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Measures of Aflatoxins Contents in Peanut Pastes and Grains Sampled in Burkina FASO

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Abstract: The peanut (*Arachis hypogaea L.*) remains one of the main oleaginous crops cultivated in Burkina Faso and a basic product very appreciated in the Western Africa. However, the presence of aflatoxins in peanut seeds and pastes constitutes a risk of public health hazard and by this way limits its marketing mostly in the European market. Sixty (60) samples of peanut paste (ten (10) per market) have been taken from women transformers of six (6) major markets in the Eastern area of Ouagadougou notably Dassasgho, Bendogho/Wayalghin, Katr Yaar, Zone I, Nabii Yaar and Zogona Yaar. These samples were conditioned and kept at -4°C, then analyzed at INERA-Kamboinsin Phytopathology lab according to ROMERLABS' ELISA AgraQuant method 1-20 ppb. The analyses show strongly contaminated samples by aflatoxins. The values range from 1,3ppb to 649,1ppb. Markets with the highest contents are Nabii Yaar Market, Dassasgho Market and Zogona Market with respective average levels of 152,78 ppb; 79,83 ppb and 63,77 ppb. Those with lowest contents are Katr Yaar Market (15,15 ppb) and Zone I Market (10,13 ppb). Out of the 60 samples, 6 meet European standards and 24 American standards.

As for peanut seeds samples collected from the farmers at Pissila Leo and Bogande, the contents vary from 0 ppb to 392,8 ppb and are less contaminated than the pastes. 82 samples meet European standards and 92 American standards.

Key words: peanut, aflatoxins, pastes, seeds, value chain, Burkina Faso

1. Introduction

The nocive effects of mycotoxins on human and animal health are well known: liver cancer, the general weakening of the body, delay in growth for some young people, synergy of action with the hepatitis B virus... Corn and peanut which are much consumed products notably in Africa remain high risk products in numerous countries. Populations are much exposed to risk of contamination by the aflatoxin. In 2004 in Kenya, 300 people fell sick after consuming aflatoxin contaminated corn out of which 125 people died [1, 2]. The European Union has set up very low thresholds of aflatoxin content for grain and animal feed importation. Producing countries are particularly affected by these measures: the limit contents for peanuts, fruit and dried shells and products derived from their transformation and destined for direct human consumption or their use as ingredients are 2 ppb for B1 aflatoxin B1 and 4 ppb for the for B1+B2+G1+G2 aflatoxin. For peanuts meant for screening process of for other physical methods before human consumption or use as food, the limit contents are 8 ppb for B1 aflatoxin and 15 ppb for B1+B2+G1+G2 aflatoxin [3]. The B1 aflatoxin limit is the most constraining because it represents 70 to 80% of the total aflatoxin leading to the rejection of many batches. Between 2003 and 2008 Ghana, Nigeria and Senegal have respectively met with 0.442; 8.845 and 1.278 rejections/1000 tons of grains and oleaginous fruit in European harbors by The Rapid Alert System for Food and Feed (RASSF) [4]. In Burkina Faso, the first works on aflatoxin were performed by Nikiema et al. (1993) [5] who found very high contents both for

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peanut grains and paste and by Lynch et al. (1993) [6] who studied aflatoxin contamination of peanut shells and grains attacked by mites. Since then, very little work has been carried out on aflatoxin in Burkina Faso. Under the **"***Improvement of Food Security and Quality and of the Incomes of Poor Peanut Chain of Values Actors in West Africa by Aflatoxin Reduction***"** (GestAflAr) project funded by CORAF, we carried out a reference study on the peanut chain of values. The objective of this study was to analyze samples from farmers depending of their modes of conservation, from traders and transformers. We picked up samples from producers, traders and transformers that we analyzed in INERA/Kamboinse Phytopathology lab.

2. Material and Methods

Hundred and twenty eight (128) peanut samples (shells and grains) were picked up from producers and traders of three villages: Pissila (Central North), Leo (Central South) and Bogande (East). Sixty (60) samples of peanut paste (ten (10) per market) were also picked up from women transformers of six (6) large and important neighborhood markets at the East of Ouagadougou: Dassasgho, Bendogho/Wayalghin, Katr Yaar, Zone I, Nabii Yaar and Zogona Yaar. These samples were conditioned and kept at -4°C, then analyzed at INERA-Kamboinsin Phytopathology lab following the ELISA Agra Quant method 1-20 ppb from ROMERLABS. The samples were crushed with a Blender and sieved. 20 g of powder were weighed and mixed with 100ml of methanol at 70% (v/v), then filtered with Watmann filters. For the butter, 20g were directly weighed from the sample. 200 µl of the "Conjugate" were introduced in the blue-green micro tubes to which were added 100 µl of each sample. The whole thing was well mixed and 100 µl of the mixture were transferred to the micro tubes containing the anti-aflatoxin antibodies. The mixtures were left to incubate at ambient temperature for 15 minutes. The micro tubes were washed with distilled purified water and 100 µl of the "Substrate" were added to the micro tubes and incubated for 5 minutes at ambient temperature. Finally, 100 µl of "Stop Solution" were added and the samples contents were read by Reader Stat Fax 303 Plus with a calibration curb pre-established with 0 ppb, 1 ppb, 2 ppb, 4 ppb, 10 ppb and 20 ppb standards.

The data were analyzed by the Excel 2013 spreadsheet with which we made the graphics.

3. Results

3.1 Aflatoxin Contents in Peanut Ppaste Ssamples from Markets

The highest content at Dassasgho market (Fig. 1) is 169.7 ppb (Sample 6) and the lowest content is 18.7 ppb (Sample 9). The average content of the samples is 79.83 ppb. There are four samples (40%) with contents more than 100 ppb (Samples 6, 1, 4 and 3 with respectively 169.7 ppb; 136.1 ppb; 120.6 ppb and 109.7 ppb) and the contents of 90% of the samples are more than 20 ppb (Samples 7, 8 and 10 with respectively 23.8 ppb; 28.4 ppb and 27.8 ppb). The content of only one sample (Sample 9; 18.7 ppb) is less than 20 ppb.

At Wayalghin and Bendogho markets (Fig. 2), the highest content was 38.6 ppb (Sample 5) and the lowest content is 10.7 ppb (Sample 8). The average content of the samples is 28.05 ppb. The contents of most samples (80%) are more than 20 ppb and the contents of 20% of the samples (Samples 7 and 8) are less than 20 ppb (respectively 15.3 ppb and 10.7 ppb).

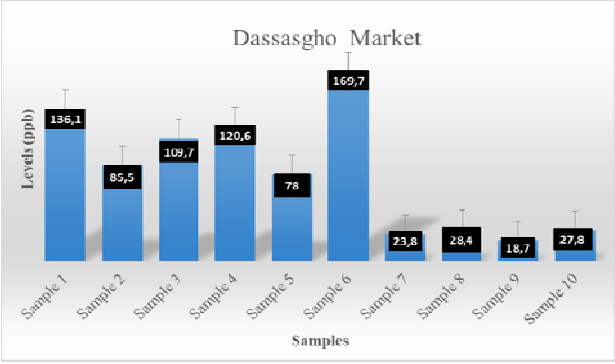

Fig. 1 Aflatoxin contents in peanut paste samples from Dassasgho market.

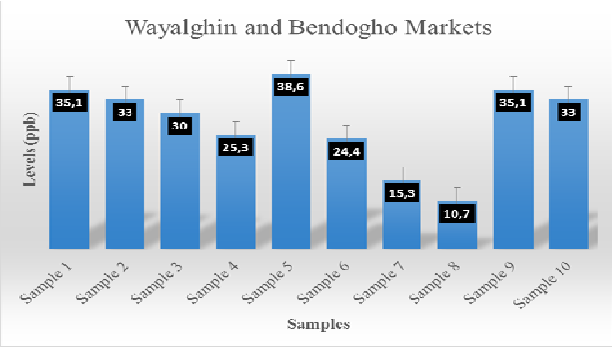

Fig. 2 Aflatoxin contents in peanut paste samples at Wayalghin and Bendogho markets.

The contents are lower at Katr Yaar Market (Fig. 3). Indeed the contents of 10% of the samples are less than 4 ppb (Sample 7 with 1.3 ppb) and those of 20% of the samples are more than 20 ppb (Samples 1 and 6 with 24.2 ppb and 28.1 ppb). The contents of 70% of the samples are included between 4 and 20 ppb. The highest content is 28.1 ppb and the lowest one is 1.3 ppb. The average content of all the samples is 15.15 ppb.

At Zone I market (Fig. 4), the contents of 100% of the samples are less than 20 ppb and the content of only one sample (Sample 4 with 3.2 ppb) is less than 4 ppb. The highest content is 15.7 ppb (Sample 5) and the lowest one is 3.2 ppb (Sample 4). The average content of these samples is 10.12 ppb. The contents of six samples (60%) are more than 10 ppb (Samples 1, 3, 6, 7, 8 and 9 with respectively 11.9 ppb; 10.1 ppb; 15.7 ppb; 12.4 ppb; 11.3 ppb and 16.5 ppb). The contents of Samples 2, 4, 5 and 8 are less than 10 ppb with respectively 5.1 ppb; 3.2 ppb; 6.7 ppb and 8.3 ppb.

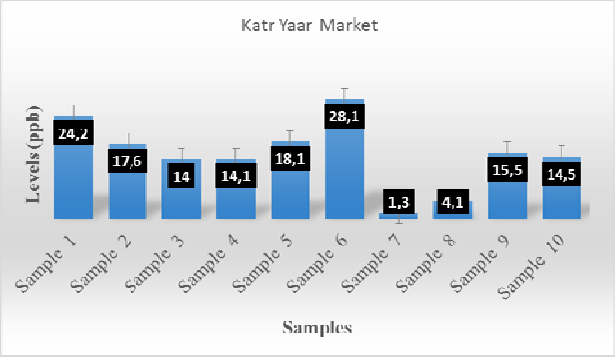

Fig. 3 Aflatoxin contents in peanut paste samples at Katr Yaar market.

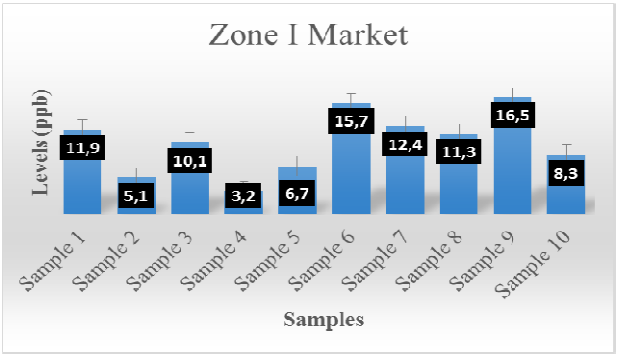

Fig. 4 Aflatoxin contents in peanut paste samples at zone 1 market.

We observed at Nabii Yaar Market (Fig. 5) that the contents of 90% of the samples are more than 20 ppb, the highest content being 649.1 ppb for Sample 3. The contents of 40% of the samples are more than 100 ppb (Samples 1, 2, 3 and 7 with 167.4 ppb; 232.5 ppb; 649.1 ppb and 141.1 ppb). The content of sample 8 alone (18.9 ppb) is less than 20 ppb. The average content is 152.78 ppb. The lowest content is 18.9 ppb.

At Zogona market (Fig. 6), the contents of 100% of samples are more than 4 ppb, those of 20% are more than 20 ppb (Samples 5 and 6 with 15.3 ppb and 10.7 ppb) and those of 40% are more than 100 ppb (Samples 7, 8, 9 and 10 with respectively 127.2 ppb; 127.2 ppb; 138.5 ppb and 100.5 ppb). The average content for these samples is 63.77 ppb.

3.2 Aflatoxins Contents in Peanut Grains from Pissila, Leo and Bogande

As for the samples from Pissila (Fig. 7), the contents in 45 samples (72.58%) are less than 4 ppb, then those

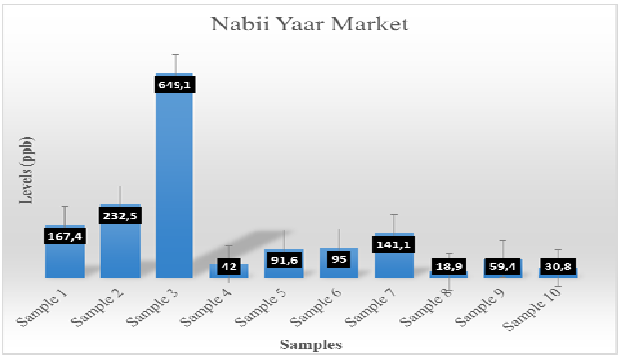

Fig. 5 Aflatoxin contents in peanut paste samples at Nabii Yaar market.

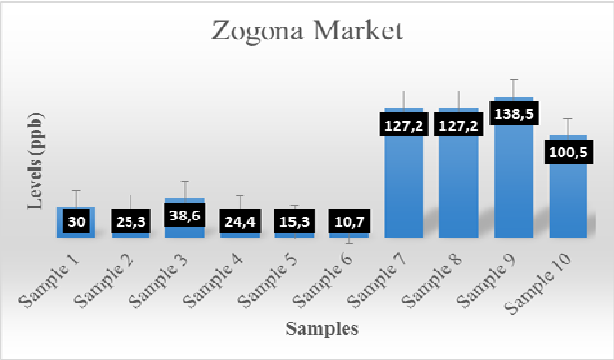

Fig. 6 Aflatoxin contents in peanut paste samples at Zogona market.

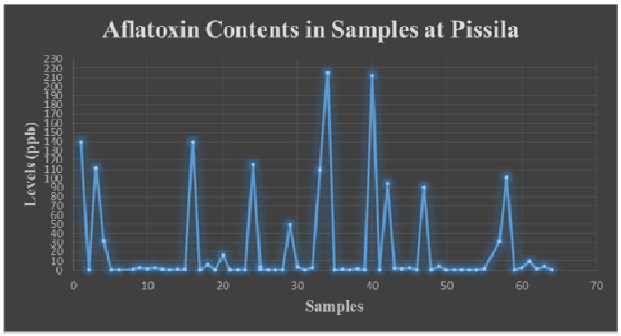

Fig. 7 Aflatoxin Contents in Peanut Seeds at Pissila.

of 48 samples (77.4%) are less than 10 ppb, and those of 49 samples (79,03%) are less than 20 ppb and finally, those of 13 samples (20.96%) are more than 20 ppb. The average content observed is 24.49 ppb and the highest one is 215.3 ppb.

In Leo and Bogande areas (Fig. 8), the contents of 37 samples (56.06%) are up to 4 ppb or less, then those of 44 samples (66.66%) are up to 10 ppb or less, and those of 46 samples (69.69%) are up to 20 ppb or less and finally, those of 20 samples (30.30%) are more than 20

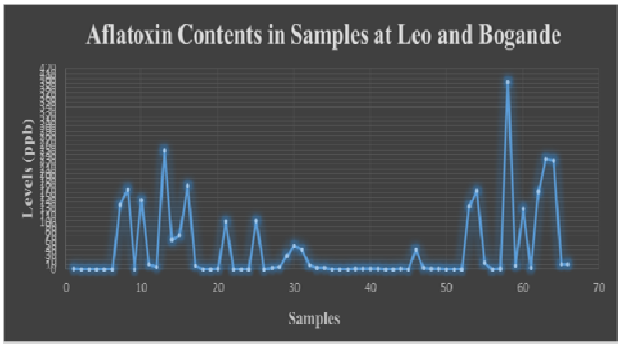

Fig. 8 Aflatoxin Contents in Peanut Seed Samples at Leo and Bogande.

ppb. The average content of these samples is 43.8 ppb and the highest one is 392.8 ppb.

4. Discussion

Out of 60 paste samples, the contents in only two (2) samples (3.33%) are less than 4 ppb (Sample 7, Fig. 3 and Sample 4, Fig. 4), those of 6 samples (10%) are up to 10 ppb or less, then those of 24 samples (40%) are up to 20 ppb or less and finally, those of 36 samples (60%) are more than 20 ppb. The contents vary from 1.3 ppb to 649.1 ppb with an average content of 58.28 ppb. Markets with high contents are Nabii Yaar (Fig. 5), Dassasgho (Fig. 1) and Zogona (Fig. 6) with respective average contents of 152.78 ppb; 79.83 ppb and 63.77 ppb. High levels of aflatoxins found in peanut pastes resulted from the method of process. Indeed, we remark that women using peanut seeds didn't sort it before making pastes. So, others of them add bran of corn to peanut seeds in pastes process. It is known that bran contains the most of aflatoxins of corn. This is the reason why these samples contained high levels of aflatoxins. Those with low contents with respective average contents of 15.15 ppb and 10.12 ppb are Katr Yaar (Fig. 3) and Zone I (Fig. 4). The sellers of these markets sorted their grains before making their pastes and didn't add corn bran. These results are similar to those obtained by Nikiema (1993) [7] who obtained contents included between 117 ppb and 553 ppb in 13 peanut paste samples analyzed in Burkina Faso with an average of 285 ppb. In other samples before the sorting, he had obtained contents between 108 ppb and 167 ppb. Sall (1998) [8] in Senegal has obtained lower contents varying between 0.38 ppb and 34.63 ppb in 40 peanut paste samples bought at the market. Domngang Mbiapo et al. (1989) in Cameroon, out of 154 paste samples analyzed, 61% were contaminated by aflatoxin and peanut balls were the most contaminated (75%), followed by corn flour (72%), peanut pancakes (65.4%) and corn and peanut balls (64%). Tantaoui-Elaraki et al. (1994) [9], in Morocco have obtained contents similar to ours by 18 $\mu g.kg^{-1}$ in corn

samples and by 820 $\mu g.kg^{-1}$ in peanut samples. Oliveira et al. (2009) [10], in Brazil, have obtained contents varying between 70.3 $\mu g.kg^{-1}$ and 126.5 $\mu g.kg^{-1}$ in peanut paste samples. Out of the products discarded in 2011 by the Rapid Alert System for Food and Feed (RASSF), Tajkarimi et al. (2015) [11] and Guchi (2015) [12] mention 622 $\mu g.kg^{-1}$ contents for the B1 aflatoxin and 810 $\mu g.kg^{-1}$ contents for all aflatoxin in peanut butter samples in Ghana. Yet, Kabbashi et al. (2014) [13] in Sudan have obtained very low contents in the peanut butter analyzed. Indeed, 10 out of 12 samples did not have aflatoxin whereas one sample had 6.17$\mu g.kg^{-1}$ content for G1 aflatoxin and 6.76 $\mu g.kg^{-1}$ content for G2 aflatoxin and the other had 4.95 $\mu g.kg^{-1}$content for G2 aflatoxin. The same in Cameroon, 5 rice samples out of 15, Makum et al. (2014) obtained contents varying between 37.26 $\mu g.kg^{-1}$ and 113.2 µg.kg-1 for B1 aflatoxin and in 8 sesame samples out of 30, the contents varied between 14.71 $\mu g.kg^{-1}$ and 140.9 $\mu g.kg^{-1}$.

According to European standards, only 6 samples (10%) are fit for consumption and according to American standards, 24 samples (40%) are fit for consumption [3].

The contents of 82 of grain samples (64.06%) were up to 4 ppb or less, then those of 92 samples (71.87%) were up to 10 ppb or less, those of 95 samples (74.21%) were up to 20 ppb or less and finally, those of 33 samples (25.78%) were more than 20 ppb. Grains contents vary between 0 and 392.8 ppb. The average content for these samples is 34.44 ppb. The low aflatoxins levels in samples are from farmers who sorted the pods and stocked them in dry and clean places. These samples didn't contain damaged and immature pods. Immature grains contain more aflatoxins than mature grains [14]. But the high levels are from farmers who stocked their peanut in garret with one opening. Other farmers cultivated peanut in the same field during many years that increases the concentration of *Aspergillus spp* in the soil. Nikiema (1993) [7] obtained contents of 11 ppb to 497 ppb similar to ours in the Boanga variety grains with an average of 138.2 ppb, whereas the contents varied between 19 ppb and 919 ppb with an average of 260.4 ppb for the Wobgo variety. Domngang Mbiapo et al. (1989) [15] have obtained contents of 368 ppm, which are close to our 392.2 ppb maximum content (Fig. 8), in raw peanuts. The same, out of the products discarded in 2011 by the Rapid Alert System for Food and Feed (RASSF), Tajkarimi et al. (2015) [11] and Guchi (2015) [12] indicated 214 $\mu g.kg^{-1}$ contents in peanut shell samples from China, 281 $\mu g.kg^{-1}$ contents in peanut grains from India and contents varying between 98 $\mu g.kg^{-1}$, 934 $\mu g.kg^{-1}$ and 1056 $\mu g.kg^{-1}$ for peanuts in their shells from Egypt. Analyses made on 1,263 peanut samples collected in Kenya showed that the contents of 37% samples were more than 10 ppb and the contents of only 4% of peanuts in their shells were more than 10 ppb [16].

Studies carried by Waliyar et al. (2002) [17] showed 269 ppb contents in Fleur 11 at Samanko (Mali) and 56.1 ppb contents at Sadore (Niger). So, after one month, we had contents that varied between 93 ppb and 352.6 ppb and after three months, the contents varied between 166.1 ppb and 400 ppb. Ntare (2004) [18], following the drying methods of a test performed with 7 farmers at Kayes (Mali), contents varying between 14.28 and 28.31 ppb by the improved method and 44.86 and 79.52 ppb by the traditional method.

According to European standards, nearly 64% of samples are fit for consumption and 74.21% are fit for consumption according to American standards.

5. Conclusion

We could note from this study that pastes are very contaminated in some markets in the eastern area of Ouagadougou with the highest levels of aflatoxins at Nabii Yaar, Dassasgho and Zogona markets resulting from the bad method of transformation. Katr Yaar and Zone I markets have low contents. Only 6 samples (10%) are fit for consumption according to European

standards and according to American standards, 24 samples (40%) are fit for consumption.

As for the grains, aflatoxins levels in 82 samples (64.06%) are in compliance with European standards and the levels in 95 samples (74.21%) are in compliance with American standards. Therefore, more than half of the samples are fit for consumption.

Woman transformers should be sensitized in good transformation practices notably about grain sorting before transforming them into paste. They should also be sensitized on the fact that it not good to mix corn bran with grains before grinding them into paste.

Acknowledgments

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