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Research Application Summary

Mitigation of mycotoxins contamination risks due to handling practices of indigenous chicken feeds in Western Kenya

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Abstract

Mycotoxins are prevalent in animal feeds and agricultural products. These toxins have been associated with morbidity and death in both livestock and humans. However, once fungi metabolizes these toxins in substrates, they are not eradicatedeasily. Therefore, avoiding contamination is the preferred method of mitigating mycotoxins in indigenous chicken feeds and cereals. In this study, feed types and handling practices that exacerbate mycotoxin contamination by smallholder farmers in farmer groups keeping indigenous chicken from three counties (Siaya, Busia and Kakamega) in Western Kenya were evaluated. Semi-structured questionnaires were used in gathering data on various types of feeds, handling practices and mycotoxins awareness from 180 farmers. Common feed types identified in Western Kenya, included maize (96%), sorghum (54%), cassava (42%), millet (40%), homemade rations (16%) while some used commercial feeds (44%). It was noted that 38% use rotten, insect-infested, unsorted and broken cereals and 62% use clean cereals as feeds. The handling practices identified included storage where 85% and 7% are using polypropylene and hermetic bags, respectively; 97% are using right drying methods; sorting where 21% are not sorting their gains; and preservatives where 29% are using no preservatives in storage. This study also assessed the feed safety and mycotoxin awareness levels of the indigenous chicken farmers. Feed safety awareness, were 44% of farmers were unaware of feed safety while 71% were aware of mycotoxins; however, 73% of the participants were unaware of dangers posed by mycotoxins contamination in feeds. The study also looked at feed and cereals handling and storage practices that could easily be adopted by farmers to mitigate mycotoxins contamination and hence reduce exposure. Information to farmers on mycotoxin and proper feed and cereals handling and storage practices should be an obligationon mycotoxin management.

Key words: Feed handling practices, indigenous chicken feeds, Mycotoxins, Mycotoxins awareness, western Kenya

Résumé

Les mycotoxines sont répandues dans les aliments pour animaux et les produits agricoles. Ces toxines ont été associées à la morbidité et à la mort du bétail et des humains. Cependant, une fois que les champignons métabolisent ces toxines dans des substrats, ils ne sont pas facilement éradiqués. Par conséquent, éviter la contamination est la méthode préférée pour atténuer les mycotoxines dans les aliments pour poulets et les céréales indigènes. Dans cette étude, les types d'aliments et les pratiques de manipulation qui aggravent la contamination par les mycotoxines par les petits exploitants dans les groupes d'agriculteurs gardant le poulet indigène de trois comtés (Siaya, Busia et Kakamega) dans l'ouest du Kenya ont été évalués. Des questionnaires semi-structurés ont été utilisés pour recueillir des données sur divers types d'aliments pour animaux, les pratiques de manipulation et la sensibilisation aux mycotoxines auprès de 180 agriculteurs. Les types d'aliments courants identifiés dans l'ouest du Kenya étaient le maïs (96%), le sorgho (54%), le manioc (42%), le mil (40%), les rations maison (16%) tandis que certains utilisaient des aliments commerciaux (44%). Il a été noté que 38% utilisent des céréales pourries, infestées d'insectes, non triées et cassées et 62% utilisent des céréales propres comme aliments. Les pratiques de manutention identifiées comprenaient le stockage où 85% et 7% utilisent respectivement du polypropylène et des sacs hermétiques; 97% utilisent les bonnes méthodes de séchage; tri où 21% ne trient pas leurs gains; et des conservateurs dont 29% n'utilisent aucun conservateur en stockage. Cette étude a également évalué la sécurité alimentaire et les niveaux de sensibilisation aux mycotoxines des éleveurs de poulets indigènes. Sensibilisation à la sécurité des aliments pour animaux, 44% des agriculteurs n'étaient pas au courant de la sécurité des aliments tandis que 71% étaient au courant des mycotoxines; Cependant, 73% des participants n'étaient pas conscients des dangers posés par la contamination par les mycotoxines dans les aliments pour animaux. L'étude a également examiné les pratiques de manipulation et de stockage des aliments pour animaux et des céréales qui pourraient facilement être adoptées par les agriculteurs pour atténuer la contamination par les mycotoxines et donc réduire l'exposition. L'information des agriculteurs sur les mycotoxines et les bonnes pratiques de manipulation et de stockage des aliments pour animaux et des céréales devrait être une obligation pour la gestion des mycotoxines.

Mots clés: pratiques de manipulation des aliments, aliments pour poulets indigènes, mycotoxines, sensibilisation aux mycotoxines, ouest du Kenya

Introduction

Smallholder indigenous chicken farmers depend largely on plant-based feeds in their production. However, indigenous chicken production is characterized by inadequate and poor quality feeds(Ochieng *et al.,* 2013), that may be associated with poor handling practices. The feeds may contain pathogenic fungal species that compromise quality by reducing nutrient content, dry matter, causing sour flavour and most significantly by mycotoxins production (Iheshiulor *et al.,* 2011). Some of these toxins for example, aflatoxins and fumonisins and fungi responsible for their production have been reported in cereals from several parts of Kenya including Western Kenya (Josephat *et al.,* 2015; Mutiga *et al.,* 2015).

Mycotoxins are low molecular weight secondary metabolites of saprophytic fungi that grow on substrates (Jeswal and Kumar, 2015). Mycotoxins production can take place when conducive conditions are in place for fungal growth in crops or crop products in the field, at harvest, during transportation, processing stages and storage (Iheshiulor *et al.,* 2011). The favourable conditions that govern formation of mycotoxins in feeds include temperature, humidity, nutrient status, hydrogen ion concentration among others (Atanda *et al.,* 2011).According to Wagacha and Muthomi (2008), the hot and humid climatic experienced in Eastern Africa favour mycotoxin production.

Among these mycotoxins, aflatoxin is the most important in public health and produced mainly by toxigenic strains of Aspergillus and other related species(Magnussen and Parsi, 2013). Aflatoxins exposure to human beings and animals is mainly through food and feed intake. In human, they cause chronic and acute toxicity, mutagenicity, teratogenicity, carcinogenicity, genotoxicity and immunosuppression (Kowalska *et al.,* 2017). According to studies in animals, poultry are known to be the most sensitive to aflatoxins B1 even to small amounts compared to other farm animals (Shuaib *et al.,* 2010). Although, poultry generally do not have a longer life span to allow for the development of cancer, disorders related to aflatoxin B1 negatively affect their health (Kana *et al*., 2013).

Mitigation of mycotoxins contamination can be at farm level to prevent feeds and cereals contamination. Feed and cereals handling practice help in prevention of mycotoxin accumulation in feeds and agricultural products. Other mitigation measures include mycotoxins awareness creation on sources of mycotoxins contamination and health risks associated with mycotoxin (Logrieco *et al.,* 2018). This studyexplores the extent to which indigenous chicken farmers are adopting proper chicken feeds handling practices and management practices that are known to mitigate mycotoxins challenge in chicken feeds in Western Kenya.

Material and methods

This study was conducted between February and March 2016, covering three counties in Western Kenyanamely; Busia (Teso South, Matoyosand Nambale sub-counties), Kakamega (Lurambi, Navakholo and Lugari sub-counties) and Siaya (Gem, Alego and Ugenya sub-counties). In each county, 60 indigenous chicken farmers were selected; in each of the 9sub-counties, 20 farmers were selected for this study. A three-stage sampling design was used in the study. First, purposively selecting Counties because they are within agro-ecological zones experiencing warm and humid weather conditions that promote mould growth and subsequent mycotoxins production; and high population of indigenous chicken (Kingori *et al.,* 2010; Okello and Kaaya, 2010). Secondly, three sub-counties were purposively selected based on the number of farmer groups involved in indigenous production and activity of the groups. Third, random sampling was used in selecting indigenous chicken farmers in the 4 selected farmer groups per sub-county with the guidance of county front-line extension officers. Only youth and women groups keeping indigenous were sampled for this survey for the reason chicken rearing is mainly done by women and youths. In each group, five farmers were randomly selected from each for an interview. Together with trained enumerators from University of Eldoret (undergraduate students) and county front-line extension officers, semi-structured questionnaires were used in obtaining information on indigenous chicken feeds. Information gathered included types of feeds; feed storage practices, sorting, preservation method, drying and farmers knowledge on mycotoxin.

Results

Majority of participants used plant-based feeds such as maize (96%), sorghum (54%), cassava (42%), millet (40%), homemade rations (16%) while some used commercial feeds (44%) in Western Kenya. Feed storage in all three counties was almost comparable, commonly used storage method across the three counties was polypropylene bags in the houses at 85% and hermetic bag at 7%, while only a few farmers used buckets, traditional granaries and polythene bags for storage. Majority (79%) of farmers sorted their produce prior to shelling, after which they were properly dried. The unwanted bad portions were usedin making local brews, as animal feeds with chicken, cattle and pigs having better shares. Most of the farmers who used plant-based feeds dried their farm produce/ feeds on either mat or polythene (97%) and 3% sundryplant-based feeds on a bare ground. Despite the various methods of preservation at the disposal of the farmers, 17% of the farmers used no treatments during the storage periods (Table 1). On mycotoxins awareness, more than half of interviewed proportion of the farmers (56 %) were aware of feed safety while 71% were aware of mycotoxins; however, 73% of the participants were unaware of dangers imposed by mycotoxins contamination in feeds (Table2).

Table 1. Feed handling practices used by 180 indigenous chicken farmers across the three counties of Western Kenya

Characteristics	Total	County		
		Siaya	Busia	Kakamega
Storage				
Polypropylene bag	88%	95%	78%	90%
Hermetic	7%	3%	11%	7%
Traditional granary	1%	-	2%	2%
Bucket	2%	2%	5%	-
Polythene bag	1%	-	2%	-
Modern store	1%	-	-	2%
No packaging	1%	-	2%	-
Grain health				
Clean	62%	58%	62%	68%
Rotten/broken/ insect infested	38%	42%	38%	32%
Drying				
Dry on a platform	97%	93%	100%	100
Dry on ground	3%	7%	-	-
Sorting				
Sorting	79%	88%	76%	73%
Unsorted	21%	12%	24%	27%
Preservation				
Actelic	48%	32%	47%	64%
Hermetic bag	6%	3%	9%	9%
Ash	8%	22%	2%	-
Actelic/ash	2%	5%	-	-
Hermetic bag/ actelic	1%	-	-	2%
Hermetic bag/ ash	1%	-	2%	-
Re-drying	1%	-	4%	-
Airtight bucket	1%	-	2%	2%
From the market (not accounted for)	17%	8%	15%	27%
No preservation	17%	29%	20%	2%

Table 2. Mycotoxins awareness among indigenous chicken farmers across three counties

		Counties		
Mycotoxins Awareness	Total (n=180)	Siaya (n=60)	Busia (n=60)	Kakamega (n=60)
Aware of feed safety	56%	58%	48%	69%
Unaware of feed safety	44%	42%	52%	40%
Aware of aflatoxins	71%	73%	70%	70%
Unaware of aflatoxins	29%	27%	30%	30%
Aware of dangers of mycotoxins	43%	47%	38%	43%
Unaware of dangers of mycotoxins	57%	53%	62%	57%
Aware of mycotoxins control methods	62%	63%	55%	67%
Unaware of mycotoxins control methods	38%	37%	45%	33%

Figure 1. Maize stored and shelved on the floor, in Alego-Usonga, Siaya County

Figure 2. Maize cobs on direct contact with soil in Ugenya, Siaya County

Figure 3. Insect infested maizefor intendeduse as chicken feeds in Ugenya, Siaya County

Discussion

Feed and cereals handling practices in Western Kenya expose them to mycotoxins contamination risk. Storage of feeds and cereals in polypropylene bags promote fungal growth due to increased moisture content and allowed air circulation (Hell and Mutegi, 2011). Fungi are aerobic micro-organisms, hence technologies in hermetic bags (Villers, 2017) and metal silos (Gitonga *et al.,* 2015) have been developed to increase carbon dioxide content in storage to limit the growth of A. flavus and subsequent aflatoxins production as well as curbing insect pest infestation. Pesticides application is also a very important factor in management of mycotoxigenic fungi (García and Heredia, 2006). However, 29% of farmers in Western Kenya, with the majority from Siaya County were not adding any preservatives to their grains during storage. Broken and damaged grains (size, colorations, odd shapes) are the source of most mycotoxin contamination (Johansson *et al.,* 2006).Sorting out these grains from an intact commodity can reduce 40%–80% of aflatoxin levels (Park, 2002). Pearson *et al.,* (2010) reported that sorting reduce 46% and 57%of aflatoxins and fumonisins contents in white corn, respectively. Therefore, sorting is crucial as a mitigation step in mycotoxin contamination of agricultural products.

Conclusion

There is need to sensitize indigenous chicken farmers from Western Kenya on safe chicken feeds and agricultural producthandling practices that would reduce risk of mycotoxin contamination.

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