
This paper presents basic information about the chemical structure of ochratoxin A (OA) and its many metabolites. OA is a remarkably stable toxin: once found on foodstuffs it will stay without effective removal by cooking, steam, pressure or irradiation. Toxicity is reviewed, with evidence of immunosuppression reported. Carcinogenesis in mice is noted but not in humans. Fungi that produce OA are diverse with multiple foods and beverages contaminated (short list: grapes, juice, must, wine, coffee, cereals, salami, ham, rice, corn, millet, spices and cheese). 50% of human daily intake of OA is due to contamination of cereal grains. Limits of OA consumption have been reduced from 100 ng/kg body weight to 14 ng/kg bw/day to be considered safe, but coffee consumption that leads to 5 micrograms/kg bw are safe! OA compounds are easily identified by chromatography methods. ELISA is rapid but is well documented to not be specific; “cross-reactivity with related molecules can vary widely giving over-estimated values.”

OA is made via the polyketide synthesis pathway. Structures are well represented. Genes for this pathway are tightly regulated, respond to environmental factors and are arranged in clusters. The p450-H11 gene involved in OA production is nearly identical to the gene involved in aflatoxin production. The p450-B03 gene is essentially the same as one of the trichothecene biosynthesis genes, suggesting conservation of horizontal transfer of gene sequences from one species to another. “Regions of homology within mycotoxin biosynthetic genes from the different species can be used to develop primers to detect the presence of …aflatoxin producers, trichothecene producers, fumonisin producers and patulin.” (NB: environmental factors that turn on mycotoxin production by one species will activate many.) Beta tubulin-1 gene sequences are important in OA (NB: see benomyl chapter in Surviving Mold). PCR is being widely used for detection of OA in foodstuffs.

Maximum mycelial growth seen at a(w) of 0.95-0.99 at 30 degrees C. None at a(w) of 0.80. Maximum concentration of OA was 17,000 ng/g of green coffee. (NB: these levels will give very high urine concentration of OA).


Conidia of Aspergillus are killed by various immune effector cells; hyphae are killed by neutrophils. Neutrophil extracellular traps contain and localize fungal components preventing systemic spread. Th (1) responses results in improved defenses against infection.


Human nasal epithelial cells phagocytose fungal conidia, preventing germination of spores.


Verruculogen is found in up to 67 Aspergillus fumigatus extracts. It modifies electrophysiologic properties of cells in vitro. (NB: Cells in mucus will be sheltered from these effects.)


At least 226 active secondary metabolites are made by A. fumigatus that come from at least 13 different families that can be identified by HPLC. Sphingofungins may play a similar role as fumonisins but often OA is misidentified.


Delivery of phenylalanine by Asp disrupts protein synthesis disruption caused by OA.


Biomarkers for OA exposure are not related to time course of exposure given their long half life in serum.

OA ingested in coffee can approach 4.1 ng daily while OA ingested from cereals is 6.7 ng. Foods of animal origin contaminated with OA could present OA/OA metabolites to consumers of animals.


OA is present in many food stuffs but total consumption in Catalonia was less than 14 ng/kg bw/day.


Blood levels of OA were determined in 406 asymptomatic patients using HPLC. Mean level was 0.18 ng/ml. No correlation between diet and plasma OA levels (NB: OA has long half life). However, cereal grain products, wine, beer and pork as well as brown bread did correlate with OA levels.


80% of OA is removed from grapes during wine making.


OA is found in over 50% of wines. Red, rose and whites have decreasing amounts of OA.


OA was detected in 99.1% of 327 asymptomatic patients. 5.2% exceeded 500 ng/L (NB: look at these data!). Mutton, lamb, cereal, wine, beer and jam/honey were correlated with OA levels.


Mycotoxins are abiotic hazards produced by certain fungi that grow on a variety of crops. Their prevalence in plant raw materials may be high.

Attempts to estimate global burden of disease caused by dietary exposure.


The full impact on human health of widespread exposure to mycotoxins remains to be defined. For OA and zearalenone the human health effects remain undefined.


Both NaCl and sugar can impact on survival of OA formers.


83% of 233 asymptomatic patients showed OA in first morning urine, with mean of 14 ng/g creatinine. Maximum was 75.6 ng/g creatinine.


72 asymptomatic patients were analyzed by HPLC for OA in urine. OA metabolite ochratoxin alpha was higher than OA with more OA alpha found with a three day food diary compared to a one day diary.


121 samples from asymptomatic patients from two sites in Iberia, with afternoon urine concentration far higher than AM samples, with levels exceeding 0.12 ng/ml (12 ppb).


OA conjugation with glucuronic acid occurs in human urine. Levels of OA again are found to exceed 0.1 ng/ml (10 ppb).

123 samples were examined for aflatoxins and OA. M1 was found in 48% of samples. B1 42% and OA 100%. Dietary assessment showed no risk of calculated intake of 1.2 ng/kg bw/day despite positive urine findings.


50 individuals provided urine and blood samples over 30 days. OA was found in all plasma samples and 46 of 50 urine samples. A significant correlation of urine OA and dietary OA consumption was demonstrated. Urine testing can show exposure to dietary OA.


OA levels were measured in serum in 138 healthy patients. All but 4 were positive. Mean values were 0.56 ng/ml (560 ppb). Summer values were higher than autumn. A subgroup of patients was tested one year later showing no significant correlation from year to year. “OA levels are a short-term biomarker with a high within-subject variability; therefore they have limited use at the individual level but can be used to characterize populations.”

What can we learn from these papers? OA is easy to find in urine though ELISA is too non-specific to ever be used. Urinary OA has no correlation with any illness as controls with both high and low levels remained well. There is clear evidence that OA is present in foods eaten by nearly everyone. There is no question that urine of just about everyone will show levels of OA that are measurably much higher than those reported to be found in CFS and sinusitis patients.

The role of activity of water is again demonstrated. If the activity of water is less than 0.80, there will be no manufacture of mycotoxins.

Mycotoxin biosynthesis is coordinated activation of specific genes that are homologous between multiple mycotoxins and across species. Environmental stimuli including rainfall and temperature are involved with regulation of the biosynthesis pathways.