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**Occurrence of mycotoxins in commercial infant formulas locally produced in Ouagadougou (Burkina Faso).**

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**ABSTRACT**

Cereals products enriched with leguminous or oleaginous are used in Burkina Faso as food complement or to avoid infant malnutrition. Infant formulas from cereals are consumed as food supplements after the weaning age. They are produced in Burkina Faso with a mixture of several cereals (maize, millet, rice, or sorghum), leguminous (bean), oleaginous (peanut, soya or sesame), sugar or salt and sometimes milk powder. The production is artisanal or semi-industrial. These infant foods from cereals should be free from mycotoxins and pathogenic bacteria. The objective of this work was to determine the occurrence of mycotoxins like aflatoxins, ochratoxin A and fumonisins in infant formulas and grains in Ouagadougou (Burkina Faso). The mycotoxins (aflatoxins, ochratoxin A and fumonisins) were determined by HPLC-FLD in 248 samples of infant formulas produced by the Recovery and Nutrition Education Centers (CRENs) and sold on the market places in Burkina Faso.

Results showed that the majority of samples of infant formulas presented high levels of mycotoxins. The frequency of contaminated samples by aflatoxin B1, ochratoxin A and fumonisins in analyzed samples were 83.9% (167/199), 7.5% (15/199) and 1.5% (3/199), respectively. The highest values registered in infant formulas were 900, 6 and 3 times higher for aflatoxin B1 (EU limit: 0.1 µg/kg), ochratoxin A (EU limit: 0.5 µg/kg) and fumonisins (EU limit: 200 µg/kg), respectively, than the EU regulation limits (1881/2006). This study presents the first results concerning the safety assessment of infant formulas regarding mycotoxins in Burkina Faso.

**Key words:** Mycotoxins, infant formulas, local production, cereals, oleaginous, Burkina Faso.

## 1. Introduction

Mycotoxins are fungal secondary metabolites which are dangerous toxins for both humans and animals (AFSSA, 2009; Ferre, 2016). These metabolites are produced and found in many foodstuffs and especially in plants during their pre-and post-harvest or during storage. Aflatoxins, fumonisins, ochratoxin A, zearalenone, and deoxynivalenol are mycotoxins that are detected in cereal crops (Zinedine, & Idrissi, 2007; Warth *et al.*, 2012; Juan, Raiola, Manes, & Ritieni, 2014; Ezekiel *et al.*, 2014) and in peanuts (Afolabi *et al.*, 2015). Among dangerous mycotoxins, aflatoxins (AFs), ochratoxin A (OTA) and fumonisins (FB1 & FB2) represent the greatest health risk in tropical Africa (Manjula *et al.*, 2009), in Asia (Li *et al.*, 2014) and the rest of the world (Alborch *et al.*, 2012) due to their high toxicity. They are known to be carcinogenic, genotoxic, teratogenic, nephrotoxic, hepatotoxic and immunotoxic for humans (Creppy *et al.*, 2002; Mahmoudi *et al.*, 2012). Certain mycotoxins contaminating foodstuffs can cause acute poisoning with rapid onset of symptoms (diarrhea, convulsions, etc.). Other mycotoxins exhibit chronic toxicity, with cumulative effects over the long term, and can lead to cancer or immune deficiencies (Bourais, & Amine, 2006). AFs and ochratoxin A were classified in carcinogenic group 1 and 2B, respectively, by the International Agency for Research on Cancer in 1993 (IARC, 1993). Among aflatoxins, aflatoxin B1 (AFB1) is the most toxic form for mammals and causes damages such as toxic hepatitis, hemorrhage, edema, immunosuppression and hepatic carcinoma (Speijers & Speijers, 2004). In fact, various epidemiological studies have implicated the AFs and OTA in the increased incidence of gastro-intestinal and liver cancer in Africa, Philippines and China (Zinedine, & Idrissi, 2007). Recently, cases of acute poisoning affecting a large geographic area in Kenya causing many deaths were reported by Centers for Disease Control and Prevention (CDC, 2004). The high incidence of aflatoxin contamination of groundnuts and cereal grains in Guinea, Gambia, Nigeria, and Senegal was correlated with an increased incidence of liver cancer (Shephard, 2004). AFs have been detected in various commodities such as maize, wheat, barley, nuts, cocoa, dried fruits, wines and spices and other foodstuffs (Se & Nadir, 2003; Juan, Raiola, Mañes, & Ritieni, 2014). OTA contaminates cereals such as barley, wheat, maize, oat, as well as green coffee, fruit juices (grape fruit), wines and spices (Zinedine, & Idrissi, 2007; Juan, Raiola, Mañes, & Ritieni, 2014). Fumonisin have been linked with esophageal cancer in the former Transkei (South Africa) and China (Shephard,

Thiel, Stockenstrom, & Sydenham, 1996). High incidence of fumonisins at low levels was reported in surveys in Eastern and Southern Africa (Manjula *et al.*, 2009). These mycotoxins occur worldwide on maize, wheat and other cereal grains and their presence and consumption was linked to human and animal diseases through of contaminated cereals.

Several countries have established or proposed regulatory limits for mycotoxins in foods. European Union countries edited regulations to limit their presence in the foods in Europe (EU Regulation, 1881/2006). These regulations have been revised several times. In Africa some countries such as South Africa, Nigeria, or Ghana have regulations on mycotoxins and produce significant research, especially on aflatoxins and fumonisins (Ezekiel *et al.*, 2014). However regulatory limits in sub-Saharan are absent or rarely in place or not properly implemented and regular surveillance is often a major issue. Burkina Faso, a country of West Africa did not set yet a mycotoxin regulation (FAO, 2003; Warth *et al.*, 2012). In Burkina Faso, cereals have a social, economic and nutritional importance for the people. According to the Ministry of Agriculture and Food Security in 2014, the cereal production in 2013-2014 was estimated at 4 869 723 tons/year. The presence of mycotoxins has an impact on health and especially affects rural sub-Saharan populations because they often consume affected crops as staple diet and because crops in tropical and subtropical regions are more susceptible to contamination due to favorable climatic conditions (Bankole, & Adebajo, 2003). However, it was proved that cereal products enriched with leguminous or oleaginous were effective as food complement or to avoid infant malnutrition in Burkina Faso (Compaoré *et al.*, 2011; Kayalto *et al.*, 2013). Previous studies have shown that cereals such as maize, millet, rice and wheat, as well as leguminous and peanuts were contaminated with mycotoxins in Burkina Faso (Nikiéma, Traoré, & Singh, 1995; Sanou, 2000; Ouattara-Sourabié, Nikiéma, & Traoré, 2011; Warth *et al.*, 2012). Since infant formulas are based on cereals, these data could alerted us on a potential risk for children's health (Juan, Raiola, Mañes, & Ritieni, 2013; Pereira, Fernandes, & Cunha, 2015). The aim of this study was to assess the level of aflatoxins, ochratoxin A, and fumonisins in infant formulas sold and consumed in Ouagadougou, Burkina Faso.

## 2. Materials and Methods

### 2.1. Samples of infant formulas and grains

Sampling was conducted between June 2013 and December 2014 around the city of Ouagadougou, capital of Burkina Faso. A total of 199 samples of different formulations of flour consumed by low-weight children were selected by CRENS scientists. Infant formulas produced in semi-industrial units and small craft industries were taken on the production sites or in super markets or grocery stores. Moreover, from cereal sellers, 49 samples of flours and various cereals and oilseeds were also collected. A total of 248 samples of 300 to 500 g were collected aseptically in plastic bags and were transported in cool boxes at 4°C to the laboratory (LaBESTA) of the research center for food and nutrition biological sciences (CRSBAN) of the University of Ouagadougou. All samples were conditioned and sent to the laboratory of food safety of the UMR Qualisud, CIRAD in Montpellier (France) for determination analysis of mycotoxins.

## 2.2. Mycotoxins quantification

Performance data of mycotoxin analysis methods are summarized in Table 1.

### 2.2.1. Aflatoxins and ochratoxin A quantification

The sample (25 g) was homogenized with 50 mL methanol-water (80:20; v/v) and 5 g of NaCl at high speed for 2 min with a blender (Waring France). The extract was centrifuged at 6000 rpm for 10 min. Two mL of the filtrate was diluted with 18 mL of PBS buffer. Ten mL of this diluted sample was passed through an immuno affinity column-IAC column (Aflaochraprep, R-Biopharm). The IAC was washed twice with 10 mL of PBS each time before being eluted with 2 mL methanol. The eluting fraction was then evaporated and 1 mL of methanol-water (50:50; v/v) was added. The obtained fraction was collected into a glass bottle, identified by High Performance Liquid Chromatography (HPLC) and quantified by spectrofluorescence (Shimadzu RF 20A, Japan) after derivatization post column with electrochemical system (Kobra Cell™ R. Biopharm Rhône Ltd, Glasgow, UK). Fluorescence detection for AFs was set at 365 nm excitation and 435 nm emission and OTA was set at 333 nm excitation and 460 nm emission. The mobile phase A was water-methanol (55:45; v/v), 119 mg of potassium bromide and 350 µL of nitric acid and the mobile phase B was water-methanol (20:80; v/v), 119 mg of potassium bromide and 350 µL of nitric acid. AFs and OTA standard solutions were used for the construction of a five-point calibration curve of peak areas versus concentration (ng/mL). The operating conditions were as follows: injection volume of 100 µL of sample and standard solutions; C18 reverse-phase HPLC column, Uptisphere type, ODS, 5 µm particle size, 5 ODB, 250 x 4.6 mm, with identical pre-column,

thermostatically controlled at 40°C; isocratic flow rate of 0.8 mL/min. Mobile phase gradient: mobile phase A: 0% (0-26 min); 65% (26-45 min); 0% (45-50 min); 41% (20-25). The detection and quantification limits on aflatoxins were 0.3 µg/kg and 1 µg/kg, respectively. The detection and quantification limits on ochratoxin A were 0.05 µg/kg and 0.1 µg/kg, respectively. The contents were calculated from a calibration curve established with aflatoxins (TSL-108, Biopharm Rhône Ltd, Glasgow, UK) and ochratoxin standards (TSL-504, Biopharm Rhône Ltd, Glasgow, UK).

### 2.2.2. Fumonisin quantification

The sample (25 g) was homogenized with 50 mL of methanol-water (80:20; v/v) and 5 g of NaCl at high speed for 2 min with a blender (Waring France). The extract was centrifuged at 6000 rpm for 10 min. Ten mL of filtrate was diluted with 40 mL of PBS buffer. Ten mL of this diluted sample was passed through an IAC column (Fumoniprep, R-Biopharm), followed by washing with 10 mL of PBS buffer. The IAC column was washed twice with 10 mL of PBS for each time before being eluted with 1.5 mL of methanol and 1.5 mL of water. The eluate was collected and derivatized with O-phthalaldehyde (OPA) prior to analyze by HPLC and quantified by spectrofluorescence (Shimadzu RF 20A, Japan). Fluorescence detection for fumonisins was set at 335 nm excitation and 440 nm emission. The mobile phase A was: acetonitrile-acetic acid (99:1; v/v), and the mobile phase B was water-acetic acid (99:1; v/v). The derivatized sample was prepared as follow: 100 µL of eluate was mixed with 100 µL of OPA. The operating conditions were as follows: injection volume of 100 µL of derivatized sample; C18 reverse-phase HPLC column, Uptisphere type, ODS, 5 µm particle size, 5 ODB, 250 x 4.6 mm, with identical pre-column, thermostatically controlled at 35°C; isocratic flow rate of 1 mL/min. Mobile phase gradient: mobile phase A: 41% (0-9 min); 61% (9-16 min); 100% (16-20 min); 41% (20-25 min). The detection and quantification limits were 5 µg/kg and 20 µg/kg, respectively. The contents were calculated from a calibration curve established with fumonisin standard solutions (TSL-202, Biopharm Rhône Ltd, Glasgow, UK).

### 2.3. Statistical analysis

Analyses of variance (ANOVA) of data were carried out with XLStat PRO version 7.5.2. in order to study the correlation between the infant formula origin and mycotoxin level as well as to study the correlation between the type of sample (i.e. infant formulas, flours and cereal and oleaginous grains) and the mycotoxin level. Interpretation of values was performed

according to the test of Fisher least significant difference (LSD) with 95% confidence interval.

### 3. Results and Discussion

Samples were considered contaminated if the level of mycotoxins in samples exceeded the limit according to the EU regulation 1881/2006. This investigation has provided a comprehensive data on the contamination in 248 different samples such as infant formulas, flours and cereal or oleaginous grains from Ouagadougou (Burkina Faso) by mycotoxins AFs, OTA and fumonisins (FB1 & FB2). The analysis of 248 samples has revealed contamination levels ranging from 0 to 672.9 µg/kg. The global frequency of contaminated samples was 78.6% (195/248). The most incriminated mycotoxin was aflatoxin B1 with a frequency of 73.4% (182/248) of contaminated samples, while frequencies of samples contaminated by ochratoxin A and fumonisins were 6.1% (15/248) and 1.2% (3/248), respectively.

#### 3.1. Frequency of mycotoxin contamination according to the type of sample

The EU Regulation 1881/2006 limits for infant formulas are 0.1 µg/kg for aflatoxin B1, 0.5 µg/kg for ochratoxin A and 200 µg/kg for fumonisins. The mycotoxin contamination frequency in infant formulas was 90.5% (180/199). Indeed 83.9% (167/199), 7.5% (15/199) and 1.5% (3/199) of samples were above the EU Regulation 1881/2006 for aflatoxin B1, ochratoxin A and fumonisins, respectively. The levels of mycotoxins contamination ranged from 0 µg/kg to 672.9 µg/kg (Table 2).

The EU Regulation 1881/2006 limits for peanuts, cereals and derived from cereals other than maize and rice was 2 µg/kg for aflatoxin B1, 4 µg/kg for total aflatoxins, 3 µg/kg for ochratoxin A and 4000 µg/kg for fumonisins. The mycotoxin contamination frequency in samples of peanuts, cereals and derived from cereals other than maize and rice was 39.3%. Indeed 39.3% (11/28) and 35.7% (10/28) of samples were above the EU Regulation 1881/2006 for aflatoxin B1 and total aflatoxins, respectively. Samples were contaminated by ochratoxin A and fumonisins, but the levels never exceed EU Regulation limits. The levels of mycotoxin contamination ranged from 0 µg/kg to 138 µg/kg (Table 3).

The EU Regulation 1881/2006 limits for maize and rice was 5 µg/kg for aflatoxin B1, 10 µg/kg for aflatoxins 3 µg/kg for ochratoxin A and 4000 µg/kg for fumonisins. The mycotoxin contamination frequency in maize and rice was 23.5%. Indeed 23.5% (4/17), 17.7% (3/17) of samples were above the EU Regulation 1881/2006 for aflatoxin B1 and total

aflatoxins, respectively. Samples were contaminated by ochratoxin A and fumonisins, but the levels never exceed EU Regulation limits. The contamination levels of mycotoxins ranged from 0 µg/kg to 413.1 µg/kg (Table 4).

The contamination varied from 0.06 to 13.23 µg/kg in oleaginous grains other than peanuts, but none of the samples analyzed exceeded the maximum levels set by EU Regulation 1881/2006 (aflatoxin B1: 8 µg/kg, total aflatoxins: 15 µg/kg, ochratoxin A: 3 µg/kg).

The maximum level of aflatoxins was 135.3 µg/kg in infant formulas and 258.0 µg/kg in maize and rice, and the maximum level of aflatoxin B1 was 87.4 µg/kg in infant formula based on millet-wheat and 183.5 µg/kg in maize grains. These results were lower than those of Warth *et al.* (2012) who reported concentration levels reaching 636 µg/kg but higher than those of Li *et al.* (2014) who reported concentration levels reaching 35.0 µg/kg in rice. Our frequency of aflatoxin contamination was higher than in other studies that obtained 14.5% for aflatoxins in Chinese rice (Li *et al.*, 2014) or 33% for aflatoxins and 50% for aflatoxin B1 in Burkina Faso cereals and peanuts (Warth *et al.*, 2012). Indeed, various researchers reported fungal contamination problems in grains, grain-based foods, and peanut in Nigeria, Burkina Faso and Mozambique (Nguyen, 2007; Nikiéma *et al.*, 2004; Sanou, 2000; Warth *et al.*, 2012). Warth *et al.* (2012) reported that contamination in AFs was pandemic in Burkina Faso. Indeed, a significant occurrence of aflatoxins (mainly aflatoxin B1) was found in infant formulas and the frequency of aflatoxin contamination was higher than in the cereal and oleaginous grains.

The frequency of OTA and fumonisins (FB1 & FB2) contamination was 7.5% and 1.5%, respectively, in samples of infant formulas based on maize. A highest concentration of ochratoxin A has been recorded in a sample of infant formula composed of a mixture of maize, soya, beans and peanuts (3.2 µg/kg). The highest concentration of fumonisins was recorded in a sample of infant formula based on millet and monkey bread (672.9 µg/kg). However, the level of OTA contamination did not exceed limit in flours and cereals or oleaginous grains. Others researchers showed that high frequency of OTA was detected in 13 out of 30 (43.3%) cereal-based infant formula, and in 4 out of the 12 (33.3%) samples of fruit-based infant formulas at levels ranging from 0.02 to 0.3 µg/kg and 0.02 to 0.156 µg/kg, respectively (Darouj, Massouh, & Ghanem, 2016). This result concerning OTA was higher than results obtained in this study. According to the literature, OTA is known as a worldwide natural contaminant, mainly in grains, cereals and their processed foods, coffee and fermented

beverages (El Khoury *et al.*, 2008) and fumonisins are well-known to contaminate maize. The occurrence of OTA contamination was 80% in flour samples in Turkey with concentrations ranging from 3.0 to 4.8 µg/kg (Demirel, & Sariozlu, 2013). In maize, Zinedine, & Idrissi (2007) have obtained a value of 7.2 µg/kg for OTA while the value for AFB1 was 5.9 µg/kg. The results of these authors were very high and could signify health risk for children liver. Indeed, the high incidence of aflatoxin contamination of groundnuts and cereal grains in Guinea, Gambia, Nigeria, and Senegal was correlated with an increased incidence of liver cancer (Shephard, 2004). According to Speijers, & Speijers (2004), among aflatoxins, aflatoxin B1 is the most toxic form for mammals and can cause damages like hepatitis, hemorrhage, immune suppression, edema or kwashiorkor (protein malnutrition) and growth retardation (Njeru, 2014). Other researches showed that presence of OTA has been correlated to congenital defects in the fetus of experimental species but mechanisms of action are not well understood yet (Raiola *et al.*, 2015). As measured in blood serum among children less than 5 years old in Benin and Togo, it was demonstrated that aflatoxin exposure was highly correlated with maize consumption (Egal *et al.*, 2005). Groundnut consumption also contributed to aflatoxin exposure among this group of children, but its importance was lower (Egal *et al.*, 2005). Other sources of aflatoxin exposure can be dried fish, yam, cassava products and cassava chips (Bassa *et al.*, 2001; Manjula *et al.*, 2009).

The geographical distribution of mycotoxins in Africa (Pascale, 2014) and the fact that regions between the latitudes 40° N and 40° S of the equator in Africa are favorable zones for aflatoxin synthesis and contamination of cereal grains (Williams *et al.*, 2004; Jayaramachandran, Ghadevaru, & Veerapandian, 2013) are in accordance with the results obtained in this study.

### 3.2. Frequency of mycotoxin contamination according to the origin of infant formulas

Concerning infant formulas, they are composed of several cereals, leguminous or oleaginous in addition to milk, sugar or oil and salt. Indeed, the combination of cereals and oilseeds improves foodstuffs for their nutritional and organoleptic qualities (Compaoré *et al.*, 2011; Kayodé, Akogou, Amoussa, & Hounhouigan, 2012; Soro *et al.*, 2013; Kayalto *et al.*, 2013). However, our study revealed the presence of mycotoxins in many samples coming from CREN, semi-industrial units and small craft industries. The frequency of samples contaminated by AFB1 was very high, 84 %. When we compared the frequency of mycotoxin contaminated samples according to the origin of production, it appeared that samples coming

from the semi-industrial units and small craft industries were the more contaminated by AFB1 (figure 1).

The frequency of aflatoxin B1 contaminated samples in these structures (96.5%) were 5 times higher than in CRENs (18.5%). The frequency of OTA contaminated samples was nearly equal in the three types of structures. However, fumonisins were only present in CRENs but it had very high level of 672.9 µg/kg. The concerned infant formula consisted of millet, monkey bread, milk and sugar. The maximum content obtained for aflatoxin B1 in CRENs was 84.6 µg/kg in an infant formula which consisted of peanut cake. In semi industrial units the maximum content was 87.4 µg/kg in AFB1 for a formula that was composed of millet and wheat. In the small craft industries, the maximum content was 19.8 µg/kg in AFB1 for a formula composed of maize and peanuts. For OTA, the maximum content was 3.2 µg/kg, found in a formula composed of corn, soybean, and peanut from a semi-industrial unit.

Even if we obtained a high mycotoxin contamination in infant formulas, we found some samples which were not contaminated by any mycotoxin. So this showed that we can get infant formulas exempt of mycotoxins. We may suppose that the processing of cereals has an effect on the contamination. Moreover, some samples were contaminated by several mycotoxins simultaneously.

### 3.3. Multiple contaminations of cereals and infant formulas

The co-occurrence of different mycotoxins in the same sample was observed. Thus, 36.7% (88/240) of the samples were simultaneously contaminated by aflatoxins and ochratoxin A. Total aflatoxins ranged from 0.06 µg/kg to 124.6 µg/kg while the levels of ochratoxin A were between 0.01 µg/kg and 3.2 µg/kg. The co-occurrence for aflatoxins and fumonisins was found in 70.8% (170/240) of the samples. Total aflatoxins ranged from 0.06 µg/kg to 124.6 µg/kg while the contents of fumonisins ranged from 9.7µg/kg to 672.9 µg/kg. Besides, 31.3% (75/240) of samples had a co-occurrence of total aflatoxins, ochratoxin A and fumonisins. Total aflatoxins ranged from 0.06 µg/kg to 124.6 µg/kg, the levels of ochratoxin A were between 0.01 µg/kg and 3.2 µg/kg and the contents of fumonisins ranged from 9.7 µg/kg to 157.5 µg/kg. A similar result was observed by Ibáñez-Vea, González-Peñas, Lizarraga, & López de Cerain (2012) who studied the co-occurrence in 123 barley samples. They observed that between 19% and 23% of the samples were contaminated by 3, 4 or 5 mycotoxins. Some studies have reported the co-occurrence of mycotoxins in infant formulas and they only noticed few cases or a low level of various mycotoxins in the same sample

(Juan, Raiola, Mañes, & Ritieni, 2014). However, other current studies showed the co-occurrence of mycotoxins in infant formulas, demonstrating the need to evaluate its incidence and to study the possibility of synergetic effects (Alborch *et al.*, 2012). Moreover, it is very important to have reliable data regarding simultaneous presence of toxins in foodstuffs and infant formulas to make a better risk assessment for adult and infant health (Juan, Raiola, Mañes, & Ritieni, 2014). This potential co-occurrence observed in our study can explain the high level of contamination of the studied food products.

### 3.4. Statistical analysis

ANOVA analysis showed that there was no significant difference ( $p > 0.05$ ) for the mycotoxin contamination according to the sampling locations. However, there were significant differences ( $p < 0.05$ ) according to the origin of the formula production and significant differences ( $p < 0.05$ ) depending on the nature of ingredients: aflatoxin contamination was correlated to maize, rice, wheat or peanuts while fumonisin contamination was linked to monkey bread, soy or maize.

Statistical analysis showed that maize was especially incriminated in the contamination. Warth *et al.* (2014), obtained similar results. Aflatoxin B1 was observed more frequently in maize (Burkina Faso, 50% incidence, median = 23.6  $\mu\text{g/kg}$ ) than in groundnuts (Burkina Faso, 22% incidence, median = 10.5  $\mu\text{g/kg}$ ).

AFB1 were the major contaminants in the infant formulas of Ouagadougou (Burkina Faso). The contaminations with OTA and FB1 & FB2 were relatively low for cereal and oleaginous products. Contamination with multiple mycotoxins was also a serious issue for infant formulas. Our results indicated that the mycotoxin contaminations can become a serious health hazard of human diet in the country and AFs seem to be a risk factor that could increase the incidence and rate of malnutrition (Raiola *et al.*, 2015).

## 4. Conclusion

According to our results, it appeared that the children under 5 years are not immune from danger when they consume food supplements contaminated with mycotoxins, essentially when the level of contamination exceeded the limits set by EU Regulation 1881/2006. These contaminations can occur because of the absence of controls by the competent authorities and regulatory rigor in the country (good agricultural practices, good manufacturing practices, HACCP) in industrial and craft units, that could permit to control fungal growth and

mycotoxin production during harvest, distribution and storage. Therefore, efforts in good storage and processing practices should be intensified as preventive measures against toxigenic strain dispersal (Ezekiel *et al.*, 2014). It was shown that mycotoxin contamination depended on the ingredients in infant formulas and that over 80 % of infant formulas were contaminated with aflatoxin B1. Even if previous measures have already aimed to produce infant formulas exempt from bacterial contamination, no action was undertaken yet to limit the presence of mycotoxins in the food. Cooking flour has no effect on the reduction of these mycotoxins in infant formulas for these children less than 5 years who seek short-term health or improve their nutritional status. The high level of mycotoxin contamination in infant and young children foods constitutes a serious risk for their health. However, solutions exist like improving the good agricultural and good manufacturing practices (HACCP) in Burkina Faso.

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**Table 1: Data of validation of mycotoxin analysis performance**

	<b>Repeatability</b>	<b>Reproducibility</b>	<b>Recovery</b>	<b>LOD</b>	<b>LOQ</b>
	<b>%</b>	<b>%</b>	<b>rate* %</b>	<b>µg/kg</b>	<b>µg/kg</b>
<b>Fumonisin</b>	91.2	90.5	88.2	5	20
<b>Aflatoxins</b>	96.1	95.2	92.4	0.3	1.0
<b>Ochratoxin A</b>	92.4	91.2	85.2	0.05	0.1

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\*Recovery rate was evaluated with samples supplied by standard organizations because of the precise characterization of their composition and their analyte concentration

485 **Table 2: Mycotoxin contamination of infant formulas**

Infant formulas	EC regulation limit( $\mu\text{g/kg}$ )	Mean value of contamination ( $\mu\text{g/kg}$ )	Range of contamination ( $\mu\text{g/kg}$ )	Occurrence in samples (%)
<b>AFB1<sup>a</sup></b>	0.1	3.8	0-87.4	83.9
<b>OTA<sup>b</sup></b>	0.5	0.1	0-3.2	7.5
<b>FB1 &amp; FB2<sup>c</sup></b>	200	30.3	0-672.9	1.5

486 <sup>a</sup> Aflatoxine B1

487 <sup>b</sup> OTA : Ochratoxin A

488 <sup>c</sup> FB1+ FB2: Fumonisin B1 & Fumonisin B2

489 Formula for Occurrence in samples:  $\frac{\sum \text{samples exceeding limit} \times 100}{\text{Total infant formulas}}$

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**Table 3: Mycotoxin contamination of peanuts, cereals and derived from cereals other than maize and rice**

<b>Peanuts, cereals, derived from cereals</b>	<b>EU regulation limit (µg/kg)</b>	<b>Mean value of contamination (µg/kg)</b>	<b>Range of contamination (µg/kg)</b>	<b>Occurrence in samples (%)</b>
<b>AFB1<sup>a</sup></b>	2	4;5	0-29.0	39.3
<b>AFs<sup>b</sup></b>	4	7.1	0-45.6	35.7
<b>OTA<sup>c</sup></b>	3	0.01	0-0.2	0
<b>FB1 &amp; FB2<sup>d</sup></b>	4000	21.1	0-138.0	0

<sup>a</sup> Aflatoxine B1

<sup>b</sup> Aflatoxins (G2, G1, B2, B1)

<sup>c</sup> OTA : Ochratoxin A

<sup>d</sup> FB1+ FB2: Fumonisin B1 & Fumonisin B2

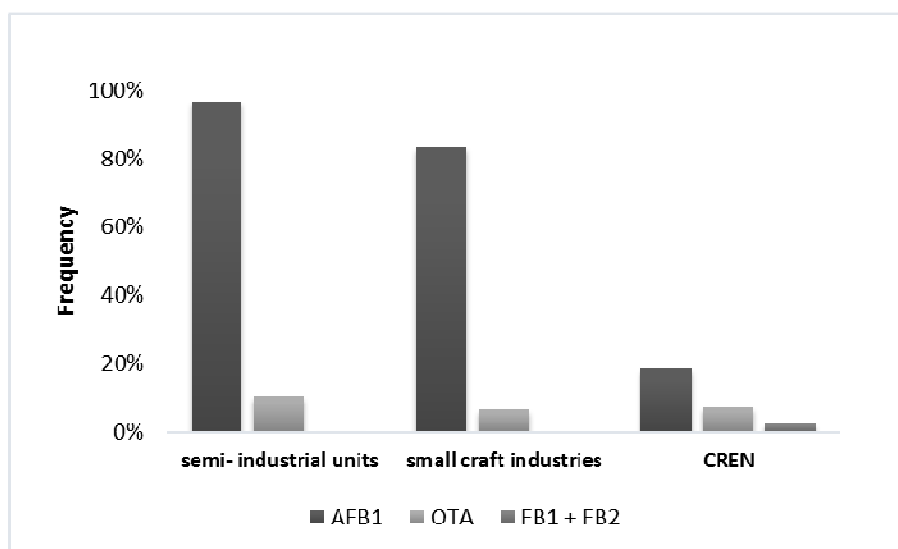
Formula for Occurrence in samples:  $\frac{\sum \text{samples exceeding limit}}{\text{Total Peanuts, cereals, derived from cereals}} \times 100$

Total Peanuts, cereals, derived from cereals

**Table 4: Mycotoxin contamination of maize and rice**

Maize and rice	EU regulation limit (µg/kg)	Mean value of contamination (µg/kg)	Range of contamination (µg/kg)	Occurrence in samples (%)
<b>AFB1<sup>a</sup></b>	5	17.5	0-183.5	23.5
<b>AFs<sup>b</sup></b>	10	24.7	0.2-258.0	17.6
<b>OTA<sup>c</sup></b>	3	0.02	0-0.08	0
<b>FB1 &amp; FB2<sup>d</sup></b>	4000	83.8	0-413.1	0

<sup>a</sup> Aflatoxine B1<sup>b</sup> Aflatoxins (G2, G1, B2, B1)<sup>c</sup> OTA : Ochratoxin A<sup>d</sup> FB1+ FB2: Fumonisin B1 & Fumonisin B2Formula for Occurrence in samples:  $\frac{\sum \text{samples exceeding limit} \times 100}{\text{Total maize and rice}}$



**Figure 1:** Mycotoxin contaminated samples according to the origin of infant formulas

**Highlights**

- Cereals enriched are used in Burkina Faso as infant formulas after weaning age
- The majority of samples of studied infant formulas presented high level of mycotoxins
- The levels of mycotoxins were higher than the European Commission regulation limits
- It's the first safety assessment regarding mycotoxins in infant formulas in Burkina