**Mycotoxins – Limits and Regulations**

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**ABSTRACT:** Since early years, a need has always been felt for some control on the quality of foodstuffs. With the discovery of aflatoxins in the early sixties, health authorities in man countries have become active in establishing regulations to protect their citizens and livestock from potential harm caused by mycotoxins. FDA mycotoxins-in-foods sampling program is continuing with an objective to remove those foods from interstate commerce that contain Aflatoxins “at levels judged to be of regulator significance” Aflatoxins, Fumonisins B1 and B2, Deoxynivalenol (DON) Ochratoxin A and Patulin occur in a number of food products. FDA workers were instructed to sample and analyze all products for different types of mycotoxins. All baby foods should always be analyzed for all type of mycotoxins. The limits of Aflatoxins B1,B2,<G2, and M1 in foods and feed stuffs varies from (0-40) ppb for foods & 0-1000ppb for food); for Ochratoxin A(0-50 ppb in food and 0-1000ppb in feed); for Don (500-2000ppb in food & 5-10,000 ppb in feed); for Zearalenone (0-1000 ppb in food); for Patulin (0-50 ppb in foods), for Diacetoxyscirpenol (0-100 ppd in feed); for chetomin (0ppb in feed); for stachybotryotoxin (0ppb in feeds and for Fumonisins (0-1000 ppb in food 5000-50,000 ppb in feedstuffs ).

**Keywords:** Mycotoxins.

**INTRODUCTION**

Mycotoxins are generally defined as metabolites of fungi, which evoke pathological changes in man and animals. The disease caused by mycotoxins as been known for a long time and is known as mycotoxicosis. The first recognized mycotoxins as bee known for a long time and is known as mycotoxicosis. The first recognized mycotoxicosis was probably ergotism, which is characterized by necrosis and gangrene and was better known in the middle ages in Europe under the name “Holy fire”; this was caused by the intake of grains contaminated with sclerotia of claviceps purpurea(1).

Another mycotoxicosis, recognized to have seriously affected human populations is Alimentary Toxic Aleukia (ATA). The symptoms of this disease include leucopenia, necrotic lesions of the oral cavity, oesophagus and stomach, sepsis, haemorrhagic diathesis and exhaustion of the bone marrow. The disease was induced by the intake of mouldy grain and occurred in man areas of Russia. The fungi responsible for these symptoms belong to the genera fusarium and cladosporium (2).

In Japan, toxicity associated with yellow coloured mouldy rice as bee a problem especially after world War II, when rice ad
to be imported from various countries. The intake of this rice by humans caused vomiting, convulsions and ascending paralysis. Death could also occur within 1-3 days after occurrence of these symptoms. The toxin producing fungi in yellow rice belongs to the genus penicillium \(^\text{3}\).

Outbreaks of other mycotoxicosis have been reported in man countries, such as disease of pigs and horses associated with the ingestion of barley infected with fusarium graminearum in USA \(^\text{4}\). Stachybotryotoxicosis of horses in the USSR; facial eczema in sheep in New Zealand due to the fungus pithomyces Chartarum \(^\text{5}\); and Alimentary Toxic aleukia were reported in eastern Siberia, which was caused by fusaria growing on grain that ad overwintered on the ground \(^\text{6}\). Another food borne disease outbreak as been attributed to the consumption of mould sorghum and maize containing fumonisini B1 in the Deccan plateau in India \(^\text{7}\).

Despite various outbreaks of diseases, mycotoxicosis remained the “neglected disease” until the earl sixties. Wit the sudden outbreak of Turkey-X-disease in Great Britain, the attitude changed drastically, with in few months, more than 1 lakh turkeys died followed by the death of thousands of ducklings and young pheasants. Investigations showed that the toxic factor occurring in Brazilian groundnut meal, which was used as feed, caused this disease \(^\text{8}\).

This toxic factor was produced by two fungi aspergillus parasiticus and aspergillus flavus, and was named aflatoxin. In the decades following the outbreak of turkey-x-disease, a wealth of information about aflatoxin and many other mycotoxins having a large variety of chemical structures with different biological effects in man and animals are known. It is clear that the presence of these mycotoxins in foods and feeds are undesirable and should be kept as low as possible. Today the food laws not only prohibit the introduction, delivery for introduction or receipt in commerce of adulterated or misbranded food, but often the include specific regulations that impose limits or tolerances on the concentration of particular contaminants in foods, such contaminants may be of industrial or natural origin. Since mycotoxins are natural contaminants exposure to some level of toxins must be tolerated \(^\text{9}\).

They are also the most recent contaminants to be considered because of their implications for public health and their economic consequences, on particular with relation to the international food trade consequently when limits are being assessed public health authorities have to balance the need to reduce consumers’ exposure to mycotoxins. However the differences between tolerances in the various countries may sometimes be quite large, depending on geographic and agronomic characteristics, political strategy, state of industrialization and economic achievement, aflatoxin which was first noted near 1960’s has been of significant health concern ever since with persistent trade problems, specific mycotoxins regulations are developed in several countries, initially referring only to aflatoxins, later regulations for other mycotoxins such as Deoxynivalenol, Ochratoxin A, patulin, citrinin and Zearalenone were also included in the food regulations for some countries.

In 1988, a first attempt was made to get an overview of worldwide limits and regulations for aflatoxins and other mycotoxins in foods and feeds, resulting in a few publication \(^\text{10, 11}\).
Rationales for mycotoxin Regulations \(^{(12, 13)}\)

The need for regulations imposing limits to the concentration of mycotoxins in foods and feeds are generally recognized in developed countries and most of them have specific mycotoxin regulations. In addition to the other factors already mentioned earlier, the choice of limits for mycotoxin regulations. In addition to the other factors already mentioned earlier, the choice of limits for mycotoxins depends on availability of toxicological data, data on the occurrence of mycotoxins in various commodities, availability of methods of sampling and analysis, implications for intercountry trade and the existence of sufficient food supply.

Regulator data for only 13 mycotoxins in different countries are available. This article is an effort to summarize the available data form scientific publications and other sources to form a concise database for reference \(^{(14)}\). The maximum tolerated levels of mycotoxins in foodstuffs; dairy products and animal feedstuffs for each country are presented in the following tables.

**Table 1:- Limits for aflatoxins B1, B2,G1,G2 and M1 in foodstuffs, Dairy Products and animal feedstuffs.**

| Countries   | Commodities                                                                 | Mycotoxins         | Limits(ppd) | References |
|-------------|-----------------------------------------------------------------------------|--------------------|-------------|------------|
| Argentina   | -groundnut, peanut, maize & by products<br>-Infant food<br>-Infant food based on cereals<br>-Infant food based on milk Products<br>-Liquid milk, Powdered milk<br>-Milk Products<br>-Soya meal | B1                  | 5           | 10         |
|             |                                                                             | B1, B2, G1, G2     | 20          |            |
|             |                                                                             | B1                 | 0           |            |
|             |                                                                             | B1, B2, G1, G2     | N.D         |            |
|             |                                                                             | M1                 | N.D         |            |
|             |                                                                             | M1                 | 0.05        |            |
|             |                                                                             | M1                 | 0.5         |            |
|             |                                                                             | B1                 | 30          |            |
| Australia   | -peanut, peanut butter, nuts & nut products<br>-all other foods             | B1, B2, G1, G2     | 15          | 10         |
|             |                                                                             | B1, B2, G1, G2     | 5           |            |
| Austria     | -all foods except meal and husked products<br>-meal and husked products<br>-milling, shelled & derived products<br>-pasteurized fresh milk, baby & children’s milk, reconstituted milk food for children<br>-other milk & it’s products<br>-whey, liquid we products | B1                  | 1           | 10,15,16   |
|             |                                                                             | B1, B2, G1, G2     | 6           |            |
|             |                                                                             | B1                 | 2           |            |
|             |                                                                             | B1, B2, G1, G2     | 6           |            |
|             |                                                                             | B1                 | 2           |            |
|             |                                                                             | B2, G1, G2         | 5           |            |
|             |                                                                             | M1                 | 0.01        |            |
|             |                                                                             | M1                 | 0.005       |            |
|             |                                                                             | M1                 | 0.025       |            |
| Country               | Foods                                                                 | Allergen Categories | Limit |
|----------------------|----------------------------------------------------------------------|---------------------|-------|
| Bahamas              | -all food & grains                                                   | B1,B2,G1,G2         | 20    |
|                     |                                                                     |                     | 17    |
| Brabados             | -milk                                                                | M1                  | 0.05  |
|                     | -all other foods                                                     | M1                  | 0.02  |
|                     | -all feedstuffs                                                      | M1                  | 0.25  |
|                     |                                                                     | B1,B2,G1,G2 & M1    | 0.4   |
|                     |                                                                     |                     | 0.02  |
| Belgium              | -peanuts                                                             | B1                  | 5     |
|                     | -milk, powdered milk & condensed milk (reconstituted)                | M1                  | 0.1   |
|                     | -feed (see Europen Union)                                            |                     | 15,18 |
| Belgie               | -corn, peanuts, maize, groundnuts                                    | B1,B2,G1,G2         | 20    |
|                     |                                                                     |                     | 17    |
| Bosnia & Herzegovina| - Wheat, maize, rice, cereals                                       | B1,G1               | 1     |
|                     | -beans                                                               | B1,G1               | 5     |
|                     |                                                                     |                     | 12    |
| Brail                | -all foodstuffs                                                      | B1                  | 15    |
|                     | -imported foodstuffs                                                 | B1,B2,G1,G2         | 30    |
|                     | -industrially prepd. foodstuffs for school meals for children 0-2 yrs. F age | B1                  | 5     |
|                     | -maize groundnut                                                     | B1,B2,G1,G2         | 10    |
|                     | -milk (products)                                                     | B1                  | 3     |
|                     | -imported milk (products)                                            | B1,B2,G1,G2         | 30    |
|                     | -peanut meal (feed)                                                  | B1,G1               | 0.5   |
|                     |                                                                     | M1                  | 0.1   |
|                     |                                                                     |                     | 50    |
|                     |                                                                     |                     |       |
| Bulgaria             | -peanuts, kernels & their products, coca beans, cocoa butter, cocoa powder, cocoa powder | B1,B2,G1,G2         | 5     |
|                     | -grains, cereals & their products                                    | B1,B2,G1,G2         | 2.5   |
|                     | -liquid milk products, cheese & similar products                     | M1                  | 0.5   |
|                     | -powdered milk                                                       | M1                  | 0.1   |
|                     | -powdered milk for dietetics & infant feeding                        | M1                  | 0     |
| Canada               | - nut & it’s products                                                | B1,B2,G1,G2         | 15    |
|                     | -animal feedstuffs                                                   | All aflatoxin       | 20    |
|                     |                                                                     |                     | 10,15 |
| Chile                | -feedstuffs                                                          | B1                  | 5-20  |
|                     |                                                                     | B1,B2,G1,G2         | 20-50 |
| Country           | Foods & Feedstuffs                                                                 | Countries Represented | Percentage |
|-------------------|-------------------------------------------------------------------------------------|------------------------|------------|
| China             | - rice, edible oils                                                                  | B1, B1, B1, B1         | 10         |
|                   | - maize, peanut products                                                             |                        | 20         |
|                   | - wheat, barley, oats, grains, fermented foodstuffs                                   |                        | 5          |
|                   | - cow’s milk & its products                                                          |                        | 0.5        |
|                   | - compound feed for laying hens & fattening pigs                                     |                        | 20         |
|                   | - maize, peanut cake, peanut residue                                                  |                        | 50         |
| Colombia          | - foods                                                                             | B1, B2, G1, G2         | 20         |
|                   | - cereals, grains, (sorghum, millets)                                               | B1, B2, G1, G2         | 30         |
|                   | - oil seeds (peanuts)                                                                | B1, B2, G1, G2         | 10         |
|                   | - cattle feed                                                                       | B1, B2, G1, G2         | 50         |
|                   | - sesame seeds, poultry feedstuffs                                                   | B1, B2, G1, G2         | 20         |
| Costa Rica        | - corn for human consumption                                                         | B1, B2, G1, G2         | 35         |
|                   | - maize (feed)                                                                      | B1, B2, G1, G2         | 50         |
| Coted’ Ivoire     | - Straight feedstuffs                                                                | B1, B2, G1, G2         | 100        |
|                   | - complete feedstuffs                                                                | B1, B2, G1, G2         | 10         |
|                   | - complete feedstuffs for pigs/poultry                                              | B1, B2, G1, G2         | 38         |
|                   | - complete feedstuffs for cattle/sheep/goats                                        | B1, B2, G1, G2         | 75         |
|                   | - complete feedstuffs for dairy cattle                                               | B1, B2, G1, G2         | 50         |
| Cuba              | - foods, cereals, peanuts, groundnuts                                                | B1, B2, G1, G2         | 5          |
|                   | - feedstuffs, raw materials for feedstuffs                                           | B1, B2, G1, G2         | 5          |
| Cyprus            | - cereals, pulses, oilseeds, dried fruit, sesame & foods produced exclusively for    | B1, B2, G1, G2         | 5          |
|                   | these, caraway seed, poppy seeds & other seeds used in baker products & confectionery |                        | 10         |
| Czech & Slovak    | - all foods except reconstituted baby milk.                                          | B1, B2, G1, G2, M1     | 5          |
| Republics         | Infant food, children’s food & other baby foods & milk                              | B1, B2, G1, G2, M1     | 5          |
|                   | - reconstituted baby milk                                                            | B1, B2, G1, G2, M1     | 0.1        |
|                   |                                                                                     |                        | 10, 15     |
| Country                  | Products                                                                 | B1, B2, G1, G2 (Other) | M1 (Other) | B1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | Notes |
|-------------------------|--------------------------------------------------------------------------|------------------------|------------|------------|------------------------|------------|------------------------|------------|------------------------|------------|------------------------|------------|-------|
| Denmark                 | - Other baby food<br>- Liquid milk<br>- Foods including peanuts & it’s products, Brazil nuts, dried figs<br>- Raw materials for manufacturing foods before cleaning read for processing<br>- Feed (see European Union) | B1 | B1 | B1, B2, G1, G2 | B1, B2, G1, G2 | 2 | 10, 12, 19 |
| Dominican Republic      | - Imported corn<br>- Corn, tomatoes & their products, peanut, soya, groundnut | B1, B2, G1, G2 | B1, G1 | B1, B2, G1, G2 | B1 | 20 | 17 |
| Egypt                   | - Peanuts, oil seeds, cereals & their products<br>- Maize<br>- Starch & it’s derivatives<br>- Milk & dairy products<br>- Animal & poultry fodder | B1 | B1, B2, G1, G2 | B1, B2, G1, G2 | B1, B2, G1, G2 | 5 | 12 |
| El Salvador             | - All foods<br>- Feedstuffs | B1, B2, G1, G2 | B1 | B1, B2, G1, G2 | B1 | 20 | 17 |
| European Union          | - Cereals, nut, nut products & dried fruits<br>- Milk & it’s products<br>- Baby & infant food<br>- Straight feedstuffs like groundnut, copra, palmunt, cottonseed, babassu, maize & their products<br>- Complete feedstuffs for cattle & sheep except their young ones<br>- Complete feedstuffs for calves, lambs<br>- Complete feedstuffs for others<br>- Complementary feed for pigs, poultry except their | B1 | M1 | B1 | M1 | B1 | 2-4 | 10 | 20 | 0.05 | 1-2 | 0.05 | 20-50 |

| Country                  | Products                                                                 | B1, B2, G1, G2 (Other) | M1 (Other) | B1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | Notes |
|-------------------------|--------------------------------------------------------------------------|------------------------|------------|------------|------------------------|------------|------------------------|------------|------------------------|------------|------------------------|------------|-------|
| Denmark                 | - Other baby food<br>- Liquid milk<br>- Foods including peanuts & it’s products, Brazil nuts, dried figs<br>- Raw materials for manufacturing foods before cleaning read for processing<br>- Feed (see European Union) | B1 | B1 | B1, B2, G1, G2 | B1, B2, G1, G2 | 2 | 10, 12, 19 |
| Dominican Republic      | - Imported corn<br>- Corn, tomatoes & their products, peanut, soya, groundnut | B1, B2, G1, G2 | B1, G1 | B1, B2, G1, G2 | B1 | 20 | 17 |
| Egypt                   | - Peanuts, oil seeds, cereals & their products<br>- Maize<br>- Starch & it’s derivatives<br>- Milk & dairy products<br>- Animal & poultry fodder | B1 | B1, B2, G1, G2 | B1, B2, G1, G2 | B1, B2, G1, G2 | 5 | 12 |
| El Salvador             | - All foods<br>- Feedstuffs | B1, B2, G1, G2 | B1 | B1, B2, G1, G2 | B1 | 20 | 17 |
| European Union          | - Cereals, nut, nut products & dried fruits<br>- Milk & it’s products<br>- Baby & infant food<br>- Straight feedstuffs like groundnut, copra, palmunt, cottonseed, babassu, maize & their products<br>- Complete feedstuffs for cattle & sheep except their young ones<br>- Complete feedstuffs for calves, lambs<br>- Complete feedstuffs for others<br>- Complementary feed for pigs, poultry except their | B1 | M1 | B1 | M1 | B1 | 2-4 | 10 | 20 | 0.05 | 1-2 | 0.05 | 20-50 |

| Country                  | Products                                                                 | B1, B2, G1, G2 (Other) | M1 (Other) | B1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | B1, B2, G1, G2 (Other) | M1 (Other) | Notes |
|-------------------------|--------------------------------------------------------------------------|------------------------|------------|------------|------------------------|------------|------------------------|------------|------------------------|------------|------------------------|------------|-------|
| Denmark                 | - Other baby food<br>- Liquid milk<br>- Foods including peanuts & it’s products, Brazil nuts, dried figs<br>- Raw materials for manufacturing foods before cleaning read for processing<br>- Feed (see European Union) | B1 | B1 | B1, B2, G1, G2 | B1, B2, G1, G2 | 2 | 10, 12, 19 |
| Dominican Republic      | - Imported corn<br>- Corn, tomatoes & their products, peanut, soya, groundnut | B1, B2, G1, G2 | B1, G1 | B1, B2, G1, G2 | B1 | 20 | 17 |
| Egypt                   | - Peanuts, oil seeds, cereals & their products<br>- Maize<br>- Starch & it’s derivatives<br>- Milk & dairy products<br>- Animal & poultry fodder | B1 | B1, B2, G1, G2 | B1, B2, G1, G2 | B1, B2, G1, G2 | 5 | 12 |
| El Salvador             | - All foods<br>- Feedstuffs | B1, B2, G1, G2 | B1 | B1, B2, G1, G2 | B1 | 20 | 17 |
| European Union          | - Cereals, nut, nut products & dried fruits<br>- Milk & it’s products<br>- Baby & infant food<br>- Straight feedstuffs like groundnut, copra, palmunt, cottonseed, babassu, maize & their products<br>- Complete feedstuffs for cattle & sheep except their young ones<br>- Complete feedstuffs for calves, lambs<br>- Complete feedstuffs for others<br>- Complementary feed for pigs, poultry except their | B1 | M1 | B1 | M1 | B1 | 2-4 | 10 | 20 | 0.05 | 1-2 | 0.05 | 20-50 |
| Country          | Description                                                                 | Level | Limit  |
|------------------|-----------------------------------------------------------------------------|-------|--------|
| Finnish          | All foods except meat, orgn, milk or cream - feed (see European Union)       | B1,B2,G1,G2 | 5      | 10,15,19 |
| French           | Any food for which level as not been fixed - peanuts, pistachios almonds, oilseeds, other than those used for prepn. Of vegetable oils, children food - all cereals - white wheat flour - wheat bran (raw) - whole wheat flour obtained from all the components of grain - all vegetable oils, virgin or mixed with refined oil - food products readily consumed by children - milk for direct consumption or for prepn. Of dairy products - liquid milk for infant food (under 3 yrs) - milk powder - milk powder for infants below 3 yrs (for feed see E. Union) | B1     | 10     | 10       |
| German           | All foods except enzymes & its preps. Intended for the production of food stuffs - enzymes & its preps intended for the preparation of food stuffs - milk - dietetic foods for babies & | B1,B2,G1,G2 | 4      | 10       |
| Country   | Products                                                                 | Tariff | EU Codes |
|-----------|---------------------------------------------------------------------------|--------|----------|
| Greece    | Infants - feed (see European Union): dried fruits like peanuts, hazelnuts, | M1     | 001      |
|           | walnuts, cashews, pistachios, almonds, pumpkin seeds, sunflower seeds,    |        |          |
|           | pine seeds, apricot seeds, maize, dried figs, dried apricots, dried      |        |          |
|           | prunes, dates, resins, plums, pears, grapes - feed (see European Union)   | B1,B2,G1,G2 | 10 | 10,12,20 |
| Guatemala | Corn, kidney beans, rice, sorghum, peanuts, 7 peanut butter - feed       | B1,B2,G1,G2 | 20 | 17 |
|           | concentrate - grounded or whole corn - baby foods - milk & its products   | B1,B2,G1,G2 | 20 | 17 |
|           | cheeses - all other foods                                                 | B1,B2,G1,G2 | 1  |          |
| Honduras  | - all foods: Groundnut kernels - groundnuts - milk products               | B1,B2,G1,G2 | 10 | 18 |
| Hong Kong | - Peanut & it’s products - any food other than peanuts                     | B1,B2,G1,G2 | 20 | 10 |
|           |                                                                          | M1,M2,P1, | 15 |          |
|           |                                                                          | B1,B2,G1,G2 | 20 |          |
|           |                                                                          | M1,M2,P1, |    |          |
| Hungary   | - Groundnut kernels - groundnuts - milk products                         | B1,B2,G1,G2 | 10 | 18 |
| India     | - all foods: Peanut meal (export)                                         | B1     | 30 | 15,21,22 |
|           |                                                                          | B1     | 120 |          |
| Indonesia | - Copra in cow pig, duck, sheep feed - groundnut, sesame seed,           | B1,B2,G1,G2 | 10000 | 12 |
|           | rapeseed meal - cassava in chicken feed - capok seed, coconut meal in    | B1,B2,G1,G2 | 200 |          |
|           | chicken feed & cow/pig duck/sheep feed - sunflower seed meal in           | B1,B2,G1,G2 | 120 |          |
|           | chicken feed - others                                                     | B1,B2,G1,G2 | 100 |          |
|           |                                                                          | B1,B2,G1,G2 | 90 |          |
| Iran      | - all foods                                                               | B1,B2,G1,G2 | 30 | 10 |
| Ireland   | - all foods                                                               | B1     | 5  | 15 |
| Country                          | Products & Feedstuffs                                                                 | B1, B2, G1, G2 | 30 | 18 |
|---------------------------------|--------------------------------------------------------------------------------------|---------------|----|----|
| Israel                          | nuts, peanuts, fig & their products & corn meal                                       | B1, B2, G1, G2|    |    |
|                                 | milk & milk powder                                                                   | M1            |    |    |
| Italy                           | all foods including dried figs                                                        | B1, B2, G1, G2| 10 | 12 |
|                                 | spices                                                                               | B1            |  5 |    |
|                                 | fed (see EUROPEAN Union)                                                             | B1, B2, G1, G2| 40 |    |
|                                 |                                                                                     | B1            |  20|    |
| Jamaica                         | foods & grains                                                                        | B1, B2, G1, G2| 20 | 17 |
| Japan                           | all foods                                                                            | B1            |    | 10 |
|                                 | imported peanut meal feed                                                            | B1            | 1000|    |
| Jordan                          | almonds, cereals, maize, peanuts, pistachios, pine nuts, rice, allepo & cedar nuts   | B1, B2, G1, G2| 15 | 10 |
|                                 | walnuts                                                                              | B1            | 30 |    |
|                                 | all feedstuffs                                                                        | B1, B2, G1, G2| 15 | 10 |
| Kenya                           | peanut & it’s products & vegetable oils                                              | B1, B2, G1, G2| 20 | 10 |
| Luxembourg                      | peanut & it’s products                                                               | B1            |    | 15 |
|                                 | feed (see EUROPEAN Union)                                                            | B1            |    |    |
| Macedonia                       | Wheat, maize, rice, cereals beans                                                    | B1, G1        |  1 | 12 |
|                                 |                                                                                        | B1, G1        |  5 |    |
| Malawi                          | peanuts for export                                                                   | B1            |    | 10,15 |
| Malaysia                        | all foods                                                                            | B1, B2, G1, G2| 10 | 10 |
| Mauritius                       | peanuts, groundnuts                                                                  | B1, B2, G1, G2|  5 |    |
|                                 |                                                                                        | B1            | 15 |    |
|                                 |                                                                                        | B1, B2, G1, G2| 5  |    |
|                                 |                                                                                        | B1, B2, G1, G2| 10 |    |
|                                 | other foods                                                                           | M1            |  0.5| 12 |
|                                 |                                                                                        | M1            |    |    |
| Mercosur (Argentina, Uruguay,   | Maize kernels, maize flour meal, peanuts it’s products                               | B1, B2, G1, G2|    |    |
| Brazil & Paraguay)              | fluid milk                                                                            | M1            |  0.5|    |
|                                 | milk powder                                                                           | M1            |    |    |
|                                 |                                                                                        | M1            |    |    |
| Mexico                          | all foods                                                                             | B1, B2, G1, G2|    |    |
|                                 | flour                                                                                | All aflatoxin |  20| 17 |
|                                 | feedstuffs for bovine & porcine fattening                                           | B1, B2, G1, G2|    |    |
|                                 |                                                                                        | B1, B2, G1, G2|    |    |
|                                 | feedstuffs for dairy cattle/poultry                                                  | B1, B2, G1, G2|    |    |
|                                 |                                                                                        | B1, B2, G1, G2|    |    |
| Netherland                      | all food & drink products & raw produce (except peanuts kept in stock for the        | B1            |  5 | 10,20 |
| Country      | Foodstuffs and Products                                                                 | Codes | ceilings | Action  |
|--------------|-----------------------------------------------------------------------------------------|-------|----------|---------|
| New Zealand  | - peanut butter, shelled nuts & the nut portion of products containing nuts              | B1,B2,G1,G2 | 15       | 10      |
|              | - all other foods                                                                        | B1,B2,G1,G2 | 5        |         |
| Nigeria      | - infant foods                                                                          | B1    | 0        |         |
|              | - all other foods                                                                        | B1    | 20       |         |
|              | - fluid milk                                                                            | M1    | 1        |         |
|              | - feedstuffs                                                                            | B1    | 50       |         |
| Norway       | - all foodstuffs including Brail nuts, buck wheat missed feedstuffs                      | B1,B2,G1,G2 | 5        | 15,19   |
|              |                                                                                         | B1    | 10-50    |         |
| Oman         | - complete feedstuffs for poultry                                                       | B1    | 20       | 12      |
|              | - other feedstuffs                                                                      | B1    | 10       |         |
| Peru         | - all foods                                                                             | B1,B2,G1,G2 | 10       |         |
|              | - all foods                                                                             | B1,B2,G1,G2 | 10       | 17      |
|              | - complementary feedstuffs                                                             | B1,B2,G1,G2 | 10       | 17      |
|              | - cereals for porcine growing feedstuffs                                               | B1,B2,G1,G2 | 100      |         |
| Philippines  | - nuts and its products & all foods                                                     | B1,B2,G1,G2 | 20       | 10      |
|              | - poultry feedstuffs foods                                                               | B1,B2,G1,G2 | 20       | 10      |
|              | - livestock feedstuffs                                                                  | B1,B2,G1,G2 | 50       |         |
| Poland       | - all foods                                                                             | B1    | 0        |         |
|              | - feedstuffs and their ingredients, complete feedstuffs for cattle/sheep/goats         | B1    | 50       | 15      |
|              | - complete feedstuffs for pigs, poultry and dairy cows                                 | B1    | 0        |         |
| Portugal     | - peanuts                                                                               | B1    | 25       | 15      |
|              | - infant foods                                                                          | B1    | 5        |         |
|              | - other foodstuffs                                                                       | B1    | 20       |         |
| Romania      | - all foods                                                                             | B1,B2,G1,G2 | 0        | 15      |
|              | - milk and diary products                                                                | M1    | 0        |         |
|              | - all feedstuffs                                                                        | B1,B2,G1,G2 | 50       |         |
| Russia       | - animals fats                                                                          | B1    | 0        |         |
| Country   | Foods                                                                 | Category | Mycotoxin | Level | Reference |
|-----------|------------------------------------------------------------------------|----------|-----------|-------|-----------|
| Saudi Arabia | - bottled fruits and vegetables  
- all others foods  
- milk and milk products | B1, B2, G1, G2 | 0.5       | 15    | 10        |
| Senegal   | - peanut products as straight feedstuffs  
- peanut products as feedstuff | B1, B2, G1, G2 | 50        | 12    | 10        |
| Serbia    | - wheat, maize, rice cereals  
- beans | B1, B2, G1, G2 | 1, 15     | 12    | 10        |
| Singapore | - all foods | All mycotoxins | n.d       | 10    | 10        |
| South Africa | - all foods  
- milk and milk products | B1, B2, G1, G2 | 5, 10     | 10    | 10        |
| South Korea | - grains, beans, peanuts and their simple processed foods | B1 | 10        | 10    | 10        |
| Spain     | - all foods for human consumption  
- feeds (see European Union) | B1, B2, G1, G2 | 5, 10     | 10    | 10        |
| Sri Lanka | - groundnuts and other oilseeds, flour and cereals  
- baby foods till 3 yrs.  
- milk and its products | B1, B2, G1, G2 | 30, 1     | 10    | 10        |
| St. Vincent | - imported corn  
- corn and its products, peanuts, soya, tomatoes and its products | B1, B2, G1, G2 | 20, 1     | 17    | 17        |
| Surinam   | - peanuts, peanut products, pulses, groundnuts and their products, legumes  
- corn  
- feedstuffs | B1, B2, G1, G2 | 5, 30     | 17    | 17        |
| Sweden    | - all foods  
- liquid milk products  
- feedstuff ingredients  
- mixed feed  
- complete feedstuffs | B1, B2, G1, G2 | 5, 0.05, 1-50, 3 | 10, 15, 19, 20 |
| Country                        | Foodstuffs                                                                 | Mycotoxins Status | Limit (ppb) | Reference |
|-------------------------------|-----------------------------------------------------------------------------|-------------------|-------------|-----------|
| Switzerland                   | all foodstuff except maize and cereals                                      | B1, B1, B2, G1, G2 | 1           | 6         |
|                               | maize and cereals (in grains or ground)                                     | B1, B1, B2, G1, G2 | 6           | 2         |
|                               | Herbs                                                                        | B1, B2, G1, G2    | 5           | 5         |
|                               | baby/infant food                                                             | M1, B1, B2, G1, G2 | 0.02        | 0.025-0.05 |
|                               | milk and dairy products                                                      | M1                | 0.25        |           |
|                               | cheese                                                                       |                   |             |           |
|                               | rice, sorghum, legumes, cereals and nuts                                     | B1, B2, G1, G2    | 20          | 15        |
|                               | feeds, oilseed meals                                                         | B1, B2, G1, G2    | 1000        |           |
|                               | Herbs                                                                        |                   |             |           |
|                               | baby/infant food                                                             |                   |             |           |
|                               | milk and dairy products                                                      |                   |             |           |
|                               | cheese                                                                       |                   |             |           |
|                               | rice, sorghum, legumes, cereals and nuts                                     |                   |             |           |
|                               | feeds, oilseed meals                                                         |                   |             |           |
|                               | All foods including oils and fats                                            | B1, B2, G1, G2    | 20          | 10        |
| Trinidad and Tobago           | all foods                                                                    | B1, B2, G1, G2    | 10          | 0         |
|                               | ice cream                                                                    | All mycotoxins    | 0           | 10        |
|                               | feedstuffs                                                                   | B1, B2, G1, G2    | 17          |           |
|                               | all foodstuffs except infant foods                                           | B1, B2, G1, G2    | 5           | 10        |
|                               | infant foods                                                                 | B1, B2, G1, G2    | 20          | 10        |
|                               | milk and milk products                                                       | B1, B2, G1, G2    | 2           | 0.5       |
| United states of America      | all foods                                                                    | B1, B2, G1, G2    | 20          | 10, 26, 27, 28 |
|                               | -whole milk, low fat milk ad skim milk                                       | M1                | 0.5         |           |
|                               | -feedstuff ingredients                                                       | B1, B2, G1, G2    | 20          |           |
|                               | -cottonseed meal intended for beef cattle swine, poultry feedstuffs          | B1, B2, G1, G2    | 300         |           |
|                               | -maize and peanut product for beef cattle swine or poultry                   | B1, B2, G1, G2    | 100-300     |           |
|                               | -butter                                                                      | B1, B2, G1, G2    | 20          | 10        |
|                               | -butter, milk and milk products                                              | M1                | 0.5         |           |
|                               | -fats and spices                                                             | B1, B2, G1, G2    | 30          |           |
|                               | -peanuts, dried fruits& products, texturized soyprotein products (flour,     | B1, B2, G1, G2    | 10          |           |
|                               |      starch concentrate                                                      | B1, B2, G1, G2    | 3           |           |
|                               | -cocoa beans                                                                 | B1, B2, G1, G2    | 5           |           |
|                               | -infant foods                                                                | B1, B2, G1, G2    | 17          |           |
| Venezuela                     | rice flour                                                                   | B1, B2, G1, G2    | 5           | 17        |
| Countries     | Commodities                                                                 | Limits | References |
|---------------|----------------------------------------------------------------------------|--------|------------|
| Zimbabwe      | -feed stuffs                                                               | B1,B2,G1,G2 | 20         |            |
|               | -foods                                                                     | B1,G1 | 5          | 18         |
|               | -groundnuts, Maize, sorghum peanut butter, cereals, flour and bread         | B1     | 4          |            |
|               | -poultry feed                                                              | G1     | 5          |            |
|               |                                                                             | B1     | 4          |            |
|               |                                                                             | G1     | 20         |            |
|               |                                                                             | B1,B2,G1,G2 | 10         |            |

Table 2:- Limits of Ochratoxin a in foodstuffs, dairy products and animal feedstuff (29).

| Countries       | Commodities                                                                 | Limits   | References |
|-----------------|-----------------------------------------------------------------------------|----------|------------|
| Austria         | -wheat, rice, durum, wheat                                                  | 5        | 10,15,16   |
| Brazil          | -rice, barley, beans, maize                                                 | 50       | 17         |
| Czech Republic  | -all foods                                                                  | 20       | 10,15      |
|                 | -infant foods                                                               | 5        |            |
| Denmark         | -pig kidneys                                                                | 10-25    | 19         |
|                 | -cereal products                                                            | 5        |            |
| France          | -cereals                                                                    | 5        | 10         |
| Greece          | -raw coffee beans, apple juice, apple products                              | 20       | 10,12,20   |
| Hungary         | -all foods                                                                  | 20       | 30         |
| Israel          | -cereal products, pulse products                                            | 50       | 30         |
|                 | -grain for feed                                                             | 300      |            |
| Netherlands     | -cereals                                                                    | 3        | 31         |
| Romania         | -all foods                                                                  | 5        | 15         |
|                 | -feed                                                                       | 5        |            |
| Sweden          | -feedstuffs for poultry                                                     | 200      | 10,15,19,20|
|                 | -feedstuffs for pigs                                                        | 100      |            |
| Switzerland     | -cereal products                                                            | 2        | 23         |
| Uruguay         | -rice, barley, beans, coffee, maize                                         | 50       | 17         |
| United kingdom  | -cereals                                                                    | 10       | 31         |

Table3:- Limits for Deoxynivalenol in foodstuffs, dairy products and animal feedstuffs.
| Countries  | Commodities                                           | Mycotoxins       | Limits (ppd) | References |
|------------|-------------------------------------------------------|------------------|--------------|------------|
| USA        | -feed for horses                                      | Fumonisin B1     | 500          | 28         |
|            | -feed for swinr                                       |                  | 10,000       | 32         |
|            | -feed for beef cattle & poultry                       |                  | 50,000       |            |
| South Africa| -corns & corn products                               | Fumonisin        | 100-200      | 30         |

Table 5:- Limits for Zearalenone in food stuffs, Dairy products and animal feedstuffs.

| Countries   | Commodities                                      | Limits (ppd) | References |
|-------------|--------------------------------------------------|--------------|------------|
| Austria     | -wheat re, durum wheat                           | 60           | 10,15,16   |
| France      | -maize                                           | 200          | 10,15      |
|             | -cereals, vegetable oils                          | 200          | 10         |
| Hungary     | -all foods                                       | 50           | 30         |
| Romania     | -all foods                                       | 30           | 15         |
| Russia      | -cereals, flour wheat bran, leguminous protein isolates vegetable oils, nuts (kernel) | 1000 | 15 |
| Uruguay     | -maize, barley                                   | 200          | 17         |

Table 6:- Limits for Patulin in food stuffs, dairy products and animal feedstuffs.

| Countries   | Commodities                                      | Limits (ppd) | References |
|-------------|--------------------------------------------------|--------------|------------|
| Austria     | -fruit juice                                     | 50           | 10         |
| Belgium     | -apple juice                                     | 50           | 32         |
| Czech & Slovak| -all foods                                   | 50           | 10,15      |
| Republic    | -infant foods                                    | 20           | 10,15      |
|             | -children food                                   | 20           |            |
| Finland     | -all foods                                       | 50           | 10,15,19   |
| France      | -apple juice                                     | 50           | 10         |
| Greece      | -raw coffee beans, apple juice, apple products    | 50           | 10,12,20   |
| Hungary     | -all foods                                       | 50           | 30         |
| Israel      | -apple juice                                     | 50           | 18,30      |
| Norway      | -apple juice                                     | 50           | 15,19      |
| Romania     | -all foods                                       | 30           | 15         |
|             | -all feedstuffs                                  | 30           |            |
| Russia      | -bottled/canned/potted fruits & berries & canned | 50           | 15         |
Table 7:- Limits for HT-2 Toxin in food stuffs, dairy products and animal feedstuffs.

| Countries  | Commodities                                              | Limits (ppd) | References |
|------------|----------------------------------------------------------|--------------|------------|
| Canada     | -diets for cattle, poultry, swine, young calves         | 100          | 10,15      |
|            | -lactating dairy animals                                 | 25           |            |
| Israel     | -grain for feed                                          | 100          | 18,30      |
| Russia     | -cereals, flour, wheat bran                              | 100          | 15         |

Table8:- Limits for Phomopsin, Diaceotoxyscirpenol, Stachybotryotoxin, and chetomin in foodstuffs, dairy products and animal feedstuffs.

| Countries | Commodities | Mycotoxins                | Limits (ppd) | References |
|-----------|-------------|---------------------------|--------------|------------|
| Australia | -all foods  | Phomopsin                 | 5            | 32         |
| Israel    | -grain for feed | Diacetoxyscirpenol NOL  | 100-1000    | 30         |
| Romania   | -all feedstuffs | Stachybotryotoxin chetomin | 0            | 15         |

DISCUSSIONS

Table 1 shows the limits for aflatoxin B1, B2, G1, G2 and M1 in foods, dairy products and animal feedstuffs. Table 2, 3, 4, 5, 6, 7 and 8 shows limits for mycotoxins other than aflatoxin in foods, feed and dairy products.

About eighty countries are known to have enforced or proposed aflatoxin regulations for foods intended for human consumption. With regards to acceptable levels in foods of aflatoxin B1 alone, a majority of the countries have a level of 5 ppb. In those countries that apply limits for the sum of aflatosins B1,B2,G1, and G2, such uniformity in the tolerance levels does not exist. The limits vary form not detectable (Argentina, Belgium and Singapore) up to 50 ppb (China). Some countries have a zero tolerance level (Bulgaria, cuba, Nigeria, Poland and Romania) that corresponds in practice to the limits of detection of the analytical method used.

Ochratoxin A has regulations in fourteen countries with acceptable limits in foods for human consumption which varies form 2-50 ppb, whereas in feed it varies form 100-300 ppb. Deoxynivalenol has legislation in six countries with acceptable limits varying from 5-10,000ppb. Zearalenone has regulations in seven countries; Patulin has regulations in fifteen countries. The limits of Patulin, mostly specified at 50ppm for fruit juices, are of marked unanimity. T-2 toxins have legislation in three countries whereas other mycotoxins (1), Chetomin (1), Phomopsin (1) and the newly discovered fumonisins (2) countries, Switzerland is the first country to have set a provisional
tolerance level for fumonisins in corns and corn based food products intended for human consumption. The limit has been set at a maximum of 1000 ppb for the sum of fumonisins B1 and B2 there are a number of countries whose regulatory data are not available namely Afghanistan, Antigua and Barbuda Bahrain, Bangladesh, Bolivia, Ecuador Iraq, Kuwait Morocco Nepal Nicaragua, panama, Pakistan, Qatar, United Arab Emirates etc.

CONCLUSION

To conclude, it may be useful to remember that even if the law is silent on the topic of mycotoxins in some countries, this does not necessarily mean that the problem does not exist or is ignored. India as legislation only on aflatoxin B1 whose acceptable limit in all foods is 30 ppb and feed (peanut meal) is 120 ppb. Studies have been performed and are still continuing to determine mycotoxins in animal feedstuff ingredients. Forty samples of maize gluten and twenty-seven samples of other maize products were examined for different mycotoxins. Aflatoxins were found within the limit of 1-5mg/Kg; Ochratoxin A in the range of 2mg/kg in to samples; Zearalenone within the limit of 500 mg/kg in eight samples. Another 40 samples of rice bran used in the animal feed industry were examined for the presence of 20 mycotoxins in which it was found that the level of contamination was low. Aflatoxin B1 was present in twenty-nine samples up to the limit of 28mg/Kg.

The ultimate objectives of this article are as follows:-

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