Prevention and Control Strategies for Aflatoxins

SELAMAT Seminar
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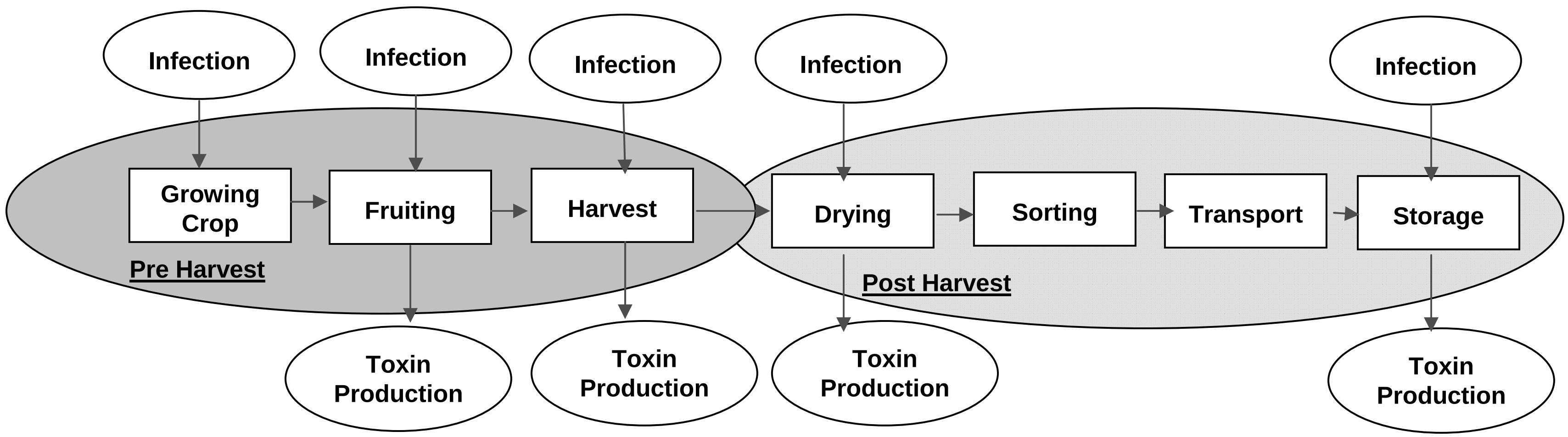
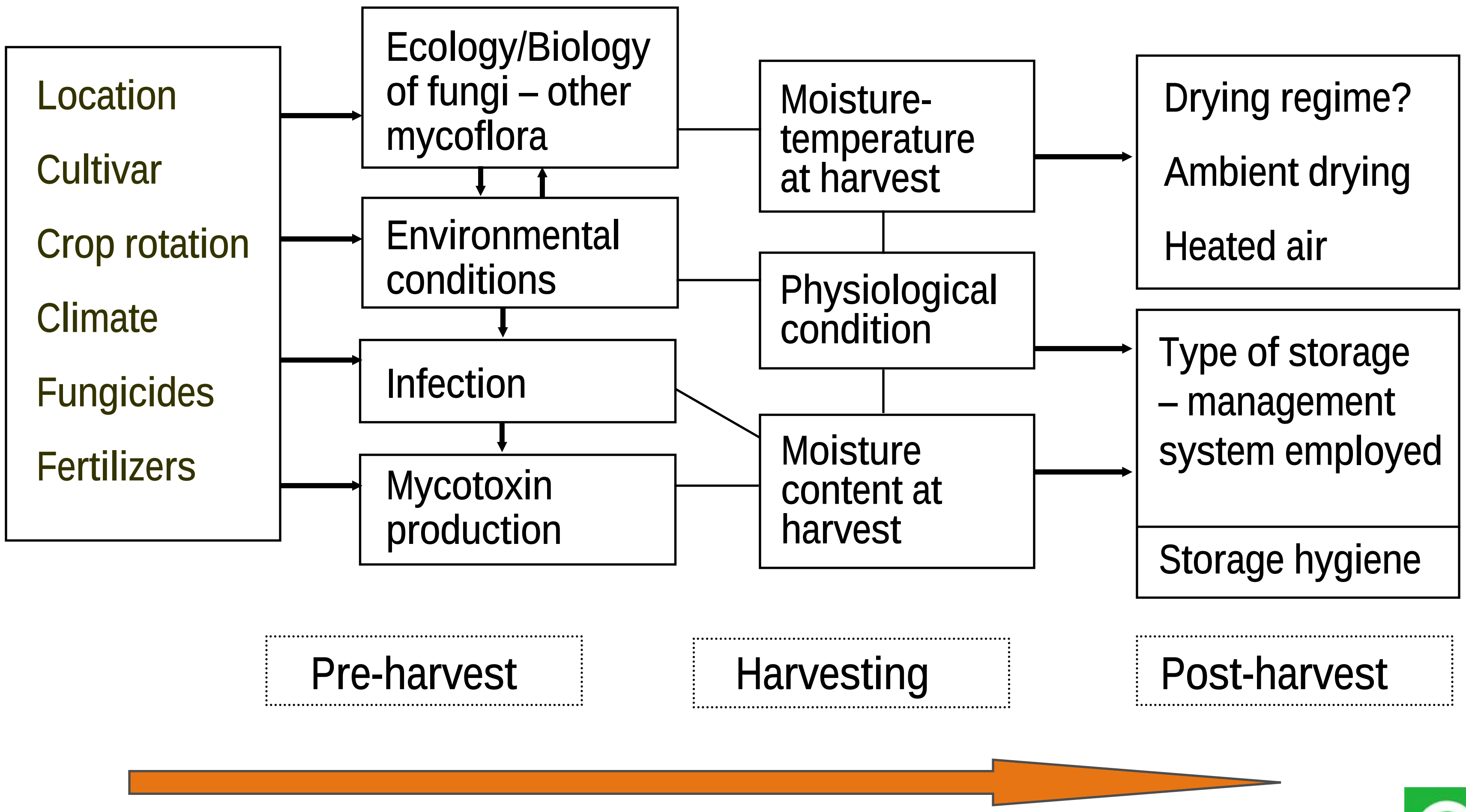
Outline of Talk

- Factors influencing fungal infection and aflatoxin formation
- Critical control points in food chain
- Pre-harvest
  - Decision tools (GIS-based)
  - Agronomic practices
- Post-harvest
  - Drying
  - Sorting
- Amelioration
  - Animal feed
  - Human feed

Vulnerability to infection along food chain



Interactions which impact on mycotoxin contamination



Identification of Critical Control Points (CCPs)

- Susceptibility of particular varieties (fungal resistance)
- Agronomic practices
  - sources of infection, fungicides, biocontrol
- Harvest and climatic conditions
  - timing of harvest
- Method of harvesting
- Drying before storage
- Storage conditions

Decision tools GIS-based systems

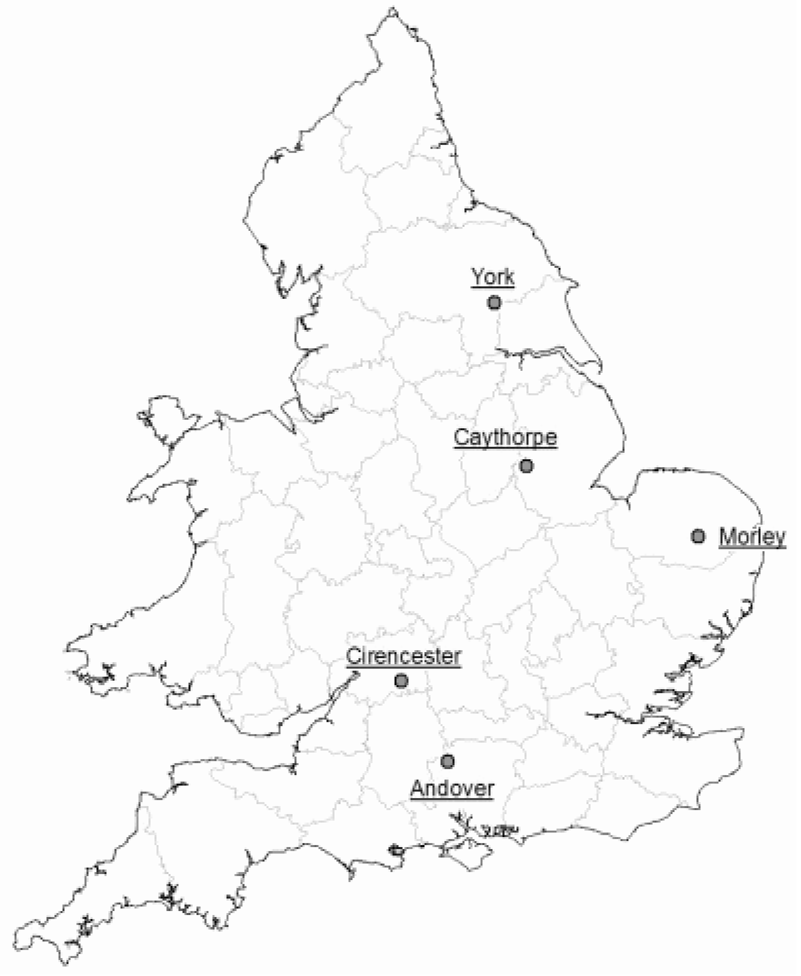
- Weather conditions recorded – temp./rainfall etc.
- Other parameters such as soil temp. etc recorded
- Aflatoxin levels determined at time intervals
- Correlations sought and predictive tools developed to provide advice on harvest interval (e.g. peanuts) and intervention strategies e.g. spraying/irrigation

Live Monitoring of Fusarium on Wheat (2008)

Crop Monitor

RAPID ACCESS TO THE LATEST REGIONAL

CROP PEST AND DISEASE LEVELS



http://www.cropmonitor.co.uk/

DONCast Europe

***Fusarium* risk management for wheat producers**

Welcome to DONcast Europe

DONcast is a tool designed for wheat producers to provide a means of predicting deoxynivalenol toxin (DON) concentration in wheat at maturity.

The DONcast calculator, developed by Weather Innovations Incorporated, uses actual, forecasted and historical weather data along with field-specific agronometric data to accurately predict DON concentrations in wheat at maturity

http://www.doncast.eu/

Afloman

AfloMan

"A decision Support System for Australian Peanut Farmers to Reduce On-Farm Aflatoxin Contamination"

- *What is aflatoxin and how can farmers minimise the risk?*
- *Weekly update of aflatoxin risk, by region, during the 2007/008 season*

The DPI&F peanut research team at Kingaroy is monitoring aflatoxin risk in a number of rainfed peanut crops in the Kumbia, Wooroolin and Coalstoun Lakes regions of the Burnett district, using the AFLOMAN program. Reports for these monitored crops can be viewed below:

http://www.apsim.info/afloman/default.htm

Agronomic practice – Better use of waste materials

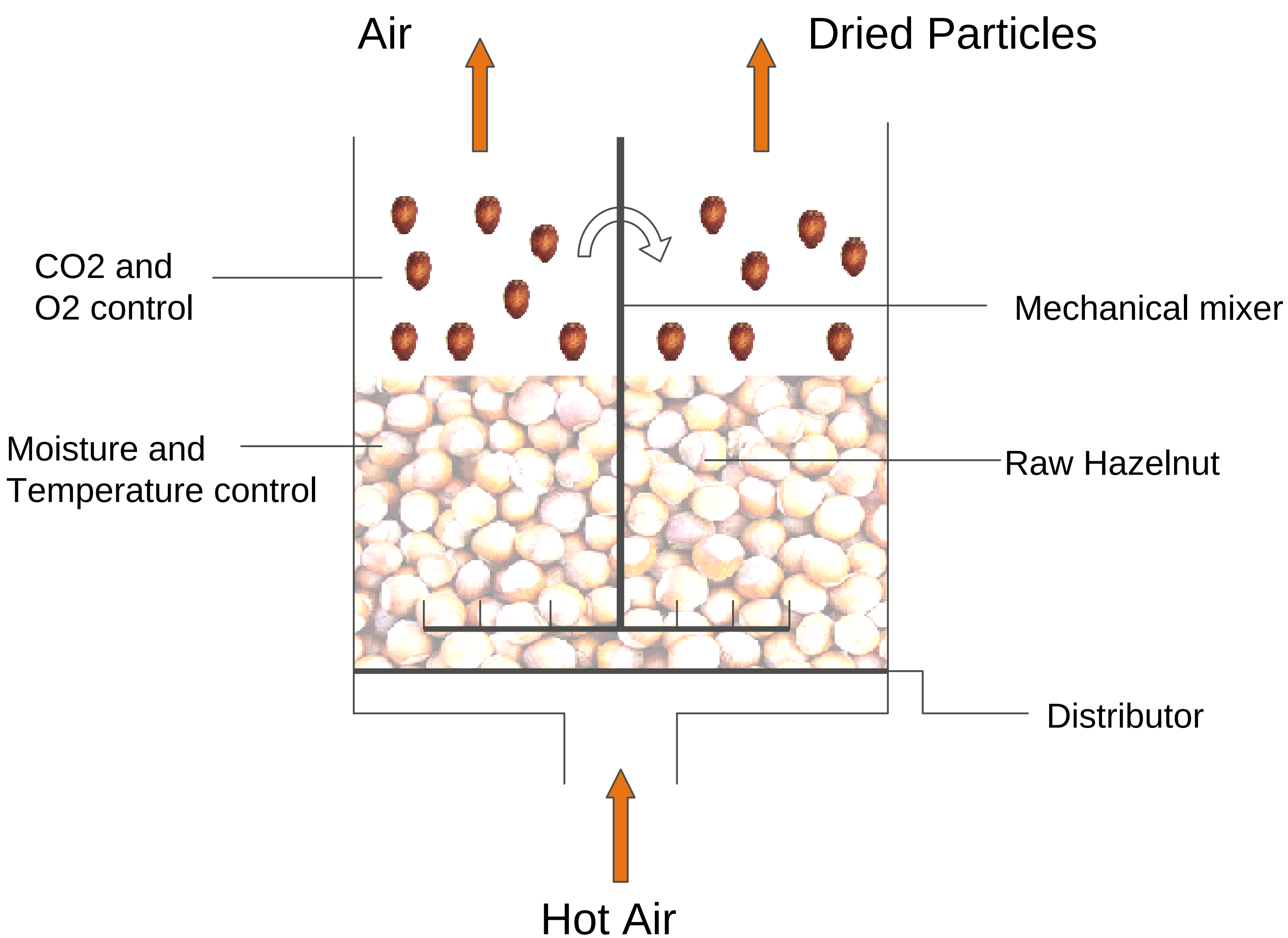
- Almonds, pistachios and walnuts contain natural phenolic compounds in the hulls that drastically reduce or eliminate aflatoxin biosynthesis *in vitro.*
- Disposal of the hulls is a serious environmental problem – no practical use.
- Use hulls as a mulch or ground cover in tree nut orchards to regulate aflatoxin biosynthesis by *A. flavus* and *A.parasiticus* in the soil.
- Use hulls or a phenolic extract thereof in nut processing e.g. in pistachio flotation baths.

Sun-drying of vine fruit e.g. sultanas

Applications of nanotechnology

- Strong antimicrobial action of e.g. silver nanoparticles prevent growth of microorganisms.
- Nanosilver formulations are available from a number of sources such as Natural-Immunogenics Corporation (USA); and Utopia Silver Supplements®, (USA).
- Nanoparticles incorporated into plastic sheeting could improve drying and storage processes.

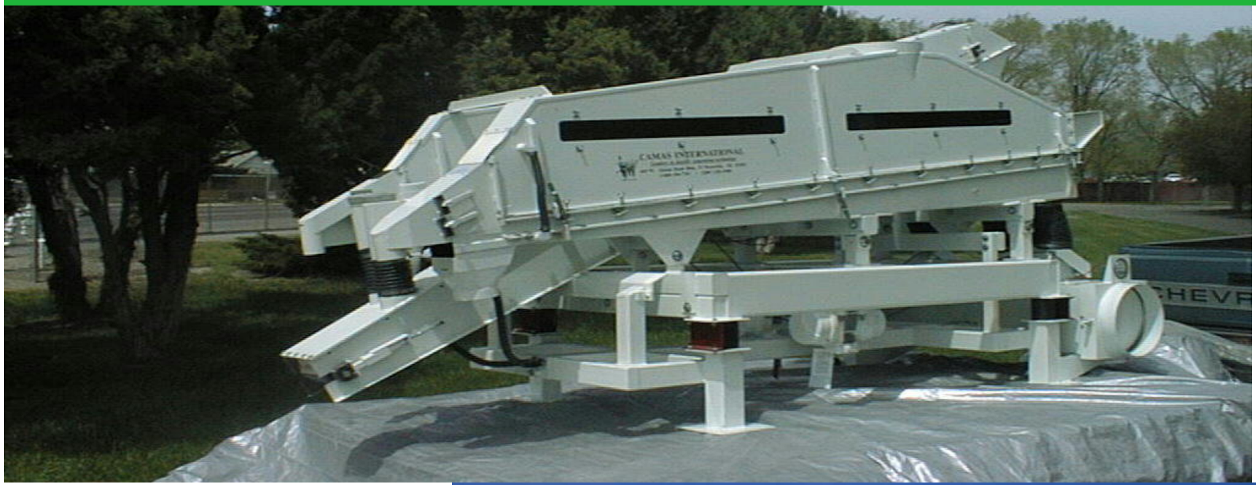
Fluidised-bed drying of Hazelnuts



Hand-sorting of Brazil nuts in Brazilian factory

Hand-sorting of dried figs under UV light in Turkey

CAMAS mechanical density separator



CAMAS density separator – mechanical removal of aflatoxins

- Corn contaminated at 180 ppb sorted and levels reduced to 16 ppb with 7.25% rejection during process.
- Traditional gravity tables removed 25% and levels of aflatoxins still above 20 ppb.

If prevention cannot be achieved then minimisation of exposure provides an alternative strategy

Adsorbent materials used in animal feeds – proprietary mixtures containing clays, bentonite, charcoal, yeasts, aluminium silicates etc.

Commercial products e.g. :-

Standard Q/FIS	Tixolex 28
Myco AD-AZ	Microton
Ryfix Total	Flo Bond
Mycofix Plus	Mycosorb

Animal Studies with NovaSil Clay

Prevention of aflatoxicosis and reduced biomarkers of exposure with NovaSil

Decreased aflatoxin residues in milk

CONCLUSION: No adverse health effects from consumption of NovaSil, and diminished exposure and toxicity with clay in the diet. Evidence for specificity in vivo: NS did not protect against ZER, Ergots, DON, T2, Ochratoxin, cyclopiazonic acid etc.

Phillips *et al* (2005)

NovaSil Clay

- Tightly and selectively sorbs aflatoxins
- Prevents aflatoxicosis in animals
- Decreases residues in food of animal origin
- Has high affinity and high capacity
- Quality control is critical

Phillips *et al* (2005)

NS Clay intervention in humans

PIII: Short-term feasibility trials in humans in the U.S. & Ghana, Africa

Design: The smallest effective dose of NS clay that can be accurately delivered by mouth (using capsules) was determined and tested in initial human trials in the U.S. (at TTU). Next, a 3-m intervention study will be conducted in Ghana for efficacy of NS against aflatoxin exposure from the diet. If successful, we will work to develop delivery mechanisms (common foods, salt & pepper, etc.) and extend this practice to long-term studies.

Phillips *et al* (2005)

Protocol for human studies

(JSA Wang & T D Phillips)

SUBJECTS: 50 healthy adults, age 22-40 (TTU); initial physical exams, lab analysis, and questionnaires

PROCEDURES: 2 groups: 1) low dose- 500 mg; 2) high dose- 1,000 mg; 3 caps x 3 times/d for 2 weeks

Distributed to each participant before meals with a bottle of spring water. Medical personnel onsite to monitor any complaints or adverse effects

Blood and urines taken at the end of the 2 wk period, lab analysis and physical exams

Reporting adverse events according to NIH guidelines.

NS capsules for human safety study 500 and 1,000 mg doses

Phillips *et al* (2005)

Incorporation of clays into food products

Use of chemoprotection in product development to improve safety and production of peanut products in Ghana, West Africa

Project #OKS55

PI: Margaret J. Hinds, Oklahoma State Univ

Co-PI: William Ellis, Kwame Nkrumah Univ of Science & Tech, Kumasie, Ghana

Project Goals

- To develop HSCAS-supplemented versions of traditional Ghana peanut products with potential to serve as natural chemopreventors to aflatoxicosis in humans.
- To evaluate effect of HSCAS on physical, biochemical and sensory quality of these products.

Challenges with HSCAS

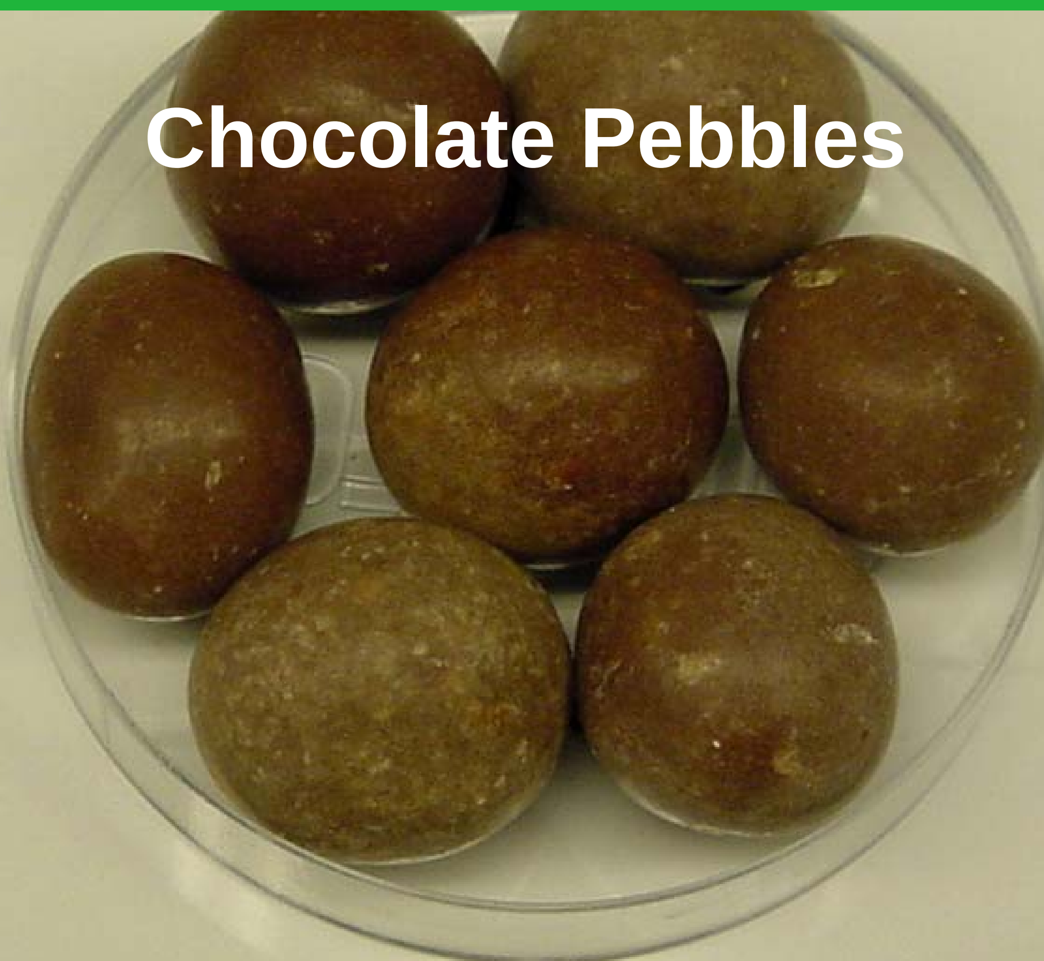
- HSCAS loses most of binding ability when heated at $\geq$ 200C for 30 min.

- No info on the aflatoxin-binding efficacy of HSCAS when it is an ingredient in processed foods, nor how HSCAS might alter product quality.


Ghana Peanut Products for Shelf-life Studies
Kurikuri (Peanut Chips)
fried product made from partially-defatted peanut paste and spices

Ghana Peanut Products for Shelf-life Studies

Chocolate Pebbles



Fried peanut coated with gum then chocolate

Summary and Conclusions

- New approaches include decision tools, nanoparticles, improved drying and improved sorting.
- Don't necessarily need high-tech solutions – simple measures can lead to reductions.
- If prevention fails then exposure should be minimised – possible intervention strategies