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Awareness on mycotoxins among commercial poultry feed handlers in Morogoro

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SUMMARY

Successful control of the mycotoxins contamination in animal feeds needs to integrate variety of techniques which involve different stakeholders along the livestock management and feed handling chain. A study was conducted in three districts in Morogoro region, Tanzania, to assess the degree of awareness among poultry feed handlers including feed processors and retailers. A structured questionnaire was delivered to 186 respondents including 36 feed miller owners or managers, 54 feed miller workers and 96 feed retailers. The respondents were randomly sampled in Morogoro municipality, Morogoro rural, and Kilosa districts. It was found that 85% of the respondents in the three districts had basic knowledge on mycotoxins. Among the respondents with the basic knowledge on mycotoxins 52% had very unsatisfactory knowledge, 44% had unsatisfactory knowledge and 4% had satisfactory knowledge. The respondents from Morogoro municipality (urban area) had significantly higher awareness on mycotoxins as compared to the ones from Morogoro rural and Kilosa ($p < 0.05$). Managers and/or owners of feed millers were more aware on mycotoxins as compared to other miller workers. Feed miller workers and retailers conducted 82% and 72% respectively of activities potential for mycotoxins control during feed handling processes while managers conducted 56% of the activities. The findings of this study display the potential roles of commercial poultry feed handlers on occurrence and control of mycotoxin accumulation in feeds and subsequent exposure to poultry. Utilization of the obtained information on implementation of mycotoxin control programs will facilitate better allocation of the limited resources, by understanding what inputs are required by different groups of role players.

Keywords; feed handlers, Morogoro, mycotoxins, poultry feeds

INTRODUCTION

Mycotoxins are toxic secondary metabolites of some which grow in soils and plant materials. A number of the fungi are known to colonize food crops and produce the toxins. *Fusarium* spp and *Aspergillus* spp are the major fungi which grow in food and feed and produce mycotoxins (Sweeney and Dobson, 1998). The toxins cause health effects to exposed humans and animals and also significant economic effects along food chain (Darwish *et al.*, 2014). Among the health effects include cancers, retarded growth, immunological suppression and reproductive disorders (Zain 2011).

Mycotoxin occurrences in foods and feeds have been reported worldwide (Binder *et al.*, 2007, Rodrigues and Naehrer 2012). While different zone of the world are affected at different levels by different types of mycotoxins, tropical countries are affected more by aflatoxins and fumonisins (Lee and Ryu 2017). The occurrence of the toxins in the tropical developing countries is higher as compared to other parts of the world. Aflatoxin B₁ which is the most toxic and carcinogenic mycotoxin is reported in most countries in the region. Contamination of foods and animal feeds has been widely reported in Tanzania (Geary *et al.*, 2016, Kajuna *et al.*, 2013).

Exposure of humans and animals to mycotoxins in the country has been documented at different levels. Whereas aflatoxins and fumonisins are the mostly encountered mycotoxins in Tanzania, fatal cases associated with acute aflatoxicosis in humans have been reported for years (NEWS-DESK 2017, TFDA 2012).

Occurrence of mycotoxins in foods is associated with climate condition of a given area, agronomical practices and crops grown (Bernhoft *et al.*, 2012, Diao *et al.*, 2015, Mutegi *et al.*, 2012). Aflatoxins are known to occur more in high temperature, low rainfall areas while fusarium toxins are more experienced in cold and wet regions (Bernhoft *et al.*, 2012). In low income countries high rate of mycotoxin occurrence in foods is precipitated by low input agriculture practised (Mutegi *et al.*, 2009). There has been an importance to control mycotoxins in feeds in order to reduce the burden of diseases and improve productivity in livestock. Controlling mycotoxins has always been achieved by integrating different methods as there is no single bullet method that has indicated to have total control of the problem. Using different methods require efforts from different stakeholders involved in different ways of production, trading, regulation and consumption of agricultural products (Milicevic *et*

al., 2015). It is therefore of high importance for every part along the feed chain to play appropriate role in achieving that.

Among the factors that have been mentioned to be important for facilitating different stakeholders do their part well is having proper and adequate knowledge of the mycotoxin problem and how to handle it (Bhat *et al.*, 2010). Studies, especially in developing countries have indicated low level of awareness among common people, health and livestock officers on mycotoxins (Adekoya *et al.*, 2017, Strosnider *et al.*, 2006). Insufficient knowledge among different key players in the food chain is also thought to contribute to continued occurrence of the toxins in foods and feeds (Strosnider *et al.*, 2006). While different efforts on awareness building have been taken in different areas, maximum achievement of the efforts requires strategic planning. This should involve, among other things, considering who does what and hence what information is required by each stakeholder. One of the important areas for consideration is on the production and trading of commercial livestock feeds.

The mycotoxin contamination status in commercial livestock, especially poultry feeds has been widely studied. In most of the studies conducted on poultry feeds in Tanzania, more than half of the feeds are indicated to have mycotoxin contamination above the accepted levels (Kajuna *et al.*, 2013). The source of contamination is assumed to be both in field and postharvest. Therefore, controlling the toxins in the feeds should focus both on using clean raw materials as well as practicing proper handling and storage to reduce postharvest contamination. In order to achieve that, feed handlers along compounding and trading part of the feed chain should have a proper conduct depending on their different parts they play.

The important roles played by the handlers along the feed chain parts they are involved with include selecting raw feed materials, transportation, compounding and storage. Traders are also involved with transportation and storage of the feeds before they are delivered to farmers. These parts are very important in managing mycotoxins contamination in the feeds. Selecting suitable raw materials, even by visual analysis can have a good impact in avoiding contaminated products. Rotten grains including maize and peanuts are more often contaminated with mycotoxins (Karlovsy *et al.*, 2016). Feed processors also have to buy adequately dry products as high moistures facilitate fungal multiplication and formation of mycotoxins during handling of the

products. Ensuring suitably clean materials goes hand in hand with avoiding building conditions which facilitate mycotoxins production. Processors have therefore to ensure milling and mixing the feeds avoid further contamination with fungi and leave the feeds dry. Proper packaging is another important area. Tight packaging of fully dry materials, which ensure very limited air supply, will greatly discourage mycotoxin accumulation during storage (Lane and Woloshuk, 2017). Traders also need to ensure they buy feeds which are visually sound and with minimal signs of going bad. The feeds have to be kept in proper environment in the stores as well as ensuring minimum storage time before they are delivered to the farmers. In order for all these to be conducted successfully, feed processors and traders have to have proper knowledge on mycotoxins and how to control them. Planning education programs for them have to consider their average level of awareness they currently have in order to know the recipe to provide.

While most of the studies on awareness on mycotoxins have been focused on farmers and health and livestock officers, less is known about the same for persons who handle the feeds during processing and trading. Therefore, this study aimed at assessing the awareness among the group on mycotoxins, their effects and how to control them. The information provides an insight of how the levels of knowledge the people have influence the presence and accumulation of the toxins in poultry commercial feeds.

MATERIALS AND METHODS

Study area and selection of respondents

The study was conducted in Morogoro region. The region of located along the east-southern part of Tanzania, and characterised with diverse climatic conditions, with dry savanna areas on the north eastern parts and high rainfall areas in west-southern parts. The region is divided into seven districts and for this study three districts were involved; Morogoro urban, Morogoro rural and Kilosa. Respondents for the study were feed processors and traders, and were purposively selected to get representation from feed miller managers, workers and sellers.

In conducting the study, it appeared that sometimes owners are the activity overseers hence qualified also as managers. List of individuals who run

poultry feed processing and selling was obtained and poultry farmers. Identified respondents were approached, briefed on the study and its intention and requested to willingly consent. A total of 186 respondents from the three districts consented to participate in the study (Table 1). The biographic and educational characteristics of the respondents are also summarized in Table 2.

Table 1. Number of respondents indicating owners/managers, miller workers and retailers and their distribution in the three districts studied

	Owners / managers	Miller workers	Retailers
Morogoro Urban	21	22	41
Morogoro Rural	7	15	22
Kilosa	8	17	33

Table 2. Biographic and educational characteristics of the respondents

	Primary education	Secondary education	Post-secondary education
Morogoro urban			
Male	29	19	4
Female	11	14	7
Morogoro rural			
Male	17	15	2
Female	6	4	0
Kilosa			
Male	27	18	3
Female	5	4	1

Study design

The study was conducted in a cross sectional design where, a structured questionnaire was delivered in form of interview to the respondents. The questionnaire was developed to capture information on general awareness of a respondent on mycotoxins, awareness on effects of the mycotoxins and awareness on actions required during handling of feeds to reduce contamination and avoid further accumulation of the toxins. Questions were also included to capture the activities a given respondent is directly involved and assess tendency of sharing skills among people who work together. The first version of the developed questionnaire was tested to five respondents in Mzumbe ward, Mvomero district, in Morogoro. The questionnaire was found possible and understandable to respondents and

with the help of district and ward livestock officers average questionnaire delivery time was found to be 15 minutes. The questionnaire was developed in English language, then translated to Kiswahili and delivered in the same language.

Assessing the general knowledge of the respondents

The first part of the questionnaire was designed to capture the respondents' general awareness on mycotoxins. Gradual interviewing on what he/she knows about feeds going bad, growth of moulds was done. The respondent was asked if he/she is aware on effects of moulds that grow on feeds, about toxins that may be present in mouldy feeds and then if he/she knows the name of the toxins. Asking if the respondent knows about mycotoxins (yes/no) was avoided, as chances are most people respond "yes", even when they are not sure what is being asked about. Being aware about growth of moulds in grains was considered as basic awareness and was given a 10 mark score. The respondents were also asked about being aware of toxic substances produced by the moulds, different types of moulds (on appearance), name of the toxins (in Kiswahili), and crops that are commonly affected.

Assessing specific knowledge on effects and control of mycotoxins

The respondents with basic knowledge were taken to the second part of the questionnaire which queried on awareness on effects and management activities required to control the problem. The target was effects and control of mycotoxins in animals, more specific on poultry, but answers focusing on humans were also taken positive. This was because in some circumstances, respondents have information on mycotoxins in foods and their control in human, but not in livestock.

Involvement on activities significant for mycotoxin management

In a part of the questionnaire the respondents were asked to indicate different activities they are directly involved with, from sourcing raw feed materials to packaging and storage. The section was separated to customize activities for feed miller operators and retailers.

Assessing the tendency of sharing information among respondents

A question was set to ask on the source of information on mycotoxins, and if one was used to

Data analysis

The answers from the questionnaires were coded and recorded in Microsoft Excel computer program and analysed for descriptive and inferential statistics using the same program.

RESULTS

Mycotoxin general knowledge awareness

Among the respondents involved, 158 (85%) had at least basic knowledge on growth of moulds in some crops and could indicate that the moulds can be harmful to consumers. The remaining 28(15%) of the respondents were not aware on the harmful growth of moulds in grains and were considered lacking basic knowledge on mycotoxins (Figure 1). Among the 158 respondents with basic knowledge, 76 (48%) could at least indicate that the harmfulness of the fungi was associated to production of toxic substances in the grains. The respondents in this group could also specify effects of the toxins or ways to control them, but not both. Whereas this was still considered unsatisfactory information on mycotoxins, the other 82 participants (52%) with basic knowledge were not aware of the toxins and this was taken as very unsatisfactory knowledge. Six respondents, who were almost 4% of the respondents with basic knowledge, had what was considered as satisfactory knowledge on mycotoxins. These respondents could at least indicate one health effect of the toxins and one measure for control.

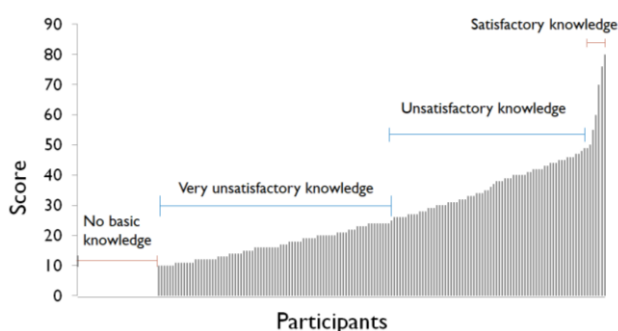


Figure 1. Distributions of the respondents along different knowledge categories depending on their scores

The level of knowledge was compared between the respondents on basis of geographical origin and specific roles of the individuals. More respondents from Morogoro urban (95%) had basic knowledge on mycotoxins as compared to Morogoro rural (73%) and Kilosa (79%) and the difference was

share any similar information with colleagues in the working place.

significant ($p < 0.05$) when tested by Chi-square at 95% confidence interval (**Figure 2**).

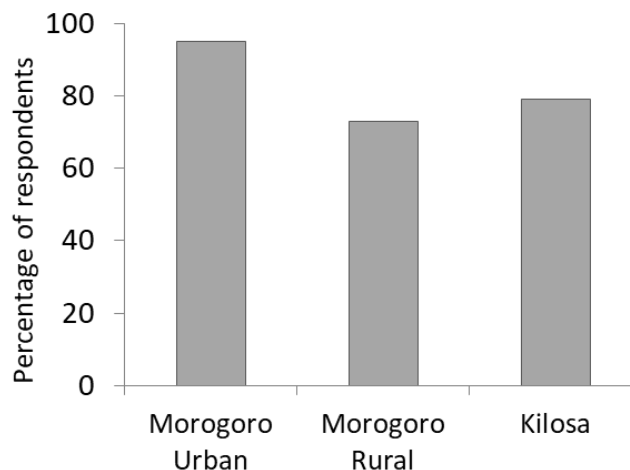


Figure 2. Percentage of respondents from the three districts with basic knowledge on mycotoxins

In general, more miller managers and owners were aware at different aspects on the mycotoxins as compared to other miller workers and feed retailers (Figure 3).

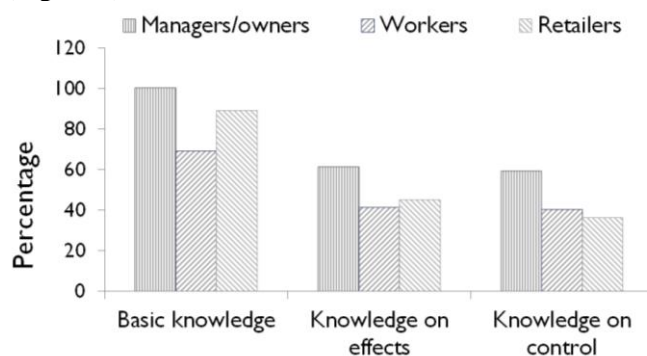


Figure 3. Percentage of managers and owners, workers and retailers with basic knowledge, knowledge on effects and knowledge on control of mycotoxins

Roles and information sharing among respondents

It was found that in average miller workers and retailers conducted 80% and 72% respectively of activities directly related to control of mycotoxins. The rates were significantly higher as compared to managers who were directly involved with 56% of the activities. Activities considered include inspecting quality of feed raw materials before being brought to the miller, packaging of the

materials for storage and ensuring adequate drying of the materials. Others include packing materials in the storage facilities, and monitoring clean, dry and sound storage environment.

Five percent of the respondents indicated that they make discussions with fellow workers to share information on matters related to feed (and raw materials) safety. The low sharing of information among respondents was reflected by poor correlation between managers the levels of knowledge of managers/owners and workers (Figure 4).

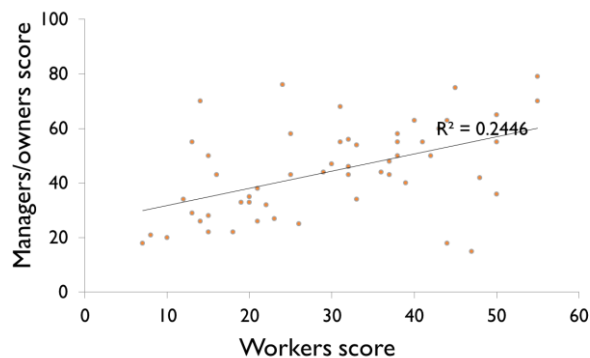


Figure 4. Scatter diagram indicating relation between scores for managers and owners against scores for other workers. The line of fit and regression coefficient is provided.

DISCUSSION

The findings of this study have once again indicated poor awareness and knowledge among key stakeholders of mycotoxin control in Tanzania. It has previously been indicated in another study that awareness on mycotoxins among heads of households in Kilosa Tanzania is low (Magembe *et al.*, 2016). Human and animal populations in Africa suffer adverse effects from mycotoxin exposure. Effective control of the problem is a subject to full participation of all key players in the food and feed value chain. Infections of most crops by mycotoxin producing fungi start in the field (Oliveira *et al.*, 2014) and continues during harvesting and postharvest times (Neme and Mohammed, 2017). That means inadequate awareness in farmers, processors, traders and consumers has a significant role in propagating mycotoxins and their exposures.

The low awareness on mycotoxins among public member in the country is contributed to different factors including socio-economic and psychological factors (Udomkun *et al.*, 2017). Naturally, most health effects due to mycotoxins are manifested chronically and come over time. Consequently,

many people miss the direct link between observed health implications and mycotoxin exposure, and as a result little attention is drawn. Current advances in mycotoxin research have generated timely information that has awakened the efforts for strategies to reduce problem (Lee and Ryu, 2015).

The current study indicates variation on level of awareness between geographical locations; being higher for participants in the urban area (Morogoro urban) as compared to the ones in the rural areas (Morogoro rural and Kilosa). This, among other factors may have been due to the higher accessibility of information tools in urban communities (Temba *et al.*, 2016). Better infrastructure and advanced information and communication technology have resulted into shifting trend of the sources of extension from hard written materials to digital sources (Mtega, 2012).

The results also indicate higher knowledge among owners and managers as compared to normal workers in animal feed value chain. The fact that awareness of people on mycotoxins is influenced by different factors including socio-economic factors (Udomkun *et al.*, 2017) can partially justify the findings. Occurrences of mycotoxins in feeds decline market acceptability and hence impair business flow (Mitchell *et al.*, 2016). Owners and managers play the first role in propagating their business and therefore may have more interest of learning issues like quality of what they produce. The study however indicate low tendency of information sharing among owners, managers, and other staff working together.

The findings from this study demonstrate the importance of strengthening awareness building initiative in efforts to fight the mycotoxin contamination in foods and feeds. Although farmers were not involved in this particular study, they are the first part of poultry feed chain who need to be educated on mycotoxins and how to avoid. Operators of grain storage points, grain mills and feed mills paly important part in dealing with postharvest safety measures of the feeds. Traders and poultry keepers also need to know about techniques of safe handling of the compounded and raw feeds in their points to protect poultry against mycotoxin exposure.

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