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Research Article

The Assessment of Aflatoxins Degradation Potential of Selected Indigenous Medicinal Plants

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Abstract
Aflatoxin is a secondarily metabolized toxin, produced mostly by fungi such as Aspergillus flavus and Aspergillus parasiticus. Aflatoxin is often present in wet/humid areas such as Pakistan, Brazil, India, South Africa, West Africa, United States of America (US) and Korea countries. Aflatoxins are common found in agriculture commodities such as rice, maize, barley and wheat etc. Aflatoxins have harmful effects on the human body e.g. liver cancer, Stunning, mycotoxicoses, acute aflatoxicosis and chronic aflatoxicosis. So, the several countries established permissible level for aflatoxins. The permissible level of aflatoxins in different food commodities is 0.025 to 100 ppb. Aflatoxins degraded via physical, chemical and microbiological method. The potential effect and functional properties degradation of indigenous medicinal plants review against the aflatoxin.

Keywords: Aaflatoxins; Degradation method; Regulation; Medicinal plant.

Introduction
Aflatoxins are the deadliest mycotoxins produced by Aspergillus flavus, Aspergillus nomius and Aspergillus parasiticus. Biotransformation products of aflatoxins have been reported mainly in milk and milk products. The main categories of aflatoxins include aflatoxin B1 (AFB1), aflatoxin B2 (AFB2), aflatoxin G1 (AFG1), aflatoxin G2 (AFG2). There are > 20 types of aflatoxin molecules. Inside the liver of animals, aflatoxin M1 (AFM1) and aflatoxin M2 (AFM2) are produced by the breakdown of AFB1 and AFB2 (Ismail *et al.*, 2018). Aflatoxins are common in sub-Saharan Africa and southern Asia. Environmental stress, incomplete crop drying and warm, humid conditions, lack of awareness among farmers, and inappropriate storage conditions are conducive to fungal growth on crops and toxin production during storage (Vijayanandraj *et al.*, 2014). exposure to aflatoxins can result in acute and chronic toxicity to humans and animals, and this condition is commonly known as aflatoxicosis. The toxicity of aflatoxins is about 68 times higher than that of arsenic. Aflatoxins have been reported to have carcinogenic, teratogenic, genotoxic, embryotoxic and immunotoxic health effects in humans and animals. The natural mixture of aflatoxins, i.e. AFB1 + AFB2 + AFG1 + AFG2 and AFB1 alone, are both classified as category 1 human carcinogens by the International Agency for Research on Cancer (IARC). Aflatoxins are the

main cause of hepatocellular carcinoma (HCC), which is the ninth most common type of cancer in women and the seventh most common type of cancer in men. Fetuses and newborns are exposed to aflatoxins through their mother's diet and through breast milk, respectively (Ismail *et al.*, 2018). The word mycotoxin is a combination of two words, i.e. mykes, the geek word for fungus, and toxicum, the Latin word for poison. Mycotoxins are secondary metabolites produced by fungi, especially Aspergillus, Penicillium, Alternaria and Fusarium mycotoxins were first recognized when Turkey X disease was reported in England. More than 0.1 million turkeys died from eating food contaminated with fungi (Balina *et al.*, 2018). According to the Food and Agriculture Organization of the United Nations, more than 25% of crops produced worldwide may be contaminated with mycotoxins during the growth or storage phase. Mycotoxin production can occur in agricultural commodities during pre-harvest or post-harvest phases (Balina *et al.*, 2018). Factors involved in mycotoxin production are nutrient availability, moisture level, pH, temperature, strain, and the presence or absence of specific gases. Mycotoxins are reported to have allergenic, teratogenic, carcinogenic or mutagenic effects. The best known types of mycotoxins include aflatoxins (AF), (AFB1, AFB2, AFG1 and AFG2), ochratoxin A (OTA), patulin (PAT), fumonisins (FB), (FB1, FB2), zearalenone (ZEA) and trichothecenes, (deoxynivalenol, T-2 Toxin, HT-2 Toxin). Chronic aflatoxicosis includes teratogenic effects, mutagenic effects and carcinogenic effects. It has also been reported that chronic exposure to aflatoxins can impair normal immune system function by reducing the number and function of T cells or by reducing phagocytic activity and function. It has reported that sub chronic toxicity from aflatoxin exposure can lead to a slower growth rate with or without the development of overt aflatoxin disease. Aflatoxins have also been reported to interfere with growth rates in infants and children. Aflatoxins also lead to nutritional deficiencies by modifying nutrients such as vitamin A or D in animal models, making them unavailable for normal body physiology (Vijayanandraj *et al.*, 2014). Several countries have set permissible limits for aflatoxins in various foods and feeds.

Acceptable levels of aflatoxin in food vary depending on the type of aflatoxin, the variety of the food product, and the economic status of the country. The acceptable level of aflatoxins in various food products ranges from 0.025 to 100 ppb) (Wang *et al.*, 2017). The Food and Agriculture Organization (FAO) has established the most stringent criterion in the formulation of regulatory limits against highly toxic and genotoxic compounds such as aflatoxins based on the concept of "As Lowest as Reasonably Acceptable" (ALARA). On the other hand, local aflatoxin limits are set based on a number of critical factors, such as the prevalence of toxic compounds in food products, consumption rates of impure foods, literacy rates, industrial levels, and climatic conditions of the country. Maximum aflatoxin values are not only set based on toxicological considerations to stop health risks, but also on the basis of technological development. For example, if the upper limit for aflatoxins were based on toxicity alone, the permissible limits for aflatoxins would have to be much lower, since the health risk cannot be completely eliminated using the safety factors that are usually used. Limits for total aflatoxins in cereal products are range between 10 and 20 ppb. Chile and the European Union (EU) have set maximum permissible limits for aflatoxins in cereal products of 2 to 5 ppb. The United States, Brazil and other countries have set a limit of 0.5 ppb for AFM1 in milk, while the EU has set a permissible limit of 0.05 ppb for AFM1 in milk.

Review of Literature

Prevalence of Aflatoxins in agricultural products

A number of researchers around the world have reported the prevalence of aflatoxins far exceeding the maximum permitted limits in agricultural products, especially maize, peanuts, pistachios, chestnuts, spices and other cereal crops. It was analyzed the concentration of aflatoxins in packaged and unpackaged spices. The average level of aflatoxin in packaged and unpackaged spices was recorded was 27.93 and 67.04 µg/kg, respectively (Naz *et al*., 2016). It reported the concentration of aflatoxins (AFB1 and AFB2) in maize. Average concentrations of AFB1 and AFB2 in corn samples were recorded as 192 ppb and 40 ppb, respectively. Ismail et al. (2016) analyzed the concentration of aflatoxin M1 (AFM1) in milk samples (n=520) collected from different areas of Punjab province, Pakistan. Sampling was carried out in each month of the year to assess the impact of seasonal changes on AFM1 concentration in milk samples. Enzyme Linked Immune Sorbent Assay (ELISA) was used to quantify AFM1 in milk samples. The result of the study showed that AFM1 was positive in more than 90% of the milk samples. The range of AFM1 in milk samples was 0.001-0.25 ng/ml, while more than 50% of samples were recorded to have AFM1 concentrations above the European Union (EU) permitted limit was 0.05 ng/ml (Paterson, 2007). The maximum level of AFM1 was recorded in the winter season, while the lowest was recorded in the summer season. Fifty-two milk samples were analyzed for AFM1 concentration. The range of aflatoxins in fresh milk samples was recorded as 90 - 3385 ng/l. The level of AFM1 was recorded above the Brazilian maximum permissible limit for AFM1 in milk (0.5 ppb) in 40.4% of the milk samples (n = 21), while in 50.6% of the samples the level of AFM1 was recorded above the maximum permissible limit of the European Union for AFM1 in milk (0.05 ppb). The researcher reported the concentration of total aflatoxins in processed infant formula samples. Average aflatoxin levels in Cerelac, milk powder, noodles and rice cream were recorded as 0.052 ppb, 0.030 ppb, 0.025 ppb and 0.025 ppb, respectively. Elangovan and Kulyanasundaram (1999) analyzed AFB1 concentration in 142 rice bran samples. Out of a total of 88 rice bran samples, 62% of the samples were positive for aflatoxins (Mushtaq *et al*., 2012).

Food contamination

Food is a primary requirement for all life forms. Food provides a range of essential nutrients needed for normal growth and development. In addition to nutrients, food is also contaminated with toxic substances such as mycotoxins, pesticides, microbes, minerals and chemical toxins. Anthropogenic activities are increasing the level of contaminants in food commodities day by day. The increase in world population ultimately increased the demand for food, while the increase in the level of nutrition education and public awareness ultimately increased the demand for safe food supplies (Milani, 2013).

Food safety

Food safety requires that food intended for human consumption is safe from microbes, heavy metals, fungi, chemicals and pesticides and does not produce harmful effects due to chemical, physical and microbiological hazards. The requirement for food safety is essential for all life forms to survive in their environment. Food-borne diseases have been the biggest problem of human health since the beginning of life. Foodborne illness can occur due to ingestion of transmissible/poisonous compounds present in food and feed or due to some naturally occurring toxic compounds. Consumer health is protected by public food safety standards, implementation of standards, advances in food safety research, and proper enforcement of rules and regulations.

Food containers

The World Health Organization (WHO) has reported that the maximum number of cases of foodborne illness is highest in the Eastern Mediterranean, Africa and South Asia. The estimated burden of foodborne illness in the United States alone is 0.047 billion per year. The World Health Organization (WHO) reported that 23,900 deaths and 759,000 illnesses are caused by contaminated food every year, the health of children (under 4 years) kills 0.0022 billion due to foodborne diseases in less developing countries. (Food Agriculture and Organization (FAO) also reported that people (more than 0.6 billion) are affected by foodborne diseases every year. It also reported that approximately 0.033 billion people are affected by foodborne diseases. Food Communicable diseases are acute and chronic in nature and all people around the world are constantly facing the threat of disease due to contaminated food and water (Ene, 2020).

Factors affecting aflatoxin production

Aflatoxin production is influenced by a number of biological, physiological and chemical factors. Temperature and humidity are the most important factors for aflatoxin production. The most suitable temperature range for the formation of aflatoxins is 25-30 °C. A water activity between 0.95 – 1.00 is the most favorable range for aflatoxin production. The nature of the substrate and the concentration of oxygen also play a significant role in the production of aflatoxins. A number of nutrients are reported to be required for aflatoxin production, e.g. starch, vitamins, fatty acids, minerals (especially zinc) and amino acids. These nutrients are the energy source for aflatoxin production. It is also reported that high concentrations of carbohydrates such as wheat, rice and oilseeds produce higher amounts of aflatoxins (Reddy *et al.*, 2010).

Mechanism of action of aflatoxins

The several researchers reported that total aflatoxins are considered to be lipolytic in nature. They are easily absorbed through the cell membranes of the organism from the place of exposure to aflatoxins, e.g. respiratory tract, digestive tract and enter the bloodstream. They then spread to a mixture of tissues and the liver. They are metabolized in the liver to a reactive epoxide intermediate or hydroxylated to the less toxic AFM1. A microsomal cytochrome P450 enzyme produced in humans and susceptible animals converts aflatoxin B1 to an epoxide that binds to DNA and albumin in the blood to form an adduct leading to DNA damage. The epoxide preferentially binds to mitochondrial DNA. The consequences of tumor formation occur when the binding of aflatoxin B1 to DNA at the guanine site in liver cells affects the genetic code of enzymes that regulate cell growth. Aflatoxins are known to bind and block enzymes and substrates that are required in the initiation, transcription and translation processes involved in protein synthesis by forming adducts with DNA, RNA and proteins (Sarma *et al.*, 2017).

Major health impacts of aflatoxins on human health

The main health effects of aflatoxins on humans and animals are carcinogenicity, teratogenicity, genotoxicity, embryotoxicity and immunotoxicity. Acute and chronic toxicity caused by exposure to aflatoxins and the condition is commonly known as aflatoxicosis. Aflatoxicosis is increased by two factors, e.g. inhalation of aflatoxin and ingestion of aflatoxin (Ene, 2020).

Mycotoxicoses

Diseases produced by mycotoxins are collectively called mycotoxicoses. The severity of the disease depends on the following factors such as age, extent of exposure, mycotoxin toxicity and nutritional status of the individual. The World Health Organization (WHO) and the International Agency for Research on Cancer (IARC) classified aflatoxins as group 1 carcinogens, while ochratoxin (OT) and fusaric acid (FA) were classified as category 2B carcinogens, and zearalenone (ZEN)) and trichothecenes were not classified as carcinogenic to humans (group 3). In addition to carcinogenicity, mycotoxins can also cause growth retardation, damage to the nervous system, liver disease, intestinal problems, skin disorders, and reproductive disorders (Ene, 2020). The main types of mycotoxins include trichothecenes, Fusarium toxins, penicllic acid, ochratoxins, aflatoxins, rubratoxins, deoxylevanelon (DON) and citruvirdin. However, in terms of toxicity, aflatoxins surpass all other mycotoxins (Ismail *et al.*, 2018).

Acute aflatoxicosis

Acute aflatoxicosis occurs when moderate to high levels of aflatoxins are consumed or a condition caused by chronic exposure to aflatoxins at high to moderate levels of aflatoxin is known as acute aflatoxicosis. Consequences of acute aflatoxicosis include liver damage, hemorrhage, edema, carcinogenic effects, life-threatening toxicity, potential chronic adverse effects, changes in digestion, nutrient absorption and metabolism, and death. Symptoms of acute aflatoxicosis are vomiting, leg edema, jaundice, rapidly developing ascites, high fever, highly colored urine, and portal hypertension (Katsurayama *et al.*, 2018).

Chronic aflatoxicosis

Chronic aflatoxicosis is long-term exposure to aflatoxins through food or as a result of ingestion of low to moderate levels of aflatoxins. The human health impacts of chronic aflatoxicosis include digestive problems, death and liver damage, reduced T cell number and function or reduced phagocytic activity and function, mutagenic, carcinogenic and teratogenic effects associated with congenital malformations (Sarma *et al.*, 2017).The amount of aflatoxins consumed contributes to mutagenic, carcinogenic, teratogenic and immunosuppressive health effects in the body. It has been reported that adverse effects of aflatoxins in human is range from acute liver toxicity to chronic diseases such as liver cancer, bleeding, swelling and even immediate death.

Mutagenic effects of aflatoxins

Mutagens can cause changes in DNA and are therefore genotoxic to humans and animals by exposure to aflatoxins in the body. A mutagen produces mutations in DNA, and a deleterious mutation can result in aberrant, impaired, or loss of function of a particular gene, and the accumulation of mutations can lead to cancer. Mutagens can therefore also be carcinogens. The mutagenic effects of aflatoxins can lead to chromosome rearrangements, changes in DNA that promote chromosomal breaks, loss and gain of a chromosome in a gene, and changes in a chromosome in a gene (Sarma *et al.*, 2017).

Teratogenic effects of aflatoxins

Due to their teratogenicity, aflatoxins can endanger the health of animals and humans. Aflatoxins inhibit protein synthesis, are cytotoxic, teratogenic and immunotoxic. Thus, they can affect fetal health both directly during critical periods of development and indirectly through their adverse effects on maternal health. Symptoms include hemorrhage, acute liver injury, edema, gastrointestinal distress, and death.

Aflatoxins affect the human liver

The International Agency for Research on Cancer (IARC) has declared aflatoxins as category 1 carcinogens. The chances of hepatocellular carcinoma increase many times if a patient with hepatitis consumes food contaminated with aflatoxins. HCC cases (<84%) are more commonly reported from less developed countries. The highest incidence of HCC was observed in African and Asian countries. Liver cancer was found to be the most common malignancy in Thai men and 3rd in importance in women. HCC cases were recorded as 61% of cases in males and 45% in females. It is increasing day by day due to poverty, aflatoxin exposure and lower socioeconomic status, alcohol, oral contraceptives and possibly tobacco smoking (Sarma *et al.*, 2017).

Effect of aflatoxin on the human nervous system

Aflatoxin, especially B1, affects the human nervous system. The normal function of nerve cells can be inhibited by mycotoxins, especially aflatoxins and their metabolites and other products such as reactive oxygen species (ROS) such as AFB-8, 9-epoxides. Aflatoxins can interfere with the normal functioning of nerve cells by the formation of DNA adducts, oxidative stress and protein adduct factors, mitochondrially controlled apoptosis of nerve cells, as well as inhibition of their synthesis of proteins, DNA and RNA. Aflatoxins can induce abnormalities in mitochondrial DNA, structure and function including defective oxidative phosphorylation in brain cells (Somda *et al.*, 2023). Effects of aflatoxins on the human nervous system include abnormal behavior and depression.

Effect of aflatoxin on human growth

Food contaminated with aflatoxins has been reported to cause growth retardation including wasting and stunting, and these health effects are often reported in African countries where aflatoxin exposure is much higher. Stunting in a child usually occurs as a result of contamination of animal milk and the mother's breast milk with aflatoxins (M1, M2) (FAO, 2019). It was reported an association between impaired growth, particularly stunting, and aflatoxin exposure in young West African children. Approximately 4.5 million children under the age of 5 die each year in sub-Saharan Africa, and the child mortality rate is about 30 times higher than in developed countries. Stunting and malnutrition are thought to underlie approximately 50% of this mortality burden. According to WHO (2008) estimates for 2004, 182.7 million children in developing countries were considered stunted. 70% of these stunted children live in South and Southeast Asia and sub-Saharan Africa (Turner *et al.*, 2007).

Aflatoxins affect the immune system

Chronic consumption of aflatoxin-contaminated foods has caused immunosuppression in humans and animals worldwide (Kumar *et al.*, 2022). In humans, aflatoxins affect cellular and humoral immune responses, where they alter immunological parameters in participants with high levels of AFB1, leading to impairment of cellular immunity, thereby reducing host resistance to infections. Because aflatoxins disrupt both the cellular and humoral immune systems, susceptible animals are more susceptible to bacterial, viral, fungal, and parasitic diseases. The effects of aflatoxins on the immune system include reduced resistance and susceptibility to HIV, TB and other opportunistic infections (Xu *et al.*, 2018).

Effect of aflatoxin on gastrointestinal plot

Aflatoxin cause serious intense impacts on gastrointestinal plot like loose bowels, heaving, digestive discharge, and liver putrefaction and fibrosis (Coulombe Jr, 1993). The principal course of passage of aflatoxins is the gastrointestinal plot (GIT). GIT is severely harmed by the openness of high portions of aflatoxins and may prompt irritation of GIT, gastrointestinal growths and colon diseases. It has been accounted for expansion in frequency of human GIT and hepatic neoplasms because of aflatoxins openness in China, Africa and, Philippines. Aflatoxins are additionally answered to harm the honesty of the pancreas. Aflatoxins because changes in the GIT physiology particularly diminished rumen motility and capability in homegrown creatures particularly cow. Aflatoxins slow down gastrointestinal morphology, clear edible energy and sialic corrosive creation in birds.

Guidelines

A few nations have perceived OK cutoff points for aflatoxins in numerous food sources and feeds. The mediocre levels for aflatoxins in crops change contingent upon the kind of aflatoxin, various food items and the financial status of a country. The mediocre level for aflatoxins in various food items goes from 0.025 to 100 ppb (Tchana *et al.*, 2010). Food and Horticulture Association (FAO) has embraced the strictest standard in the detailing of cutoff points against high harmfulness mixtures, for example, aflatoxins, in view of the idea of "As Most minimal as Sensible OK" (ALARA). European Association (EU) and the US Food and Medication Organization (FDA) has given rules, guidelines, and rules for different nations to make their own guidelines for a passable constraint of aflatoxins in food and feed items. By and large, reasonable breaking points fluctuate starting with one country then onto the next country. The greatest satisfactory cutoff against aflatoxins is most severe by the EU when contrasted with FDA. EU has determined the reasonable furthest reaches of aflatoxin in dairy feed as 5 ppb, however FDA have determined admissible breaking point for aflatoxin in dairy feed as 20 ppb (Alvarado *et al.*, 2017). The laid out allowable cutoff for AFM1 in milk and dairy items ranges between 0 to 1.0 ppb, as far as possible for complete aflatoxins in creature feed is 20 ppb and for AFM1 in milk it is 0.05 ppb. The EU determined greatest admissible breaking point for aflatoxin B1 in newborn child food is 0.1 ppb. European Food handling Authority (2013) has determined aflatoxins most extreme admissible restriction of 4 ppb in breakfast cereals, while greatest permissible constraint of 1 ppb in handled cereal items. Taking into account aflatoxin harmfulness, various nations have decided resilience limits for aflatoxin in staples.

European nations have taken on most rigid guidelines against aflatoxins and accordingly least aflatoxins levels are accounted for in the food items of European locale. Lower levels of aflatoxins in European nations might be connected with the reception of severe standard cutoff points against aflatoxins, execution of rules and guidelines, progression in post-reap advances, and rancher and purchaser mindfulness. African nations contain higher aflatoxins levels in various food things. More significant levels of aflatoxins in African nations might be related with ill-advised capacity conditions, positive ecological circumstances for aflatoxin creation, rancher, shopper mindfulness and, mechanical obstacles and, rancher, most importantly, neediness. Furthermore, a few different factors likewise play huge principles in the event of aflatoxin in food products including topographical area, time of the year, food type, as well as post-gather period and the executives' conditions. A various elements, similarly of a logical and financial nature, conceivably will control the establishing of mycotoxin cutoff points and guidelines. These incorporate accessibility of toxicological information, accessibility of information on the event of mycotoxins in different products, information on the dispersion of mycotoxin focuses inside a great deal, accessibility of scientific techniques, regulation in nations with which exchange contacts exist and, need for adequate food supply. The initial two variables make accessible the fundamental data for danger evaluation and openness appraisal separately, the critical elements for risk evaluation. Risk evaluation is the logical appraisal of the possibility of frequency of known or conceivable unfriendly wellbeing impacts coming about because of human openness to food-borne dangers; it is the essential logical reason for the foundation of guidelines.

Prevalence of Aflatoxins in Food Items all over the Planet

Since the disclosure of aflatoxins in 1960's, different nations from everywhere the world have announced the predominance of aflatoxins in various food wares like oats (particularly maize, rice and wheat), flavors (particularly red pepper and dark pepper), and dry natural products (like dates, apricot and raisins) and in endlessly milk items. Attributable to the worldwide exchange of aflatoxin polluted food items, different nations of the world are confronting the risks of aflatoxicosis, the greater part of the cases are accounted for from Asian and African nations. Commonness of aflatoxins in different food items from various nations of world are summed up underneath. It was measured the degrees of aflatoxins in examples of flavors and spices (absolute 94 and 38 examples, separately). The examples were gathered from the business sectors of Beriut city of Lebanon. The evaluation of aflatoxins was performed through LC/MS (Hell *et* al., 2009). The absolute of 8% spices tests and 19% flavors tests were tracked down sure for the degree of aflatoxins. The mean tainting level of absolute aflatoxins in flavors and spices was 168µg/kg and 36µg/kg, separately. The degrees of all out aflatoxins in 15% flavors and 5% spices tests were found to surpass the EU most extreme cutoff points for complete aflatoxins (10 µg/kg) while 13 % flavors and 3% spices tests were found to surpass the EU greatest cutoff for AFB1 (5 µg/kg). It was broke down aflatoxin in newborn child cereals (rice, oat, wheat, corn, and blended grain-based) examples (n=60) gathered from the business sectors of Spain during long term period (Herrera *et al.*, 2019). The measurement of aflatoxins was performed through HPLC. Aflatoxins were tracked down certain in 12 examples (20%), 6 examples of baby oats surpassed the EU most extreme reasonable cutoff for AFB1 laid out at 0.10 ppb, while the pollution level of one example was recorded as 200 ppb. AFB1 and AFG1 were tracked down sure in 11 examples (18.3%) and 6 examples (10%), separately, while aflatoxins AFB2 and AFG2 were tracked down certain in just 1 example (1.7%) (Katsurayama *et al.*, 2018). Measured aflatoxin in 187 rice tests. The rice tests were gathered from field; handling and market from two unique creation frameworks, wetland from the province of Rio Grande do Sul, dry land from the territory of Maranhão and market tests from the territory of São Paulo. Aflatoxins were identified by attention and evaluated by HPLC procedure. The mean worth of aflatoxins in red rice and dark rice were recorded as 0.622 and 0.579 ppb, separately. Aflatoxins were found positive in two market test of rice and the two examples surpassed the Brazilian Public Wellbeing Reconnaissance Organization most extreme admissible breaking point for aflatoxins for example 5 ppb. broke down aflatoxins in 178 food test (32 wheat test, 146 wheat items). The examples were gathered from the store of chines. The evaluation of aflatoxins was performed by LC-MS procedure. Tender loving care was utilized for the discovery of aflatoxins in wheat and wheat item. Aflatoxin B1 was found positive in 18.8% wheat and 8.8% saltine test. Mean aflatoxin B1 in wheat and wafer were recorded 0.06 and 0.05ppb, separately. EU most extreme breaking point for complete aflatoxins is 10 µg/kg, 15% wheat and 5% saltine tests were found to surpass this cutoff while 10 % wheat and 2% wafer tests were recorded to surpass the EU greatest breaking point for AFB1 for example 5 µg/kg. Ismail et al., (2016) measured aflatoxin M1 in 520 milk tests during pre-winter, winter, spring and summer times of 2013-14. The examples of milk were gathered from five locale of Southern Punjab-Pakistan. ELISA technique was utilized for the measurement of aflatoxin M1. The scope of aflatoxin M1 was recorded as 0.001-0.26 ppm. Aflatoxins were found positive in 93% milk tests. The milk test (53%) was surpassed EU most extreme admissible breaking point for aflatoxins M1 for example 0.05 ppm. Aflatoxin M1 was distinguished most noteworthy in the request winter > spring > harvest time > summer. The rate aflatoxin M1 during various day times, morning milk was recorded as 37-half more tainted than night milk. The scope of aflatoxin M1 during various times of year for different age bunches was recorded as assessed day to day admission (EDI) 0.22-5.45 ng/kg/day. The researcher examined aflatoxins in takes care of tests (n= 274). The examples of feed were gathered from Focal Greece. ELISA was utilized for the evaluation of aflatoxins. Tender loving care was utilized for recognition of aflatoxins in feed. Aflatoxins were viewed as sure in 30 % test of feed. Mean defilement level of absolute aflatoxins in takes care of tests was 90 ppb. The reach tainting of aflatoxins in feed test was recorded as 80 to 100 ppb. 14.23% feed tests were recorded to surpass the EU most extreme allowable cutoff for aflatoxin for example 10ppb (Manouras and Malissiova, 2015) examined aflatoxin in juice tests (n=60) like Washington navel orange (Citrus sinensis L.), grapefruits (Citrus paradisi Macf) and, apple organic products (Malus domestica)). The examples were gathered from various general stores in two distinct regions I. e. Kalubia and Gharbia Governorates, Egypt. Attention was utilized for recognition of aflatoxin. The measurement of aflatoxins was performed by HPLC. .

Aflatoxins were viewed as sure in 9.75 % apple, 50.63 % orange and 39.62% grapefruit. Just 3% apple, 15% orange and 12% grapefruit juices test were recorded to surpass the EU greatest allowable breaking point for aflatoxin for example 5ppb. It evaluated aflatoxins in mechanically created creature feed berseem (Trifolium alexandrinum) tests (n=40) gathered from the southwest of Iran. HPLC strategy was utilized for the evaluation of aflatoxins. All out Aflatoxins were found positive in 75% feed tests (30). Mean tainted degree of all out aflatoxins in creature feed test was 80ppb. Scope of polluted absolute aflatoxins was recorded as 70-90ppb. 0nly 35% creature feed were recorded to surpass EU most extreme admissible breaking point for aflatoxin for example 5ppb (Eskandari and Pakfetrat 2014). It has been measured aflatoxins in 121 examples of dried natural products (45 dried fig, 30 raising, 35 apricots and 11d ate). The examples were gathered from the focal zone of Iran. Aflatoxins were investigated by ELISA procedure. The recuperation rates of aflatoxin in spiked dried organic product tests at groupings of 5, 10 and 20 ppb were recorded as 84.9%, 89.3% and 90.4%, separately. The typical grouping of aflatoxin was tracked down in examined tests (20.7%) was recorded as 3.9 ppb. Aflatoxins were tracked down certain in 10.4% dried fig, 44.7% raising, 6.7% apricots, and 10.0% date. Just 7.9% dried raising examples and 2.1% dried fig tests were found to surpass EU greatest passable breaking point i.e.10 ppb. It has been broke down aflatoxins in date natural product test (n=50). The examples were gathered from the different nearby grocery stores in the Taif locale. Tender loving care was utilized for the recognition of aflatoxins, while the measurement of aflatoxins was performed by HPLC. Aflatoxins were found positive in 70% date organic product test. Mean defiled degree of absolute aflatoxins in date organic product test was 45ppb. Scope of defiled absolute aflatoxins was recorded as 30-60ppb. Just 45% date natural product tests were recorded to surpass the EU most extreme admissible breaking point for example 10 ppb. The researcher dissected aflatoxins in (n=180) tests of dried products of the soil (20 dried apricot, 20 dates, 10 dried figs, 15 mulberries, 10 dried raisins, 15 apricot pieces, 10 almonds with shells, 10 almonds without shells, 10 nut with shells, 10 peanuts without shells, 10 pistachios with shells, 10 pistachios without shells, 10 pecans with shells, 10 pecans without shells and 10 pine nuts with shell). The examples were gathered from exchange shops and neighborhood markets of different spots of NWFP and Northern areas of Pakistan. The measurement of aflatoxins was performed by HPLC. Aflatoxins were tracked down sure in 26% dried mulberries and 20% dried apricot, 10% dates and half dried figs, 20% raisins, while in 26% apricot bits almonds, 30 almonds without shell, 40% pecans with shell, 70% pecans without shell, 40% nut with shell, half peanuts without shell, 20% pistachios with shell, half pistachios without shell and 20% pine nuts with shell. Mean upsides of aflatoxins in nut and one pistachio tests were recorded as 14.500 ppm and 14 ppm separately. Aflatoxins were tracked down in two pecans with shell, three pecans without shell, one nut with shell, two peanuts without shell, one dried apricot, three dried fig, one raisin, one apricot part, and two pistachios without shell tests were found to surpass EU greatest admissible cutoff points for aflatoxins for example (4 ppm). The scientist measured aflatoxins in 91 examples of Spanish newborn child grains for example Natural (n=17) or regular (n=74) cereal based types. Gluten free based baby cereals (n = 23, particular recipe, typically founded on rice and maize, which are particularly intended for babies from 4 to a half year old enough), baby oats with organic products (n=5, equation regardless of gluten-based grains and got dried out organic products added, intended for babies from 4 to a half year old), baby cereals with milk (n=15, equation containing follow-up newborn child equation, which comprises the main fluid wellspring of sustenance for newborn children matured from a half year), baby multi cereals (item formed to fulfill requirements of babies from 5 to a year old, in light of blended gluten cereals), baby cereals with honey (n=16, equation like multi cereal with option of honey, yet particularly intended for newborn children from a half year to 2 years age old), and baby cereals with cocoa (n=6, equation in view of multi cereal with cocoa added, regularly prescribed for babies from 1 to 2 years of age) (Hernandez-Martinez and Navarro-Blasco, 2010). The examples of Spanish newborn child grains were gathered from Spain from eight unmistakable traditional (Legend child, Milupa, Settle, Nutriben, Nutricia, Ordesa, Puleva and Sandoz-Sanutri). Evaluation of aflatoxins was performed by HPLC. Identification of aflatoxins was performed by tender loving care. Complete aflatoxins were found positive in 66% Gluten free based newborn child oats, 46 %infant grains with natural products, 40% baby cereals with milk, 34 newborn child multi cereals, 11% baby cereals with honey and 8% cereals with cocoa tests of Spanish baby cereals. The five example of natural details (3.11, 1.98, 0.94, 0.47 and 0.21 ppm) were found to surpass EU most extreme allowable breaking point for AFB1 (0.10 ppm) versus two traditional oats (0.35 and 0.12 ppm). The scope of aflatoxins in Spanish baby oats was recorded as 0.34-1.95 ppm. The scholar Broke down aflatoxins in the example of Bean stew peppers (n=132). The example of Stew peppers were gathered from country regions tests (n=44), semi-provincial regions (n=44) and metropolitan regions test (n=44) among April and December 2009 in the Punjab district of Pakistan. The evaluation of aflatoxin was performed by HPLC method. Absolute aflatoxins were found positive in example of 52.3% stew peppers rustic (23), half stew semi-provincial (22) and 65.9% bean stew metropolitan (29). The mean upsides of aflatoxins in example bean stew peppers of rustic, semi-provincial and metropolitan were recorded as 27.7, 17.7and 16.2 ppb, separately. Just 20% provincial, 15% semi rustic and 10% metropolitan chillies tests were found to surpass EU reasonable breaking point for aflatoxins for example under 5ppb. It has been evaluated aflatoxins in 151 examples (98 dried figs and 53 sultanas). The examples were gathered from Turkey and European Association. The evaluation of aflatoxins was performed by HPLC. Aflatoxins were tracked down sure in 60% examples of dried figs and 43% examples of king. The scope of aflatoxins sultana tests and dried figs were recorded as 0.51-58.04 µg/kg and 0.87-24.37 µg/kg separately. It has been reported that two examples of the sultanas (4%) to surpass EU most extreme allowable cutoff for aflatoxins i.e.10 µg/kg (Iqbal *et al.*, 2010) the measured aflatoxins in 180 examples of dried vegetables (50 okra, 40 hot 30 bean stew, 25 tomato, 15 melon seeds, 10 onion and 10 baobab leaves from Benin, Togo and Mali. The examples were from gathered Northern Guinea Savannah (NGS) and the Southern Savannah in September to October 2006. The measurement of aflatoxin was performed by HPLC procedure. Aflatoxins were tracked down in okra (45%), hot stew (54%), tomato (35%), melon seeds

(45%), onion (half) and baobab leaves from Benin, Togo and Mali (30%). The mean upsides of aflatoxins AFB1 and AFB2 in okra and hot stew were recorded as 5.4 ppb and 3.2 ppb separately. Aflatoxin B2 was just present in okra at the convergence of 0.6 ppb. It has been measured aflatoxins in the 209 examples of various gatherings of food sources. The examples were gathered from nine distinct towns dispersed in the north (Tunis and Siliana), the middle (Zaghouen, Sousse, Kasserine and Kairouan) and in the south Tunisia (Sfax, Gafsa and Tatawin). ELISA strategy was utilized for measurement of aflatoxins. Tender loving care was utilized for the discovery of aflatoxins in various gathering of food things. Aflatoxins were found positive in 86% examples gathering of food test (n=180). Mean upsides of aflatoxin B1 was recorded as3.5 ppm. Just 40% nutrition classes were found to surpass the EU most extreme reasonable breaking point for AFB1 for example 5ppb. It has been broke down aflatoxin B1 in 186 nut items (140 peanuts, 32 peanut butter, and 14 nut cakes). The example of Peanuts, peanut butter, and nut cakes were gathered from the stores of Trinidad during the period June to October 2005. The evaluation of aflatoxins was performed by radioimmunoassay strategy (Appeal II) test. HPLC was additionally utilized for the evaluation of aflatoxins in Peanuts, peanut butter, and nut cakes. The aflatoxin B1 was found positive in 40% peanuts, 25% peanut butter and 10% nut cakes. Just 5.5 % nut, 3.5% peanut butter and 2.9% nut cake were found to surpass the EU most extreme allowable cutoff for aflatoxins B1 for example 5 ppb. The scientist examined aflatoxins in peanut butter test (n=21). The examples were gathered from the neighborhood grocery stores and little retail shops in all pieces of Japan. The evaluation of aflatoxin was performed by HPLC strategy. Attention was utilized for the identification of aflatoxins in peanut butter. Absolute pollution aflatoxins were found positive in 45% peanut butter test. AFB1 and AFB2 in peanut butter were recorded as 354.0 and 94.0 ppb. Just 10% sullied peanut butter was found to surpass EU greatest admissible breaking point for aflatoxins (AFB1 and AFB2) for example 5ppb (Kumar *et al.*, 2022). The researcher dissected aflatoxins in espresso test (n=30). The examples were gathered from various areas (Zimbabwe, Brazil, India, Uganda, Colombia, and Indonesia). Attention was utilized for the identification n of aflatoxins in espresso tests, while evaluation of aflatoxins was performed by HPLC method. All out tainting aflatoxins were tracked down certain in 30% example of espresso. The scope of aflatoxins in espresso was recorded as 25-50ppb. 5.8% tainted espresso were found to surpass most extreme passable cutoff for example 5ppb. The scientist broke down aflatoxins in (n=40) tests (25grains of rice, 10 heartbeats and 5 oilseeds. The examples (grains of rice, heartbeats and oilseeds) were gathered from nearby business sectors of Calcutta for human utilization. TLC was used for the detection of aflatoxins in rice, pulses and oilseeds, while HPLC was used for the quantification of aflatoxins. Aflatoxins were positive in 60% of rice, 45% of legumes and 20% of oilseeds. The range of aflatoxin B1 was recorded as 333–10416 ppb. 20% of rice, 10% of pulses and 5% of oilseeds were found to exceed the EU maximum permissible limit of 10 ppb (Begum and Samajpati, 2000).

Decontamination / Degradation of aflatoxins

Aflatoxins can be degraded or decontaminated in food and feed by various physical, biological and chemical methods. Heating, microwave, irradiation and UV radiation are physical methods. Separation and solvent methods are used to remove aflatoxin during the post-harvest and pre-harvest stages. Oxidizing agents (e.g. ozone and hydrogen peroxide), hydrolytic agents (e.g. acids, bases and aldehydes) and various types of gases are known as chemical methods. Immunization, hydrogen peroxide, sodium bisulfite, ozonation, and plant extract degrade aflatoxins in several food commodities and animal feeds. Biological methods involve the use of bacteria, yeast or their specific enzymes or metabolic machinery to degrade aflatoxins, although a number of bacterial and yeast species are also able to absorb aflatoxins in several foods (Ismail *et al.*, 2018). Proper breakdown of aflatoxin requires a suitable energy source and treatment conditions. These can provide an acceptable way to detoxify contaminated food and feed. Energy is available in the form of ultraviolet (UV) or visible light, gamma rays and heat. These are used for such treatment for detoxification of aflatoxin. The sensitivity of aflatoxins to different types of radiation is influenced by the energy dose. "Binding" or association of aflatoxin toxins with food components also affects the effectiveness of detoxification by careful selection of treatment methodology and conditions for all foods are consequently a prerequisite for investigating physical methods of decontamination or degradation.

A physical method for the removal / degradation of aflatoxins

Physical separation of impure grains can be useful for reducing aflatoxin levels throughout the batch. Separation is usually based on the detection of color change, fluorescence and the presence of mold on grain surfaces and can be done either manually or instrumentally. The most commonly studied physical methods for aflatoxin degradation include thermal inactivation (heating, extrusion, microwave) and irradiation (gamma, UV). The thermal method is used to decontaminate aflatoxin in food and feed. Aflatoxin B1 is stable in solid form against dry heat up to a melting point of 260 °C. Aflatoxin B1 is decomposed by heat (269 °C). Aflatoxin B1 is also degraded by high temperature (300°C) in certain foods. Physical methods of degradation include heating, microwaves, irradiation and UV irradiation. The separation and dissolution method is used to remove aflatoxin during the post-harvest and pre-harvest stages. There are two types of physical methods. The first is the removal of the toxin or contaminated parts from food and feed and the second is the degradation of the aflatoxin toxin. The mycotoxin structure is degraded by chemical compounds including oxidizing agents (e.g., ozone and hydrogen peroxide), oxidizing agents (e.g., ozone and hydrogen peroxide), and various types of gases. Current studies have shown that medicinal plant extracts also have chemically active properties for aflatoxin degradation. Aflatoxins are broken down by microwaves (electromagnetic radiation). Microwave wavelength frequencies are needed for aflatoxin degradation, e.g. 0.3 GHz to 300 GHz with wavelengths from 1 mm to 1 m. Microwaves are often used in combination with roasting to degrade aflatoxins in food and feed. Less than 96% of aflatoxins were degraded in peanuts by microwave roasting at 6 kilowatts (kW) for 4 minutes. Additional results of aflatoxin degradation in contaminated peanuts were obtained using microwave roasting at > 1.5 kW for > 17 min or < 3.3 kW for < 6 min. More than 94% of the total degradation of aflatoxins was obtained using a high temperature of 150 °C. A home microwave oven is less effective for aflatoxin degradation in a contaminated peanut sample at a low power level of 0.7 kW for 8.5 min. It was also reported that 61% of aflatoxin B1 and 40% of AFG1 were destroyed in naturally contaminated peanuts (Samarajeewa *et al.*, 1990). Bullerman and Bianchini (2007) analyzed that aflatoxins were degraded using extrusion with ammonia (0.7%), hydroxide (1.0%) and bicarbonate (0.4%). 50–80% and 95% of degraded aflatoxins were recorded in contaminated maize. It also reported that aflatoxins can be decontaminated by roasting with ammonia. The physical decontamination method reported in 1997 has significant limitations due to the high cost of the large-scale process, the time-consuming method, and the fact that food treated with this technique cannot be used for human consumption. Physical methods are cost-effective, ecologically neutral and insignificantly affect the quality of food products. Thus, the current verification does not demonstrate the possibility of degradation of aflatoxins in food only by gamma radiation. Therefore, the application of the physical method is limited by several critical factors described earlier in this paragraph (Ates *et al.*, 2008).

Biological method of aflatoxin degradation

Biological methods are most suitable for aflatoxin decontamination due to their additional advantages such as less food spoilage, cost-effective and environmentally friendly Enzymes, bacterial and yeast cells break down aflatoxins in food and feed. Viable cells degrade aflatoxins and inactivated cells reduce the bioavailability of aflatoxin (Rao *et al.*, 2017). Biological methods used for the degradation of aflatoxin including microorganisms or other related products such as enzymes indicate another attractive method for the food industry considering their "natural" attractiveness and the growing consumer rejection of chemical food treatment. Aflatoxins are broken down by microorganisms. The main reason for using microorganisms is their high efficiency, specificity and cost-effectiveness, provided that they do not use food material for growth and do not produce undesirable compounds in the food matrix. Aflatoxins detoxify microorganisms. This method can be used pre-harvest to remove aflatoxin contamination in food, feed and crops and used post-harvest to remove aflatoxin from grain. Lactic acid bacteria (LAB) and Saccharomyces cerevisiae strains are the main types of microorganisms for aflatoxin degradation in food, feed and crops. Microorganisms are used to decontaminate aflatoxins in food and feed. Microorganism applications are mostly applied in food and feed for aflatoxin decontamination due to their high efficiency, specificity and economy, provided that they do not use food material for growth and do not release undesirable compounds into the food matrix. Microorganisms or associated products such as enzymes offer another attractive proposition for the food industry, given their “natural” demand and the growing consumer aversion to chemical food processing (Alberts *et al.*, 2009). With respect to uncontaminated food products, aflatoxin synthesis by Aspergillus flavus may be reduced if the fungal substrate is previously used by non-aflatoxigenic strains of Aspergillus flavus. The researcher reported that aflatoxins degrade by biological method. This mechanism of aflatoxin detoxification normally occurs through two main processes, enzymatic degradation and sorption, both of which (enzymatic degradation and sorption) can be achieved by biological systems. Aflatoxins removed by dead and living microorganisms can be absorbed either by binding of the mycotoxin to their cell wall components or by active internalization and accumulation. Even dead microorganisms can absorb mycotoxins and this phenomenon can be overcome by creating biofilters to decontaminate liquids with aflatoxins or probiotics to bind and remove mycotoxins from food commodities. Aflatoxins are degraded in food and feed by several types of microorganisms such as Pseudomonas, Bacillus, Lactobacilli, Burkholderiasp and Ralstonia and Burkholderiaspp. Enzymatic degradation can be utilized by either extracellular or intracellular enzymes (Alberts *et al.*, 2009).

Chemical method of aflatoxin degradation

Chemical methods are used based on the degradation of the aflatoxin structure using chemical compounds.(El-Shanshoury *et al.*, 2022) reported the degradation of aflatoxin using ozone. Total degradation of AFB1 in solution occurred within 900 minutes (15 seconds using 20 wt% ozone). Food and Drug Administration (FDA) approval has resulted in the use of ozone as an antimicrobial agent for food preparation, storage, and processing. Ozone has been used for degradation/decontamination of aflatoxins in fresh juice, degradation of pesticides, pest control and chemical toxicants. Ammonium was one of the first chemical methods studied, and results indicated that it could successfully detoxify aflatoxin-contaminated corn and other commodities (ParK *et al.*, 1988) It reported that ammonia and several other substances actually change or degrade the aflatoxin molecule, most of them are not practical or have safety concerns of potential formation of toxic derivatives or lead to changes in nutrient content and sensory properties product. Plant extracts provide an alternative way to degrade aflatoxins in various foods and feeds. The demand for plant extracts is increasing day by day due to customer satisfaction and the compounds present in the extracts are biodegradable, environment friendly, bio safe, renewable and potentially cheap (Amenyogbe *et al.*, 2022).

Medicinal plant extract for breaking down aflatoxins

Current studies have revealed that aqueous extracts also have chemically active properties against aflatoxins. In recent years, the possible application of medicinal plant extracts for the degradation of aflatoxins has been studied because the compounds available in the extracts are biodegradable, biosafe, environmentally friendly, potentially inexpensive and renewable. Several wild plants are reported to have medicinal properties such as antifungal, antibacterial and antioxidant properties. According to the World Health Organization (WHO), 75% of people worldwide use herbal (medicinal) plants as their primary source of health care. A number of plants are reported to have medicinal properties such as antifungal, antibacterial and antioxidant properties. According to the World Health Organization (WHO), 75% of the world's people use herbal (medicinal) plants as their primary source of health care. A number of medicinal plants have been reported to have the potential to degrade aflatoxins Medicinal plants have been reported to have both positive and negative effects on aflatoxin degradation due to the presence or absence of active ingredients (Bibi, 2011). Medicinal plant extracts are obtained from natural sources and are considered safe for human and animal health. Antifungal and antimicrobial activities of medicinal plants are believed to have a significant impact on their aflatoxin degradation potential. The potential application of aqueous plant extracts for aflatoxin decontamination has been widely studied in recent years because the compounds present in the extracts are biodegradable, environmentally friendly, biosafe, renewable and potentially inexpensive. The aflatoxin degradation potential of 31 medicinal plants was analyzed. Among the plants analyzed, Vasaka (Adhatoda vasica Nees) leaf extract was reported to show greater than or equal to 98% degradation after an incubation period of 24 hours at 37°C. The time period of incubation was also reported to play an important role in the detoxification of aflatoxins, i.e. 69% of AFB1 was degraded within 6 h, while greater than or equal to 95% degradation was noted after 24 h of incubation (Al-Tohamya *et al*., 2018). Thin layer chromatography (TLC) was used to detect aflatoxins. Enzyme-linked immunoassays (ELISA) and liquid chromatography-mass spectrometry (LC–MS) were also used to quantify AFB1. It has been reported that AFB1 was degraded by Thymus daenensis plant extracts. The degradation percentage of AFB1 was reported to be 87%. Thin-layer chromatography was used for aflatoxin detection, while high-performance liquid chromatography (HPLC) was used for AFB1 quantification. AFB1 and AFB2 were reported to be degraded by Corymbia citriodora extracts. The percentage degradation of AFB1 and AFB2 was recorded as 65% and 65%, respectively. 75%. An ELISA test (Enzyme Linked Immune Sorbent Assay) was used for the quantification of aflatoxins. Aflatoxin detection was performed using thin layer chromatography. A number of medicinal plants have been studied for their aflatoxin degradation potential (Tohamy, 2018). A natural plant extract has the ability to degrade aflatoxins in contaminated food and feed (Yin and Cheng, 1998). In several countries, Russia, Japan and India use the natural medicinal plant. Natural medicinal plants have traditionally been used to preserve foods from contaminated aflatoxins (Wilson and Wisniewski, 1992). Antimicrobial agents, antioxidants and antifungals are found in extracts and powders from various spices, herbs and essential oils. Antioxidant and antifungal and antimicrobial activity especially against mycotoxins (aflatoxins) and some of them also prevent aflatoxin formation (Thanaboripat *et al*., 2004). Aflatoxin detoxifies with natural phytochemicals. Natural phytochemicals may be an alternative to synthetic chemicals for aflatoxin detoxification. Various medicinal plants known to fight microbial infections have been reported to have aflatoxin detoxification potential. Some medicinal plant extracts have also been reported to be effective inhibitors of fungal growth and aflatoxin production. The scientist has been reports that aflatoxins are degraded in food by plant products such as plant extracts and plant oils. Natural extracts of medicinal plants are of interest for the degradation of aflatoxins in food and feed as a source of safer (Katsurayama *et al.,* 2018). Medicinal plant extracts are more effective substitutes for synthetic antimicrobials and may provide alternative ways to prevent mold or aflatoxin contamination of food or feed. Aflatoxin growth and aflatoxin production is inhibited by medicinal plant extract. There is no previous report on the use of aquos extract from medicinal plants to decontaminate aflatoxins in contaminated food and feed, although some studies have shown the effectiveness of using aquos extract from medicinal plants contained in food and feed as an additional method. for prevention of natural oxidants and antimicrobial activities (Mahmoud, 1994). The scientist analyzed the extract of a total of 9 spices including garlic (Allium sativum), ginger (Zingiber o cinale), black cumin (Nigella sativum), cloves (Syzygium aromaticum), holy basil (Ocimum basilicum), lemon grass (Cymbopogon citratus L. (DC) Stapf)), thyme (ymus schimperi), fenugreek (Trigonella foenum-graecum) and lemon for AFB1 degradation. A sample of spices (n=81) (3 samples of each spice × 3 markets × 9 types of spices) were purchased from local retailers in Ethiopia. Degradation of AFB1 was performed by HPLC and LC-MS/MS. The degradation test was performed on two types of samples, i.e. commercially available standard AFB1 (T1) and naturally contaminated corn samples (T2). The level of increase in T1 and T2 was 100 ng in 500 µl of plant extract. The contact time was 24 hours. Among the different spice extracts used in the degradation test, garlic extracts showed the maximum degradation potential after 24 h, i.e. 61.7% degradation of AFB1 in T1 and 68.3% reduction in T2 (Negera, and Washe 2019).. It was analyzed that aflatoxins were degraded from peanut seeds (n=50) by Lycium halimifolium. The sample was taken from eastern Algeria. Degraded substances were detected by TLC and HPLC was used to quantify aflatoxins. The degradation test was performed by adding (50 μg) to 250 ml of Lycium halimifolium extract. The sample was placed in a dark room at 37°C for 24 hours. Degradation of aflatoxins by Lycium halimifolium extract in peanut seeds (30) was reported as 60%. (Rao *et al.*, 2017) analyzed aflatoxins (AFB1 and AFB2) degraded by aqueous extracts of Trachyspermum ammi (T.ammi) (n=20). The samples were taken from the Pakistani cities of Lahore and Faisalabad. Degradation of AFB1 and AFB2 in food products was performed by LCMS/MS and HPL. Aflatoxins were degraded by TLC. The degradation test was performed as a standard (100 μg/L) AFB1 and (50 μg/L) AFB2 were added to 250 μL of T. ammi extract to detoxify AFB1 and AFB2. The samples were placed for 24 hours at room temperature for incubation. A control standard was prepared as 50 μL of standard aflatoxins added to 250 μL of water and incubated under the same conditions. Degradation of AFB1 and AFB2 in food was recorded as 92.8 and 91.9%, respectively. T.ammi seed extract was found to be significantly ($P < 0.05$) in the degradation of AFB1 and AFB2. Corymbia citriodora extract was analyzed to play a significant role in the degradation of aflatoxins (AFB1 and AFB2). Quantification of aflatoxin degradation (AFB1 and AFB2) determined by Enzyme-Linked Immune Sorbent Assay (ELISA) and thin-layer chromatography (TLC) was used for aflatoxin detection. For the aflatoxin degradation assay, 50 μL of AFB1 and 50 μL of AFB2 were added to 150 μL of Corymbia citriodora extract and incubated for 24 h. The control standard was prepared as 50 μL of standard aflatoxins added to 150 μL of water and incubated under the same conditions. Degradation of AFB1 and AFB2 was recorded as 66% and 66%, respectively. 76%. The scientist analyzed the aflatoxin decontamination potential of 31 medicinal plant extracts. Aflatoxin AFB1 degradation assay was performed by ELISA when 100 ng of AFB1 was added to 500 μl of medicinal plant extract. Samples were incubated at 37°C for 24 hours and analyzed by ELISA. Detection of aflatoxins was performed by TLC when 100 ng of aflatoxins were mixed with 500 μl of water and incubated at 37°C for 24 h. After incubation, the aflatoxin in the solution was extracted with chloroform. Samples were analyzed by TLC. Further execution of the AFBI assay decontamination study was also performed using LC–MS as 50/100 ng was mixed with 500 μL of A.vasica extract. Samples were incubated at 37°C for 24 hours. After incubation, the decontaminated AFB1 yield was analyzed by LC–MS. Among the plants analyzed, Vasaka (Adhatoda vasica Nees) leaf extract was reported to show the same or higher 98% degradation after an incubation period of >25 h at >38°C. Incubation time was also reported to play an important role in aflatoxin degradation, i.e., >70% of AFB1 was degraded within 6 h, while greater than or equal to 95% decontamination was noted after 24 h of incubation (Vijayanandraj *et al.*, 2017). Velazhahan *et al.*, (2014) analyzed the degradation potential of G1 aflatoxins in 34 medicinal plants. The samples were collected from the herb garden at the Horticulture College and Tamil Nadu Agricultural University, Research Institute, Coimbatore, Tamil Nadu, India. AFG1 assay decontamination was analyzed, standard AFG1 0.5 μg was added to 500 μl T. ammi extract. Samples were incubated at 37 °C for 48 h. AFG1 was analyzed by TLC. Quantification of AFG1 by ELISA, i.e. standard AFG1 50 ng was added with T. ammi extract 500 μL. Among the plants analyzed, Ajowan (Trachyspermum Ammi (L.) Sprague ex Turrill) seed extract was reported to show greater than or equal to 64 % degradation of G1. Aflatoxin G1 was degraded by dialyzed T. Ammi extract was recorded as less than 91%. Degradation of aflatoxins AFB1, AFB2 and AFG2 was recorded as 61%, 54% and 46%, respectively. Incubation time was also reported to play an important role in aflatoxin detoxification, e.g., less than 79%% of AFG1 was degraded within 6 h, while greater than or equal to 90% degradation was noted after 24 h of incubation. Thin layer chromatography (TLC) was used to detect aflatoxins. Enzyme-linked immunoassays (ELISA) and liquid chromatography-mass spectrometry (LC-MS) were also used to quantify AFG1. Aflatoxins detoxified by baobab (Adansonia digitata) extract, which have antioxidant, antimicrobial, antifungal and antibacterial effects against aflatoxins were analyzed. A. digitata fruit pulp powder was purchased from Al Naser Company, Khartoum, Sudan. TLC was used for aflatoxin detection while HPLC for aflatoxin quantification. An aflatoxin decontamination test was performed, i.e. 0.5 µg of standard aflatoxins was added to 500 µl of Adansonia digitata extract. The range of degradation of total aflatoxins and AFB1 was recorded as 47.2-95.7% and 28.1-89.7%, respectively. Aflatoxin degraded by Ageratum conyzoides extract was analyzed. Degradation of aflatoxins was performed using GC/MS and HPLC. Aflatoxins were detected by TLC. Samples were collected from local retailers around Hawassa city, southern nations, nationalities and people's region of Ethiopia. Degradation of aflatoxins was performed by mixing 10 ng with 500 ng of Ageratum conyzoides extract. Aflatoxin is completely degraded at 40 ppb and 20 ppb concentrations, and 10 ppb degrades aflatoxin production to 65%, 65%, and 48%, respectively. Average AFB1 values in contaminated corn samples were recorded at 7.47 ppb. An extract from neem plants (Azadirachtaindica A. juss) was analyzed and used for the degradation of aflatoxin B1. The sample was collected from different districts of Marathwada. Aflatoxins were detected by TLC. Quantification of aflatoxins was performed using the HPLC technique. Neem leaf extract has been shown to have a significant effect on growth and aflatoxin B1 production. Aflatoxin degradation assay was performed when 0.5 µg of standard aflatoxins were mixed with 500 µl of neem leaf extract. The extent of degraded aflatoxin B1 was recorded as 79–89%. A more pronounced effect on aflatoxin B1 was seen at eight days, while no effect on aflatoxin B1 was seen at two days. Average values of degraded aflatoxin were recorded as 0.84 ppb. (Zain, 2011) analyzed aflatoxins were degraded extract from the leaves of the medicinal plant zimmu (Allium sativum) (n=30). Medicinal plants were collected from the herb garden at the Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India. The TLC method was used to detect aflatoxins. Aflatoxin detection assay was performed by TLC, for example 70 ng/ml AFB1 was added with 5 ml of zimmu leaf extract. The sample was incubated at room temperature (28 ± 2C) for 5 days. Decontamination of aflatoxins by zimmu leaf extract was recorded as 73% (Zhao *et al.*, 2017). The scientist analyzed, aflatoxins were decontaminated by medicinal plant products such as Cowdung cake, captan and neem cake, pongamia cake, W. somnifera, H. suaveolens, E. citriodora, sinensis, C. medica and P. granatum. Samples were collected from local market in Shimoga and India, wastelands in Shimoga district, around Kuvempu University campus and fruit markets and juice shops. Quantification of aflatoxins was performed by ELISA, i.e. 20 g of soybean powder was mixed with 20 ml of water. The sample is placed in a 250 ml Erlenmeyer flask. 1 ml of aflatoxin B1 was added. The mean values of degraded aflatoxin B1 by captan, neem cake, pongamia cake, W. somnifera, H. suaveolens, E. citriodora, sinensis, C. medica and P. granatum were recorded as 0.82, 0.34, 0.43, 0 .56, 0.546, 0.546, 0.81, 0.43 and 0.46 ppb respectively (Krishnamachari *et al.*, 1975).

Conflict of Interest

The authors have not declared any conflict of interest.

Authors Contributions

All the authors have contributed equally to the research and compiling the data as well as editing the manuscript.

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