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**Is a common food fungus worsening the AIDS epidemic?**
By Greg Williams

A type of fungus coating much of the stored corn, wheat, rice and nuts in developing countries may be quietly worsening the AIDS epidemic, according to a paper published today in the World Mycotoxin Journal.

**In developing countries, food stored in piles of sacks in warehouses is often contaminated with fungi that give off toxic substances .** Kept in sacks piled in barns and warehouses, food stores in countries near the equator are contaminated by Aspergillus flavus and A. parasiticus, fungi that produce a toxic substance called aflatoxin. About 4.5 billion people worldwide are exposed to aflatoxin at unsafe levels, and chronic exposure has been linked to liver damage and related cancers; but its role in the spread of infectious disease could make it even more deadly.

"Our work suggests that aflatoxin exposure may be taking an even greater toll in areas where millions are infected with HIV, including Africa and Asia, the latter with a fast-growing HIV population and rice storage areas contaminated by fungi," said Pauline, Jolly, Ph.D., professor in the Department of Epidemiology within the School of Public Health at the University of Alabama at Birmingham (UAB). Strict regulation and monitoring minimize exposure in the United States.

Jolly and her colleagues recruited 314 HIV-positive people who were not yet on antiretroviral therapy for the study in Kumasi, Ghana. They divided patients into four groups based on their level of aflatoxin exposure and found that those in the highest exposure group were 2.6 times more likely to have a high HIV viral load than those in the lowest exposure group. Higher viral load translates into higher rates of HIV transmission and the potential for earlier progression to the opportunistic infections of AIDS.

"Previous studies by our team had looked at the possible interaction of aflatoxin and HIV on immune suppression, and this study examined twice as many patients as previous studies," said Jolly, the study's corresponding author. "It also was structured to eliminate factors such

as opportunistic infections and antiviral combination therapy in clarifying the relationship between aflatoxin exposure and HIV for the first time."

Leading theories suggest that the fungal toxin may suppress the immune system by reducing the production of certain immune cells or the proteins that activate them. The toxin also may increase the expression of genes that result in more copies of the virus, but more study is needed to confirm the mechanisms.

Along with Jolly, the study authors were Seidu Inusah and Baogen Lu, M.D., in the UAB departments of Biostatistics and Epidemiology; William Ellis, Ph.D., Kwame Nkrumah University of Science and Technology in Kumasi; Alberta Nyarko, M.D., Kumasi South Regional Hospital in Kumasi; Timothy Phillips, Ph.D., Texas A & M University Department of Veterinary Integrative Biosciences; and Jonathan Williams, Ph.D., University of Georgia College of Agricultural and Environmental Science.

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"We have done a series of studies now confirming a link between HIV viral load and aflatoxin exposure, but the problem has not yet been recognized or addressed," said Jolly, an HIV immunologist who does most of her work in Ghana. "While this study was larger than our previous study, a fungal contribution to HIV transmission will only be proved once and for all by larger randomized studies for which there now is no funding. The scientific and world-health communities need to decide soon whether or not this question is worth answering."

**Journal Article**


**Association between high aflatoxin $B_1$ levels and high viral load in HIV-positive people**


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**Abstract**
Since both aflatoxin and the human immunodeficiency virus (HIV) cause immune suppression, chronic exposure to aflatoxin in HIV-positive people could lead to higher levels of virus replication. This study was conducted to examine the association between aflatoxin $B_1$ albumin adduct (AF-ALB) levels and HIV viral load. Antiretroviral naive HIV-positive people (314) with median CD4 count of 574 cells/μl blood (mean ± standard deviation = 630±277) were recruited in Kumasi, Ghana. Sociodemographic and health data, and blood samples were collected from participants. The plasma samples were tested for AF-ALB and HIV viral load. Univariate logistic regression analysis was conducted using viral load (high/low) as the outcome and AF-ALB quartiles as exposure. Multivariable logistic regression analysis was performed between quartile AF-ALB, viral load and CD4 adjusting for sex, age, and year of HIV diagnosis. Both univariate and multivariable logistic regression showed that viral load increased as AF-ALB levels increased. By univariate analysis, high viral load was 2.3 times more likely among persons in the third AF-ALB quartile (95% confidence interval (CI): 1.13, 4.51), and 2.9 times more likely among persons in the fourth AF-ALB quartile (CI: 1.41, 5.88), compared to persons in the first quartile. In the multivariable model, persons in the fourth AF-ALB quartile were about 2.6 times more likely to have high viral loads than persons in the first quartile (CI: 1.19-5.69). When AF-ALB and viral load were log transformed and linear regression analysis conducted, the univariate linear regression analysis showed that for each pg/mg increase in AF-ALB, viral load increased by approximately 1.6 copies/ml ($P$=0.0006). The association was marginally significant in the adjusted linear regression model (i.e. for each pg/mg increase in AF-ALB, the mean viral load increased by approximately 1.3 copies/ml, $P$=0.073). These data show strong and consistent increases in HIV viral load with increasing AF-ALB levels. Since the median and mean CD4 were greater than 500 cells for participants in each AF-ALB quartile, the results indicate that the immune modulating and virus transcription effects of aflatoxin may occur quite early in HIV infection, even while the CD4 count is still above 500, resulting in higher viral loads.

Keywords aflatoxin $B_1$ albumin adducts, HIV viral load, Ghana