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RESEARCH ARTICLE

DETERMINATION OF AFLATOXIN LEVELS IN MAIZE SAMPLES IMPORTED FROM NEIGHBORING COUNTRIES UGANDA AND KENYA

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Abstract

Aflatoxins are toxic secondary metabolites produced by *Aspergillus flavus* and *Aspergillus parasiticus* that pose severe health and economic threats. This study investigated aflatoxin contamination in maize samples imported into South Sudan from Kenya and Uganda. A total of 23 maize samples were collected and analyzed at the South Sudan National Bureau of Standards (SSNBS) for the year 2024. Results revealed aflatoxin presence in 91% of samples, with concentrations ranging from 0.01 ppb to 42 ppb. Uganda recorded the highest contamination, with one sample exceeding international safety limits (42 ppb). South Sudan and Kenya samples remained within permissible limits set by FDA, WHO, and the East African Standards (EAS). These findings highlight the urgent need for strict border inspections, farmer education, and regional harmonization of food safety measures to minimize aflatoxin exposure.

Introduction: -

Background of the study

Aflatoxins are a group of highly toxic, mutagenic, and carcinogenic mycotoxins produced mainly by Aspergillus flavus and Aspergillus parasiticus under warm and humid conditions [1]. They contaminate staple foods such as maize, groundnuts, and animal feeds. Chronic exposure is associated with hepatocellular carcinoma, immunosuppression, stunted growth in children, and reduced livestock productivity [1]. Some fungal pathogens are known to produce mycotoxins both in pre-harvest and post-harvest periods in maize. The filamentous moulds most commonly found in stored cereal grains and oil seeds are Aspergillus, Penicillium and Fusarium species. These fungi can cause food spoilage, biodeterioration and are capable of producing different mycotoxins. Aspergillus species are 2 the most common toxigenic species in various grains, legumes, oil seeds and foods and feeds [2];[3];[4]. Aspergillus flavus Link and Aspergillus parasiticus Speare are the predominant fungi responsible for aflatoxin contamination of crops prior to harvest and during storage ([5]; [6]. The other species of Aspergillus such as A. ochraceus, A. niger and A. carbonarius isolated from cereal and cereal-based feed produce ochratoxin A in warmer and tropical parts of the world [1]. Agricultural soil serves as the main reservoir of inocula for these fungi [7]. The fungus, A. flavus belongs to the Genus Aspergillus, Subdivision Deutoromycotina [8]. The fungus grows on

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a wide range of agricutural commodities that include peanuts, dried corn, millet, tree nuts and cotton seeds [9]and leftover foods such as rice. It is also found in water damaged carpets. This fungus is one among several species known to produce aflatoxins [10].In South Sudan, maize is widely consumed as a staple food, but much of it is imported from neighboring countries where storage, transport, and handling practices are substandard. Weak regulatory enforcement increases the risk of contaminated maize entering the food supply chain. Imported maize often bypasses stringent safety inspections, increasing the risk of aflatoxin exposure. Currently, there is no published research on aflatoxin levels in maize marketed in South Sudan, creating a gap in food safety monitoring and public health policy.The main objective of this subject was General Objective: to determine aflatoxin levels in maize imported from neighboring countries in order to measure aflatoxin concentrations in maize samples from South Sudan, Kenya, and Uganda, to compare detected levels against international safety standards (FDA, WHO, and EAS) and to assess whether imported maize poses a public health and economic risk.

Findings from this study has provided evidence-based guidance for policymakers, regulatory bodies, and farmers. Updated information on aflatoxin contamination will help strengthen regulations, protect consumer health, and safeguard South Sudan’s economy.

Material and Method: -

Study Area

The study was conducted at the South Sudan National Bureau of Standards (SSNBS)in chemistry laboratory in Juba County, Central Equatoria State, South Sudan. Juba City is situated at latitude 4°51′5.94″N and longitude 31°34′56.89″E, at an elevation of 518 m above sea level, covering approximately 1,699 km². The region has a tropical climate with a wet season from April to October and a dry season from November to March.

Research Design: -

The method of study was conducted using primary data prepared in the department laboratory at South Sudan Bureauof Standards.

Sample collection, preparation and experimental procedures

The Sample were collected from a total of 23 maize samples, 3 samples from South Sudan,5 samples from Kenya and 15 samples from Uganda.

Aflatoxin analysis

Sample preparation and analysis

Sample preparation and aflatoxin analysis were done in the Department laboratory at South Sudan Bureauof Standards of. The whole sample of maize for mycological analysis from each Country was ground with a Romer mill (Union, IL, USA). A 50g sub- sample of the milled maize flour was mixed with 250 ml of methanol/water (60: 40, v/v) and the mixture vortexed at high speed for 3 minutes. This was followed by centrifugation at 3600 rpm for 10 minutes and the recovery of 125ml of the supernatant filtered (Whatman filter paper, No.1) into a separatory funnel. The mixture was then defatted by adding 30 ml saturated sodium chloride solution and 50 ml of hexane on a vortex for 30 seconds and left to separate. The methanol content of the extract was diluted to 10% using phosphate buffer solution (PBS) then analysis by Enzyme Linked Immunosobent Assay (ELISA).

Data analysis

Microsoft Office tools were used for statistical analysis. Results were compared against safety limits set by FDA, WHO, and EAS.

Results: -

Detection of Aflatoxin and level limits

Total Aflatoxin and level limit summary for South Sudan

Table.1: Shows Aflatoxin case and level limitsummary for South Sudan

Sample	*Test Results*	*Aflatoxins Concentration in ((Ppb)*	*The level limit set by FDA, WHO, EAS, and KEB (Ppb)*
SS1	Detected	5.1	10
SS2	Detected	7.5	10

SS3	Detected	1.14	10
Mean		**4.58**	

Where:
awl = Aflatoxin within the limit**andppb = Parts per billion**

From the 3 samples collected from the South Sudan, aflatoxin wasdetected in three samples with highest concentration of 7.5ppb (SS2). While the lowest aflatoxin level was 1.14 ppb in (SS3) (Table 1.). The mean of Total aflatoxin concentration was 4.58

Total Aflatoxin level and level limit summary for Kenya
Table 2: shows total Aflatoxin level and level limit summary for Kenya

Sample	*Test Results*	*Aflatoxins Concentration in (ppb)*	*The level limit set by FDA, WHO, EAS, and KEB (ppb)*
K1	Detected	2.2	10
K2	Detected	0.7	10
K3	Detected	1.0	10
K4	Detected	2.0	10
K5	Detected	6.3	10
Mean		**2.44**	

Where: *ppb = Parts per billion

From the 5 samples collected from the Kenya, aflatoxin wasdetected in five samples with highest concentration of 6.3 ppb (K5). While the lowest aflatoxin level was 0.7 ppb in (K2) (Table 2.). The mean of the Total aflatoxin's concentration was 2.44

Aflatoxin and level limit case summary for Uganda
Table 3: Shows aflatoxin and level limit case summary for Uganda

SAMPLE	*TEST RESULTS*	*AFLATOXINS CONCENTRATION IN ((PPB)*	*THE LEVEL LIMIT SET BY FDA, WHO, EAS, AND KEB (PPB)*
UG1	Detected	3.9	10
UG2	Not Detected	0	10
UG3	Detected	0.01	10
UG4	Not Detected	0	10
UG5	Detected	0.14	10
UG6	Detected	6.6	10
UG7	Detected	9.9	10
UG8	Detected	7.8	10
UG9	Detected	1.3	10
UG10	Detected	42.5	10
UG11	Detected	8.5	10
UG12	Detected	7.5	10
UG13	Not Detected	0	10
UG14	Detected	8.2	10
UG15	Detected	1.3	10
MEAN		**6.51**	10

Where: *ppb = Parts per billion

Out the 15 samples collected from the Uganda, aflatoxin wasdetected in 12 samples with highest concentration of 42 ppb (Ug10), which was the only sample beyond the level limit. While the lowest aflatoxin level was 0.01 ppb in (Ug5) (Table 3). The mean of the total aflatoxin's concentrations mean was 6.51.

Discussion: -

From the results it is evident that Uganda Country had the highest aflatoxin level of 42.5 ppb of one sample which above the limit as compared to the other 2 countries. This was contributed by the highest number of samples which tested positiveof aflatoxin (12 samples). Kenya had the second with aflatoxin level of 6.3 ppb, South Sudan country was 3rd with mean level 4.58 ppb. This study was in line with similar study carried out by Kering K. *et., al*. (2014) in Kenya.in their study, the results indicated that out of the10 samples analyzed, 2 samples had > 50 ppb, 5 had >20 ppb and the remaining 3 had < 20ppb of aflatoxin (AF) levels. The highest AF levels were recorded in samples from Kibwezi (60.35 ppb) and Kathiani (50 ppb) Divisions while the lowest wasfound in Kangundo (0ppb).

Conclusion: -

The concentration of aflatoxin ranged from 0.01 ppb. Out of 23 collected samples in the whole three Countries samples. 21 samples tested positive which form 91% of total samples.Two samples tested negative, which form 9% of the total samples. One sample from Uganda was above the limit which is a risk not only to our health but also to our economy

Recommendation:-

Based on the research findings,

1.Capacity building: train customs officers and food safety officers on aflatoxin detection and sampling protocols.
2. Farmers to sort their maize properly before storage to avoid aflatoxin contamination.
3.Strengthen border inspection: enforce strict testing and documentation for maize imports at border.
4.Regional collaboration: work with neighboring countries to implement harmonized aflatoxin control strategies across the supply chain.
5.Training for technology dissemination, have a laboratory in each border to monitor.

Conflict of interest

I Declare that there is no any financial interest or any conflict of interest exists

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