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Effect of Aflatoxin Contamination in Dairy Products and its Toxicity on Public Health: The Case of Ethiopian Dairy Sector: A review

Abera Fekata Dinkissa [1], Yonas Hailu[2]

[1]Department of Animal and Range science, Bule Hora University, Bule Hora, Ethiopia.
[2]School of Animal and range science, Haramaya University, Dire Dawa, Ethiopia.

[1]Corresponding author: fekataabera@gmail.com

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Abstract

The objective of this review paper was to assess the effect of aflatoxin contamination in dairy products and its toxicity on public health in the Ethiopian dairy sector. Feed contamination by mycotoxins causes serious issues with the economy, food security, and safety. The economic impact can take different forms, direct market costs of missed trade or lower profits resulting from the rejection of contaminated animal products, reduced productivity, animal death, particularly in more sensitive calves, and increased treatment. Nougcake, which is often used as feed for dairy animals, is a significant source of aflatoxin contamination in the peri-urban dairy value chain in Addis Ababa. Aflatoxin AFM is the primary hydroxylated AFB metabolite in milk from cows that were discharged after consuming a meal contaminated with AFB for 12 hours. Prolonged or chronic exposure to aflatoxins has a number of harmful effects on health, including potent carcinogens and may affect all organ systems, especially the liver and kidneys; that cause liver cancer, mutagenic, hepatotoxic, carcinogenic, and teratogenic effects on cattle. According to Brazilian law, the maximum permitted levels for liquid milk, milk powder, and cheese are 0.5mg/kg,5.0mg/kg and 2.5mg/kg, respectively. As a result, there is increased aflatoxin contamination in both humans and animals. In conclusion, as compared to other countries, the effect of aflatoxin contamination and its toxicity was higher in Ethiopian dairy sector. In order to regulate aflatoxin contamination all coordinated efforts from all relevant groups should work together and further intervention should be implemented via policymakers, dairy sectors, Government and non-Governmental organizations.

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Introduction

Aflatoxins (AF) are produced by the grain-storage *fungus Aspergillus* species as toxic secondary metabolites. Although the fungus can start producing secondary metabolites as early as 10 °C, the optimal temperature for growth is 25 °C with a minimum of 0.75 water activities. Along the entire value chain, beginning in the field and continuing through storage, transportation, and processing, aflatoxin contamination can happen (Alvarado *et al.*, 2017)

Among the typical foods impacted by aflatoxins are cereals (wheat and maize), groundnuts, cassava, oilseeds (cotton, sunflower), fruits, wines, legumes, milk, and milk products. The primary sources of human exposure to aflatoxins are groundnuts and maize, which are both frequently consumed and more prone to contamination. The most prevalent aflatoxin, AFB, which is the main cause of aflatoxicosis, can also induce genotoxicity, immunotoxicity, and both chronic and acute toxicity (Lizárraga-Paulín *et al.*, 2011; Wild, 2010). Four well-known and naturally occurring types of aflatoxins are aflatoxins AFB (1), AFB (2), AFG (1), and G2 (2). AFM (1) and AFM (2), which are excreted in milk and urine, respectively, by animals fed AFB (1) contaminated diets (Stronider *et al*., 2013).

The economics, food security, and safety are seriously in danger due to mycotoxin contamination of feed in the dairy business. Examples of how economic impact manifests itself include the direct market costs of lost trade or reduced revenues resulting from the rejection of contaminated animal products and decreased productivity, the death of the animal, particularly calves who are more sensitive, and the increased cost of treatment and mycotoxin mitigation (Gbashi *et al*., 2018). It is common knowledge that consuming tainted milk may be harmful in a variety of ways. It might include disease-causing foodborne bacteria (Gizachew *et al.*, 2016). Studies have shown the incorrect and unregulated use of antibiotics, the use of milk preservatives such as hydrogen peroxide and the prevalence of aflatoxins in milk, especially from the use of feed (Ahlberg *et al*., 2016).

Aflatoxin exposure that is chronic or protracted can have a range of harmful impacts on health, including Aflatoxin-containing compounds are potent carcinogens that can impair various organ systems, particularly the liver and kidneys, and have been linked to a variety of malignancies. Hepatitis B virus (HBV) infection significantly boosts aflatoxin's capacity to induce liver cancer in humans, according to research (WHO, 2018). Molds are kinds of fungi that are filamentous (fuzzy or dusty), and they usually show up in roughages and concentrates. The majority of the times, mycotoxins are connected to weather extremes that stress plants or dehydrate feedstocks, insect damage, careless storage practices, subpar feed quality, and inadequate feeding circumstances (Bhalla, 2017).

Aflatoxin is present in the feed that dairy cattle eat, and the toxins may affect the animals. Additionally, it can be obtained in milk that a cow produces after ingesting dangerous feed. Although the aflatoxin in milk differs chemically from the aflatoxin the cow ingested, it nevertheless exhibits some toxicity and carcinogenicity. Aflatoxin AFM (1) is the primary hydroxylated AFB(1) metabolite found in milk from cows who have been given a diet contaminated with AFB (1) and released after 12 hours of giving contaminated food (Yohannes *et al*., 2018). To this effect, knowing the effect of aflatoxin contamination may help researchers better understand the effect of aflatoxins in milk and their toxicity on the public health in the Ethiopian dairy sector. The current review was focused on the toxicity of aflatoxin on public health and its impact on dairy feed farmers, feed processors, feed traders, and consumers of dairy products. Finally, the review paper assessed the effect of aflatoxin contamination in dairy products and its toxicity on public health in the Ethiopian dairy sector.

Overview of Aflatoxins contamination in milk and dairy products

What is aflatoxin? Aflatoxin-producing fungi are produced by specific strains of Aspergillus *parasiticus* and *Aspergillus flavus*. Aflatoxin can be produced at 12-40 °C and with 3-18% moisture (Duncan, 2008). The words "mycotoxins" and "toxicum," both of which signify poison in Latin and Greek, respectively, are derived from mold. Mycotoxins are secondary metabolites of fungi that are generally low in molecular weight and harmful to both animals and humans. They are produced by a variety of fungi and have an impact on a wide range of agricultural goods meant for human consumption and animal feed. Food and feed safety is a critical concern due to the presence of mycotoxins, which have detrimental impacts on both human and animal health (Nogaim, 2014).

Fatal varieties of *Aspergillus parasiticus* and *Aspergillus flavus* routinely reside and colonize feed components and other nutritive commodities, producing aflatoxins, in addition to main crops including corn, groundnuts, rice, and maize (Mohammed *et al.*, 2016). G (1), G (2), B (1), and B (2) are the four main naturally occurring aflatoxins that are present in dairy and animal milk products. B1 is the most potent liver toxin and a class I human carcinogen (Wu *et al*., 2010).

The dosage, length of exposure, species, breed, diet, and nutritional state all have an impact on how they affect animals. Animals that are younger, like calves, are more sensitive. In addition to having effects that are mutagenic, hepatotoxic, carcinogenic, and teratogenic, it also impairs the immunological system of cattle (Aydin *et al*., 2008). Milk and milk products may become contaminated as a result of cows being fed feed that has aflatoxin contamination. A number of agricultural products, such as coffee, corn, cottonseed, groundnuts, rice, soybeans, sunflower seeds, and wheat are contaminated by groups of structurally similar polyketide mycotoxins known as aflatoxins (Bhat *et al*., 2010). However, noug cake (*Guizotia abyssinica*), a common source of aflatoxin contamination, is used as feed for dairy animals in Addis Ababa's peri-urban dairy value chain (Gizachew *et al.*, 2015).

Types of Aflatoxins in milk

Classes of extremely poisonous, mutagenic, and cancer-causing chemicals known as aflatoxins are produced by *Aspergillus flavus* and *Aspergillus parasiticus* (Vijayanandraj, 2014). The florescence characteristics of aflatoxin B(1), B2, G(1), and G(2) allow for identification. Aflatoxin G(1) and G(2) illuminate in the yellow spectrum under UV light, but aflatoxin B1 and B2 glow brightly in the blue spectrum. According to their level of toxicity, aflatoxins are ranked as follows: B1 > G1 > B2 > G2. The hues blue and green that these compounds glow when exposed to UV light are represented by the letters "B" and "G." The numbers 1 and 2 represent major and minor compounds, respectively (Yitbarek and Tamir, 2014).

Aflatoxin types B1, B2, G1, and G2 have been found in all major food crops, making them highly harmful for people and animals. However, contaminated nuts, grains, and goods made from them are the main source of human exposure. Aflatoxin M1 AFM (1), a result of the metabolism of aflatoxin B1 AFB, may also be present in milk in areas with significant aflatoxin exposure. As a result, people may be exposed to this aflatoxin through milk and milk products, including breast milk, especially in areas where the lowest quality grain is used for animal feed. Food crops may become infected both during harvest and afterwards (WHO, 2018).

Aflatoxins' physical and chemical characteristics in milk

Aflatoxins are a distinct class of highly oxygenated, heterocyclic chemicals with structurally similar to one another (Balina *et al*., 2018). Aflatoxins are crystals that range in color from white to pale yellow and glow when exposed to UV light. They are easily soluble in moderately polar solvents including chloroform, menthol, and dimethyl sulfoxide and only mildly soluble in water (10–20 g/ml). When there is oxygen present, UV radiation, or an extreme pH (3 or >10), they become unstable. Aflatoxin destruction occurs when the lactone ring opens in an alkaline environment; however this reaction is reversible in an acidic environment. Ammonization causes the lactone ring to open at a high temperature, which results in the irreversible decarboxylation of aflatoxins (Physical and chemical properties of aflatoxins). A few crucial physical and chemical characteristics of the main aflatoxins are shown in Table 1.

Table 1. Major aflatoxins' physical and chemical properties

Aflatoxin	Molecular	Molecular	Melting	Amax	UV absorption (e)	Fluorescence
Type	Formula	Weight	point (°C)	(nm)	ε (L. mol-1. Cm-1)	Emission (nm)
					x 10-3	
B1	$C_{17}H_{12}O_6$	312	268-269	223	25.6	425
				265	13.4	
				362	21.8	
B2	$C_{17}H_{14}O_6$	314	286-289	265	11.7	425
				363	23.4	
G1	$C_{17}H_{12}O_7$	328	244-246	243	11.5	450
				257	9.9	
				264	10	
				362	16.1	
G2	$C_{17}H_{14}O_7$	330	237-240	265	9.7	450
				363	21	

Source: (Kumar, 2018)

Effect of milk and milk products contaminated with aflatoxin

Aflatoxin (AFM1) in milk

Milk contains significant amounts of the main hepatic 4-hydroxylated metabolite known as "milk toxin," which is excreted by mammals that consume AFB1-contaminated diets. Dairy cow feed regimens typically require 5 to 6 kg of maize grain per cow per day. Dairy cows fed contaminated grain caused the milk to become significantly and widely contaminated with AFM (1) (Pietri and Piva, 2007).

The milk and dairy feeds at the Greater Addis Ababa milk shed are substantially polluted with aflatoxins, claim (Gizachew *et al*., 2015). Every milk and feed sample had amounts of aflatoxin. The majority (93%) of milk samples were beyond the 0.05 mg/L limit established by the EU. Additionally, the study area's dairy meals all contained more than 5 mg/kg of AFB (1). Mycotoxin contamination of milk and dairy products can occur directly when molds grow in milk or on dairy products as intentional additives or unintentional contamination, but it can also occur indirectly when lactating animals eat feed that contains AFB1 contamination, which will pass to the milk as a mycotoxin AFM(1) (Sengun *et al*., 2008).

The highest AFB1 concentration was found in the concentrate feed sample from Debre Zeit, which contained a blend of wheat bran, noug cake, and sweet pea husk, whereas the AFB(1) contamination in silage feed was the lowest (7 mg/kg). Analysis of individual feeds revealed relatively low levels of aflatoxin contamination in wheat bran, maize grain, and Brewer's dry yeast, however noug cakes in Ethiopia were severely infected with AFB1 (290-397) mg/kg (Gizachew *et al.,* 2015).

Table 2. Aflatoxin M1 in milk in Sub-Saharan Africa

Country	**Test**	**Sample**	**n**	**Positive**	**Above Eu**	**Max**	**Mean**	**Reference**
				(%)	Limit (%)	(g/Kg)	(g/Kg)	
Burundi	ELISA	Milk (fresh and	16	1		0.08	0.03	Udomkun *et al*. (2018)
		yoghurt)						
Ethiopia	ELISA	Milk	110	1	0.918	4.98	0.4	Gizachew *et al*. (2016)
	ELISA	Milk	96	1	0.664	4.63	0.29	
Kenya	ELISA	Milk	291		0.519	1.1	0.08	Lindahl *et al.* 2018
	ELISA	Milk	512	0.397	0.104	6.9	0.003	Senerwa *et al*. (2016)
	ELISA	Milk	200		0.55	1.67	0.128	Kirino *et al,* 2016
Nigeria	HPLC	Milk powder	125	0.536		0.46		Oyeyipo *et al.* (2017)
	HPLC	Raw milk	100	0.75	0.64	0.46	0.11	Oluwafemi *et al*. 2014
Sudan	Fluorometry	Raw milk	35	1	1	2.52	0.92	Ali *et al*. (2014)
		Imported	12			0.85	0.29	
		powder milk						
South	ELISA	Milk	30	1	0.906	0.15	0.09	Mulunda *et al*. (2016)
Africa		Milk	37	1	0.621	0.11	0.07	
Tanzania	HPLC	Milk	37	0.838	100	2.01		Mohammed *et al*. (2016)

Aflatoxin (AFM1) in Cheese

Humans consume a lot of dairy products, which are also polluted with aflatoxin M (1). For three separate reasons, AFM (1) can be found in cheese: Aflatoxin production by A. *flavus and A. parasiticus* growing on cheese (B1, B2, G1, and G2); (2) the presence of AF (B1, B2, G1, and G2) in raw milk due to AFB1 contamination of cow feed; and (3) the presence of these poisons in dried milk used to enrich milk used to manufacture cheese. The incidence of AFM in cheese has been the subject of study by numerous academics from various countries (Azizollahi *et al*., 2012).

Hayouni *et al*. (2008) reported that the factors that affect the production of Iranian white brine cheese. The amount of water removed and, thus, the amount of AFM (1) in the cheese curds, were both influenced by reneging temperature, press time, and saturated brine pH. On the other hand, the level of AFM (1) in Parmesan cheese increased gradually up to the ninth month of storage after commencing the ripening stage with a high level and then declining until around the fifth month. In contrast, during the 4.5 months of storage, the AFM (1) content of mozzarella minimally changed. These could be brought on by a number of factors, including exposure, proteolysis, and heat treatment.

Aflatoxins AFM (1) in Yogurt

Low pH during fermentation causes milk proteins such caseins to alter in structure, resulting in the formation of yoghurt coagulum. AFM (1) connection with this protein and the casein structural change that occurs during yoghurt production may be impacted, which could affect the toxin's adsorption in the precipitate. AFM (1) was more stable when kept refrigerated in yoghurts with a pH of 4.6 as opposed to 4.0. For yogurts with pHs of 4.6 and 4.0, respectively, the percentage loss of the original amount of AFM (1) in milk was calculated to be between 13 and 22% at the end of fermentation and between 16 and 34 percent by the end of storage (Govaris *et al*., 2002).

Aflatoxins (AFM1) in Other Milk Products

Many other milk products, such as cream, butter, and ice cream, may also include AFM1. Although not thoroughly investigated, the existence of AFM (1) in these products may have intriguing research implications. The levels of AFM (1) in dairy products such as butter, buttermilk, cream, and skim milk were studied. In contrast, skim milks had a mean AFM (1) level that was 3% higher than bulk-tank milk. During the production of butter, the protein membrane encasing the fat globules is damaged, and the serum phase is separated. Due to its chemical makeup and affinity for casein, AFM (1) binds to this region of the protein, which is why cream containing (Bakirci, 2001).

Acceptable Levels of Aflatoxin in milk and milk products

Risk reduction measures in Ethiopia should focus on minimizing aflatoxin contamination in per-urban dairy value chains given the level of aflatoxin contamination found in milk and feed (Gizachew *et al*., 2015). Certain nations have established allowed levels of aflatoxins in food in order to regulate and diminish or reduce the adverse effects of toxins. These ceilings are adjustable and determined by each country's economic and development status (Negash, 2018). Brazilian law adopts the MERCOSUL maximum allowable quantities of 0.5 mg/kg for liquid milk, 5.0 mg/kg for milk powder, and 2.5 mg/kg for cheese (Anvisa, 2011). A combined 20 ng/g in dairy feed and 0.5 g/kg or 50 ng/l in milk are permitted by the US Food and Drug Administration (FDA) (Negash, 2018). For the production of milk based foods, the European Union has set a maximum limit of 0.05 mg/kg for raw milk, heat-treated milk, and milk (Murphy *et al.*, 2006).

Aflatoxin toxicity on public health in Ethiopian dairy sector

The European Union (EU) has established tolerance limits for aflatoxin at 0.05 to 0.5 g/kg. The permitted levels of aflatoxin might also change depending on external factors like the climate. Tropical nations are permitted greater amounts of this toxin in comparison to chilly and mild regions (Negash, 2018). All milk samples included AFM1, and contamination levels ranged from 0.028 to 4.98 mg/L, Only 8.2% of the 110 milk samples had AFM(1)concentrations less or equal to 0.05 mg/L. Furthermore, 29 (26.3%) milk samples exhibited concentrations greater than 0.5 mg/L. AFB1 was present in all of the meal samples in amounts ranging from seven (7) to 419 mg/kg (Gizachew *et al*., 2015).

Effects of Aflatoxin toxicity on Human health

The presence of aflatoxins, especially when they make large admissions into milk-based meals, has a negative impact on human health because dairy products are extensively consumed by both adults and children (Sadik *et al*., 2022). Humans that are exposed to aflatoxin experience a variety of harmful health effects, including effects on the nervous system (abnormal behavior and depression), lower sperm count and increased infertility, low birth weight, and slowed growth in infants and children. Because they generally do not consume cow's milk, young children's usage of AFM1-contaminated milk, in particular, weakens their disease resistance mechanisms and contributes to stunted growth. As a result, their immunity is less effective at a young age (Gong, 2004).

According to WHO (2014) report, up to 30% of liver cancer cases worldwide each year may be caused by or contribute to aflatoxin. The economics, food security, and safety are seriously at danger due to mycotoxin contamination of feed in the dairy business. The economy is impacted by the direct costs of missing trade opportunities or lower earnings due to the rejection of contaminated animal products and decreased production, as well as the death of the animal, particularly calves who are more susceptible, and increased treatment costs (Gbashi *et al*., 2018). All participants in the dairy industry, including feed manufacturers, dairy farmers, milk processors, and consumers, are accountable for the regulation's effects on aflatoxin (Rodrigues *et al*., 2011).

AFB1 is metabolized in the liver or consumed in tainted milk and dairy products are the two main ways that AFM1 poisoning manifests itself (Neal *et al*., 1998). It is thought that the aflatoxin AFM (1) found in milk and milk products causes certain hygiene dangers to people's health (Kocabas, 2003). Aflatoxin exposure can have a deleterious effect on human health in four different ways: acute poisoning, stunting, immunological suppression, and a higher risk of liver cancer. Aflatoxin AFB (1), a human carcinogen, is used to calculate the population's risk of developing cancer because it has a higher carcinogenic potency in developing countries. Due to the negative effects, AFM (1) control limits in milk are 0.05 g/kg in Europe and 0.5 g/kg in the USA (Chaney, 2015).

Effect of Aflatoxin Toxicity Livestock Health

Aflatoxin B1 in animal feed affects the metabolism of carbohydrates, lipids, and nucleic acids, among other things, to produce major issues in the genital, digestive, and respiratory tracts. The effects of aflatoxin B1 on livestock vary with concentration, contact time, strain, and diet (Deshpande, 2002).

Acute toxicosis and mortality are caused by very high levels of aflatoxins, however chronic consumption of lower levels of aflatoxins can injure the liver, cause digestive problems, and affect appetite, reproductive function, growth, average daily gain, body weight, and output in cattle (Khlangwiset *et al*., 2011). Because young calves in Ethiopia continue to consume their mothers' milk until weaning, before their rumens have a chance to develop, they are more vulnerable to the harmful effects of aflatoxins (Gizachew *et al*., 2015).

Mycotoxins, of which aflatoxins make up a higher fraction than the others, are reportedly present in about 20% of the foods produced annually around the world, according to studies by the Food and Agriculture Organization (FAO). The frequency of cancer and animal diseases on farms, the weakened immune systems of livestock, and a decline in milk production and productivity are just a few examples of milk in the dairy industry. Toxins in livestock feed and commodities derived from animals, such as milk, must be avoided and eliminated in order to limit substantial financial losses and public health issues (Milicevi *et al*., 2010).

Aflatoxin incidence is higher in winter and fall than it is in summer and spring since farmers had to use stockpiled forages during this adverse season. Seasonal factors might also increase the level of aflatoxin in milk (Panariti 2001; Creppy, 2002). Dairy cattle fed feed with aflatoxins are the main source of milk contaminated with aflatoxins. As a result, it is possible to decrease aflatoxin contamination by indirectly regulating the cleanliness of dairy cattle feed (Ellis *et al*., 1990; Degirmencioglu *et al*., 2005).

Regulation of Aflatoxin Levels in Milk and Milk Products

The current permissible levels of aflatoxins in milk and milk-based products depend on a number of factors. The primary factors of acceptable aflatoxin levels include elements such as the nation's economic situation and weather patterns (Yitbarek *et al*., 2013). There are accepted criteria for the permissible levels of aflatoxin in milk and milk products in a number of nations in order to reduce and manage the harmful characteristics of the substance. The Food and Drug Administration (FDA) in the US has authorized an overall quantity of 0.5g/kg, or 50ng/l in milk, and 20ng/g in dairy cattle feed (Ellis *et al*., 1990).

Compound dairy feed, brewer's yeast, silage, maize, and pea hull were all found to contain 100% AFB1, surpassing the regulatory limit set by the EU and EAC of 5 g/kg in all of the samples. On a regional level, the East Africa Community (EAC) set regulatory restrictions for AFB1 at 5 g/kg in dairy feed and for AFM1 at 0.5 g/kg in milk. Additionally, through the Rwanda Standards Board (RSB), Rwanda has established a legal maximum of 5 g/kg for AFB1 in cattle feed additives (Nishimwe *et al*., 2019). The majority of nations have enacted various regulations for aflatoxin levels in food and/or feed in an effort to prevent exposure to the substance because of the harmful impact it has on both human and animal health (Van *et al.*, 2013). AFB(1) has a maximum concentration of 8 mg/kg in food that has undergone physical or other processing prior to being consumed by humans, and a direct human intake limit of 2 mg/kg. There are no laws governing aflatoxin or another mycotoxin in Ethiopia. This makes it more likely that both humans and animals will become contaminated with aflatoxin (Dereje *et al*., 2012).

In comparison to past periods, a large portion of the country now regulates aflatoxins. The lower aflatoxin restrictions had a significant impact on Ethiopia's capacity to export goods, as well as other developing African nations. In a developing nation where food supplies are already scarce, legal restrictions could lead to food shortages and astronomical prices. Grain for animal feed is allowed in the US at 300 ppb of aflatoxin (Wolde, 2017).

According to Dereje *et al*. (2012), the FAO MTL, 16.6% of the groundnut samples evaluated exceeded the 30-ppb standard in Northern Ethiopia. The European Union (EU) MTIL determined that 83.9% of the groundnut samples were dangerous for direct human consumption, and 46.6% were unfit for export to EU countries. The average concentration of aflatoxin in all samples was 10 times greater than what was allowed. Similar to this, Habtamu *et al*. (2001) discovered that numerous African countries' main foods for people contain 10 to 30 times the recommended maximum.

International trade is significantly impacted by the regulation of aflatoxin, especially to developing nations like Ethiopia. Aflatoxin poisoning prevents poor nations, which produce 95% of the world's groundnuts, from selling large quantities of groundnuts on the international market. Due to the country's reliance on exports, Ethiopia's high prevalence of commodities contamination has a substantial influence on those (FAO, 2002).

Control and Prevention of Aflatoxin in Animal Feed and Milk

A number of methods can be used to reduce aflatoxins, which are present naturally in diet and feed. Currently, GAP (Good Agricultural Practice) or HACCP is used to establish improved agricultural management methods, faster drying, and controlled storage (Hazard Analysis: Critical Control Point) (IARC, 2002). Aflatoxin contamination of milk-based products or aflatoxicosis can only be prevented by giving dairy animals diets free of the toxin, which can be enhanced by utilizing good agricultural techniques in dairy production farms and processing schemes as well as preventing fungus development in feed. Therefore, continual efforts as well as a system of systematic evaluation and analysis are required (Dashti *et al*., 2009).

Avoiding mycotoxins in the field is the best method of control, which is made possible by proper crop rotation and the timely application of fungicides. Certain defenses against specific toxin types and groupings are needed when poisons are present (Binder, 2007). Prandini *et al*. (2009) claim that in order to control the presence of AFM (1) in foods, it is necessary to prevent fungal growth and AFB (1) formation in agricultural commodities intended for animal use in order to reduce AFB (1) contamination of dairy cattle feeds.

In order to assess the risk of AFM (1) contamination in milk and milk products, it is critical to examine the risk factors for AFB (1) contamination in corn, one of the most contaminated feedstuffs. The key variables that influence the production of aflatoxins during the production of corn silage include harvest time, fertilization, irrigation, insect management, silage moisture, and storage practices. To reduce the possibility of contamination, grains must be harvested with the lowest moisture content feasible, near to or below 14% and must be kept at a mass to homogeneous moisture level. A number of factors need to be carefully controlled, such as grain cleaning techniques, conservation temperature, and mechanical damage to the kernel (Van, 2013).

Direct Methods for Milk Aflatoxin Reduction

Utilizing biological, chemical, and contaminant absorbents can also result in a direct reduction of aflatoxin in milk and its byproducts, the employment of biological, chemical, and contaminant absorbents is also advantageous for the direct reduction of aflatoxin in milk and its products (Bovo *et al*., 2013). Hydrogen peroxide is the finest chemical compound for decreasing aflatoxin and is used to preserve dairy-based products (Fallah, 2010). For adequate results in removing aflatoxin from milk, it is preferable to use a mixture of chemicals, such as lacto peroxidase, riboflavin, and hydrogen peroxide in addition to heat treatment. AFM (1) in milk is additionally typically neutralized with potassium sulfite (Bovo *et al*., 2013; Fallah, 2010).

Conclusion

The objective of this review paper was to assess the effect of aflatoxin contamination in dairy products and its toxicity on public health in Ethiopian dairy sector. Aflatoxin exposure that is chronic or protracted can have a range of harmful effects on health, including: Aflatoxin-containing compounds are potent carcinogens that can impair various organ systems, particularly the liver and kidneys, and have been linked to a variety of malignancies. Humans have been reported to develop cancer after exposure to AFB (1), and this exposure significantly increases the risk of liver cancer. Along with weakening their immune systems, it has mutagenic, hepatotoxic, carcinogenic, and teratogenic effects on cattle. There are no laws governing aflatoxin or another mycotoxin in Ethiopia. As a result, there is increased aflatoxin contamination in both humans and animals. In conclusion, Ethiopia's dairy sectors are exceptionally contaminated with aflatoxin compared to other countries, and this contamination is bad for both animal and human health. In order to reduce the effect of aflatoxin contamination in dairy products and its toxicity on public health, policy makers, and Ethiopian dairy sectors, the government, non-governmental organizations, and coordinated efforts from all relevant Organizations should pay particular attention.

Conflict of Interest

The authors declare that they are clear of any financial or personal disputes that might affect their paper.

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