milk samples from Poland and 70 milk powder samples from Poland, other V4 countries and Iran. Raw milk was collected using two sampling models. The first model included 228 raw milk samples from bulk tanks from nine large, intensive dairy farms in western and central Poland, sampled repeatedly from January to December 2025. These farms kept cows indoors throughout the

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year and used TMR feeding systems based mainly on maize silage, grass or lucerne silage/haylage, concentrates and mineral supplements. The second model included 56 raw milk samples from 28 conventional family farms in eastern Poland, located in the Lubelskie, Mazowieckie and Podlaskie voivodeships, with samples collected in winter and summer. In the intensive production model, AFM1 was detected above the LOQ in only 4 out of 228 samples, corresponding to approximately 1.7% of samples. The detected concentrations were low and ranged from 0.004 to 0.019 µg/kg, and none of the samples exceeded the EU maximum level of 0.050 µg/kg. In the conventional family farm model, all 56 samples were below the LOQ for both AFM1 and AFM2. Due to the very small number of positive results, the findings should be interpreted descriptively and do not allow firm conclusions to be drawn regarding seasonal or regional patterns. Nevertheless, they indicate a generally favourable safety profile of the analysed Polish raw milk samples. The study also included 70 milk powder samples, including 35 samples from Poland, 25 samples from Czechia, Slovakia and Hungary (V4), and 10 samples from Iran. In milk powder purchased in Polish shops, AFM1 was detected in 2 out of 35 samples, at concentrations of 0.077 and 0.101 µg/kg. In milk powder samples from the other V4 countries, neither AFM1 nor AFM2 was detected above the LOQ. In the Iranian samples, AFM1 was detected in 2 samples and AFM2 in 5 samples, suggesting a higher detection frequency than in the analysed V4 samples. The results for milk powder should be interpreted separately from raw milk, because AFM1 is thermally stable and becomes concentrated during dehydration. Overall, the data confirm that the occurrence of AFM1 in Polish raw milk was low and sporadic, with no exceedances of the EU maximum level. However, because positive results were rare, the dataset should be regarded as evidence of a favourable safety profile rather than as a basis for detailed trend analysis.

5. Practical challenges

The main practical challenge in controlling aflatoxin M1 (AFM1) in milk is that contamination usually originates from aflatoxin B1 (AFB1) present in feed, rather than from the milk itself. After ingestion by dairy cows, AFB1 is metabolised and excreted into milk as AFM1. Therefore, effective prevention must focus primarily on feed quality, feed storage and feeding practices (Min et al. 2021; Zentai et al. 2023).

In Poland, particular attention should be paid to maize-based feed materials, maize silage, compound feed and imported feed components. Maize silage is widely used in dairy cattle nutrition, especially in intensive production systems. Its safety depends on harvest conditions, dry matter content, compaction, sealing, aerobic stability and proper management during feed-out. Damaged silage covers, oxygen access, high moisture content or visibly mouldy material may increase the risk of fungal growth and mycotoxin contamination.

Although Poland has traditionally been considered a lower-risk region compared with countries with warmer climates, climate change may increase the importance of aflatoxin monitoring. Higher temperatures, drought stress and changing moisture patterns may favour the development of aflatoxin-producing fungi in crops, including maize, and may increase the risk of AFB1 contamination in feed materials (Battilani et al. 2016; Van der Fels-Klerx et al. 2019).

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Another challenge is the use of feed materials of different geographical origins, including imported components. Feed originating from warmer regions may be associated with a higher risk of aflatoxin occurrence, especially if storage or transport conditions are inadequate. For this reason, traceability, supplier verification and targeted testing of higher-risk feed batches are important practical tools.

A further limitation is the restricted availability of detailed occurrence data on AFM1 in Polish milk. Official monitoring summaries usually report the number of samples and non-compliant results, but rarely provide full concentration distributions, regional information or seasonal breakdowns. This makes it difficult to assess low-level trends or identify early changes in risk patterns.

The available data suggest that the occurrence of AFM1 in Polish raw milk is low and sporadic. However, the small number of positive results also limits statistical interpretation. It is not possible to draw reliable conclusions on seasonality, regional differences or farm-level risk factors. Therefore, the low occurrence should not reduce vigilance, but rather support a risk-based monitoring approach focused on feed quality, silage management and changing climatic conditions.

For comparisons at the V4 level, harmonisation of analyses and reporting is also important. Differences in sampling design, matrix type, analytical methods, LOQ values and reporting formats may complicate comparisons between countries. Harmonised data collection and exchange would improve the ability to identify emerging risks across the region.

Overall, the main practical challenge in Poland is not the frequent exceedance of AFM1 limits in milk, but maintaining effective prevention in a changing risk environment. Control should continue to focus on feed safety, good agricultural and storage practices, targeted monitoring and rapid communication between farmers, feed operators, milk processors, laboratories and competent authorities.

6. Conclusions

Based on the available data from Poland, there are currently no clear indications for introducing additional national regulatory measures or for intensifying routine AFM1 testing in milk. The results indicate a very low occurrence of AFM1 in Polish raw milk, and the levels detected were well below the EU limit. From a practical point of view, the most appropriate approach appears to be the maintenance of basic official supervision and the concentration of preventive measures on situations of increased risk, particularly those related to feed quality, maize silage, imported feed components and unusual weather conditions favouring the growth of toxigenic fungi.

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