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Fluorescence spectra of aflatoxin in cow's milk and coffee

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Abstract

This article considers the fluorescence spectra of aflatoxin in cow's milk and coffee grounds. It was shown that fluorescence spectra of aflatoxin change in time. Fluorescence maximum I increases linearly with time and can be expressed with linear regression. For cow's milk, regression is I[rel.unit]=195+17.75×t [days] and for coffee grounds it is I[rel.unit]= 240+9.58×t(days). This work presents a small step towards better protection of human health from the unfavorable effect of aflatoxin.

Keywords: Aflatoxin; Milk; Coffee; Fluorescence

1. Introduction

Besides the corn [1], aflatoxin was detected in other materials. As it is well known that cow's milk is often used for human consumption, and it is often prepared industrially for storage and further use. It is the most commonly used milk in developed countries. Milk production on farms has become very intensive, so in many countries, this process is quite automated which increases the rate of utilization and reduces the possibility of milk contamination. Therefore we assume that the milk control on the presence of aflatoxin is very important for people's health. On the other hand, with the increase of the standard in the world, coffee consumption (drinking) increases [https://www.businesswire.com/portal/site/home]. The International Coffee Organization has data according to which the consumption of coffee in the world will increase to 25 million bags a year in about 10 years - where each bag weighs 60 kilograms. Therefore, the aim of our research was set up to show that the danger of aflatoxin lies not only in the milk but also in the coffee. Also the presented results could be a useful procedure for rapid determination in home conditions of the presence of aflatoxin in coffee.

2. Material and method

It is well known that fluorescence can be used as a powerful tool in biological and biomedical research [2;3;4;5]. Namely, with fluorescence, in defined conditions, one can be able to detect and observe adverse agents for human health such as bacteria [6], viruses[7], cell conditions [8], etc. Therefore, we have used light-induced fluorescence as a suitable method for observing aflatoxin in the cow`s milk and coffee.

The experimental setup is presented in Figure 1. Fluorescence emitted radiation from the sample chamber was collected and directed through an optical fiber (N.A. of 0.22 and 1000 μm diameter) that was coupled to a portable 2048-element CCD spectrometer (AVS PC- 2000). Data collection and spectrum processing were conducted in real-time with a microcomputer and commercial software OOI Base (AVANTES Inc.). Fluorescence measurements took 1.5 min for each

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measured sample with average values of 10000 measurements. Samples were excited with light coupled LED (350nm/3mW).

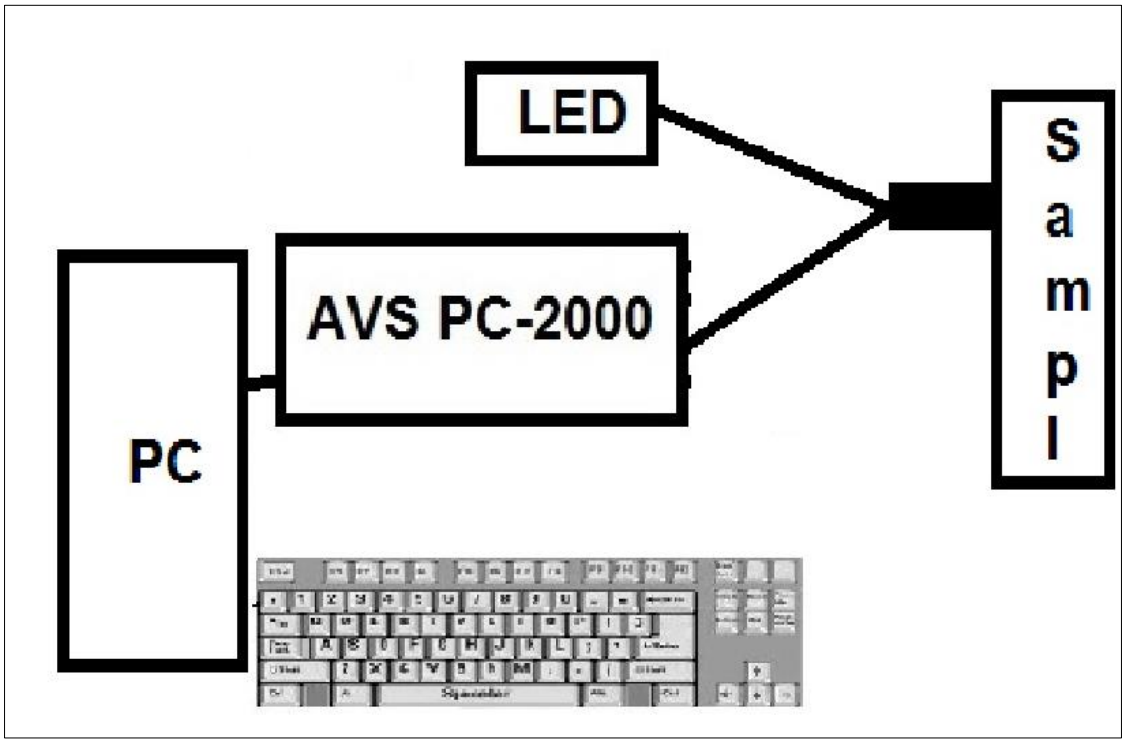

Figure 1 Experimental set up

2.1. Theory

For detection of the presence of aflatoxin in milk and coffee is not necessary to have special equipment. Namely, it is enough to look carefully with the naked eye at the milk or coffee grounds in the cup. A bluish-green mold will be seen on the surface of the mentioned objects.

In everyday life, this problem is solved by pouring milk and washing a cup of coffee. But sometimes this is not done right away so the presence of aflatoxins can contaminate the vessels or if the milk is drunk it can cause serious health problems. It would be very useful to eliminate the presence of aflatoxin immediately. Therefore this research was done in order to make a simple system for home use for early detection of the presence of aflatoxin.

3. Results and discussion

In the Figure 2 presents the fluorescence spectra of cow's milk with time.

In Figure 2, one can see that fluorescence maximum increases with time. It is expected, knowing that with time concentration of aflatoxin increases. This is in agreement with literature data which show that a direct connection between aflatoxin concentration and fluorescence exists [9;10] in corn [11], peanut [12], soybean and groundnut [13]. The milk fluorescence intensity shown in Figure 2, as a function of time, can be expressed with linear regression as I[rel.unit]=195+17.75×t [days], r=0.9483, where r is the regression correlation coefficient. The obtained linear regression between fluorescence intensity and aflatoxin concentrations is in agreement with literature data. Namely, it was found that aflatoxin fluorescence intensity dependence on its concentration can be presented with linear regression in corn[14]

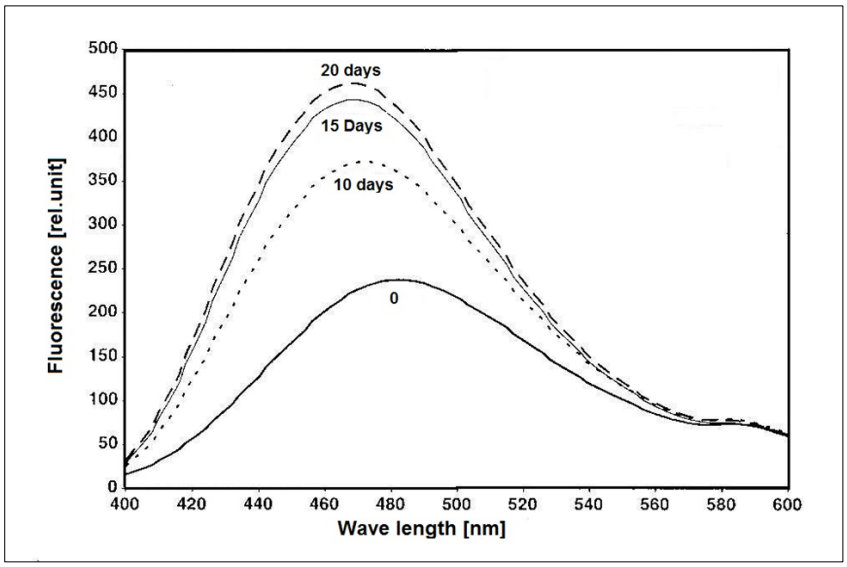

Figure 2 Fluorescence spectra of Aflatoxin in cow milk during the time. Days: 0 (—); 10 days(---); 15 days(....); 20 days (— —)

Figure 3 presents the change of the fluorescence maximum of aflatoxin in coffee grounds. From Figure 3 one can see that the intensity of the fluorescence maximum changes in the same way as in cow's milk. Namely, the fluorescence maximum increases with time due to an increase in aflatoxin concentration. This is in agreement with the mentioned above and literature data [14].

On the Figure 3 are presented fluorescence spectra of Aflatoxin in coffee during the time (0-24 days).

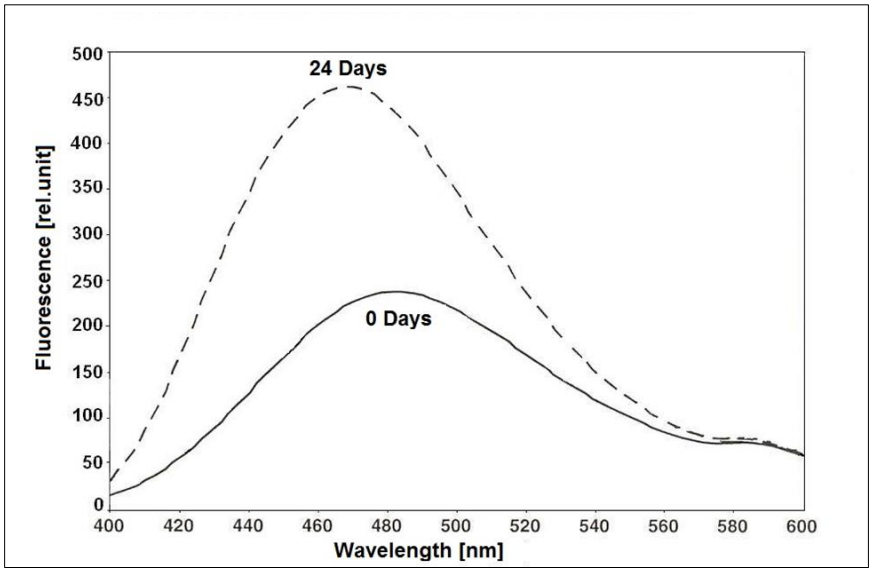

Figure 3 Fluorescence spectra of Aflatoxin in coffee during the time. Days: 0(—); 24 (– –)

Taking into account the mentioned above, it is clear that the longer time passes, the concentration of aflatoxin increases, as well as the intensity of fluorescence maximum. An explanation for cow`s milk can be: the longer time passes, the concentration of aflatoxin increases, and the direct consequence is higher fluorescence.

For coffee fluorescence intensity, shown in Figure 3 and other experiments data is a function of time and can be also expressed with linear regression $I=240+9.58\times t(days)$; $r=0.988$, where r is the correlation coefficient.

We have assumed that the presented results can be the base, in controlled conditions and geometry, for making a simple device for quick detection of the presence of aflatoxin in milk and coffee.

4. Conclusion

It is very important to detect the presence of aflatoxin, both in the cow`s milk and coffee grounds. Fluorescence of aflatoxin in cow`s milk and coffee grounds increases with time due to the increase of its concentration. Changing of fluorescence intensity maximum, in both materials, can be present with linear regression.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Yaoa,H., Hruskaa,Z., Kincaida,R., Brownb,R., Clevelandb,T., D. Bhatnagar, D. (2010) Correlation and classification of single kernel fluorescence hyperspectral data with aflatoxin concentration in corn kernels inoculated with Aspergillus flavus spores. Food Additives and Contaminants , 27,701–709.

[2] Lichtenthaler,H.K.(1987) Chlorophylls and carotenoids: Pigments of photosynthetic biomembranes. Methods in Enzymology. 148, 350-382.

[3] Sieroń,A.,Sieroń-Stołtny,K., Kawczyk-Krupka,A.,Latos,W., Kwiatek,S., Straszak,D., Bugaj, A.M. The role of fluorescence diagnosis in clinical practice. (2013) Onco Targets Ther., 6, 977–982.

[4] Lichtenthaler,H.K.,Babani,F.,Langsdorf,G.(2007) Chlorophyll fluorescence imaging of photosynthetic activity in sun and shade leaves of trees. Photosynth Res. 93,235–244.

[5] A Kyrychenko,A. (2003). Using fluorescence for studies of biological membranes: A review. DOI: 10.1088/2050-6120/3/4/042003.

[6] Welling,M., Hansbergen, A.W., Bunschoten, A., Welders, A.H., Scheper, H., Smits, W.K., Restenberg, M., van Leeuwen, F.W.B. (2019). Clinical and Translation Imaging, 7,125-138.

[7] Parveen,N., Borrenberghs,D., Rocha,S., Hendrix, J.(2018) Single Viruses on the Fluorescence Microscope: Imaging Molecular Mobility, Interactions and Structure Sheds New Light on Viral Replication. Viruses. 10, 250, doi: 10.3390/v10050250.

[8] A Kyrychenko, A. (2003) Using fluorescence for studies of biological membranes: A review. DOI: 10.1088/2050-6120/3/4/042003

[9] P. J. COTTY, P.J.(1988) Simple Fluorescence Method for Rapid Estimation of Aflatoxin Levels in a Solid Culture Medium. App. Environ. Micrpbiok., 54, 274-276.

[10] Gan,Z., Ju,J., Zhang,T., D.Wu,D.(2011) Preparation of Rhodamine B Fluorescent Poly(methacrylic acid) Coated Gelatin Nanoparticles. J. Nanomaterials,2011, Article ID 753705, doi:10.1155/2011/753705.

[11] Smith, J.S., Williams, W.P.,Williams, G.L.Windham (2019) Aflatoxin in maize: a review of the early literature from "moldy-corn toxicosis" to the genetics of aflatoxin accumulation resistance. Mycotoxin Res., 35,111-128.

[12] Lien,K.W., Wang,X., Pan, M.H.,Ling, M.P. (2019) Assessing Aflatoxin Exposure Risk from Peanuts and Peanut Products Imported to Taiwan. Toxins (Basel), 11,80: doi: 10.3390/toxins11020080.

[13] Murshed, ,S.A.A.M,Bacha,N.,Alharazi, T.(2019) Detection of Total Aflatoxins in Groundnut and Soybean Samples in Yemen Using Enzyme-Linked Immunosorbent Assay. J. Food Quaolity, Article ID 1614502 | https://doi.org/10.1155/2019/1614502

[14] Yaoa,H., Hruskaa,Z., Kincaida,R., Brownb, R.,Clevelandb, T., Bhatnagar,D. (2010) Correlation and classification of single kernel fluorescence hyperspectral data with aflatoxin concentration in corn kernels inoculated with Aspergillus flavus spores. Food Additives and Contaminants, 27,701–709.