HACCP case study – Mycotoxins in Copra

Laurence Castle

Central Science Laboratory

York (UK)

Mycotoxins in Copra

This case study is taken from

“Manual on the application of the HACCP system in mycotoxin prevention and control”

Mycotoxin HACCP manual

Chapter 1. Introduction to mycotoxins

Chapter 2: An overview of hazard analysis and critical control point (HACCP)

- Introduction
- Pre-requisite programmes
- Basic principles of HACCP
- Developing a HACCP plan
- Application of HACCP to mycotoxin control
- Conclusions

Mycotoxin HACCP manual

Chapter 3: Illustrative examples of application of HACCP to mycotoxin control

Example 1: Yellow maize kernels - South East Asia

Example 2: Maize-based Animal Feed - South East Asia

Example 3: Copra cake and meal - South East Asia

Example 4: Peanut butter - Southern Africa

Example 5: Apple juice (Apple drink) - South America

Example 6: Pistachio nuts in West Asia

HACCP case study – Aflatoxin in Copra

This HACCP example dates back to the 1990s.

The EU tightened aflatoxin B1 regulations for dairy feed to 5 µg/kg and also reduced the limit for aflatoxin B1 in copra by-products to 20 µg/kg.

A HACCP-type approach was used to reduce the number of batches failing the new regulations.

The findings of the associated research (Andanar, W., 1991 & Anon., 1993) have been used as a basis for this example.

Only an abbreviated version of the full HACCP plan is given in this presentation.

Copra cake and copra meal

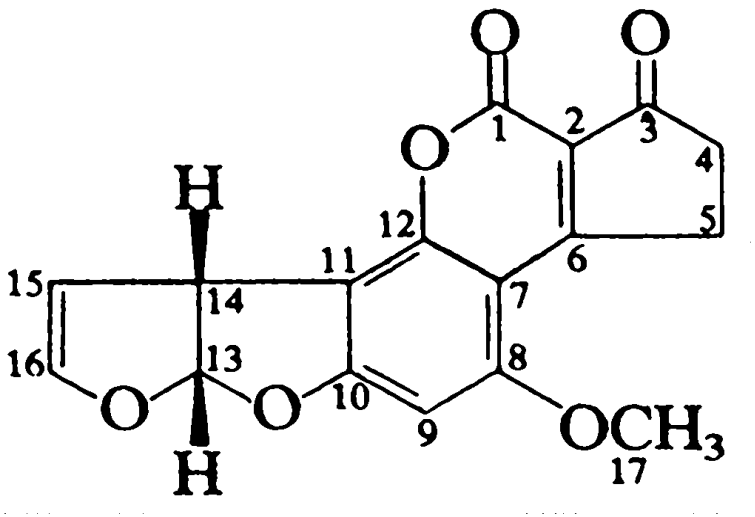
Coconut oil is produced by extracting oil from copra, which is dried coconut flesh.

When the oil is expelled mechanically the residue is called copra cake.

If this is then solvent extracted to increase the yield of oil, the product is called copra meal.

These copra by-products are valuable protein sources in animal feeds, especially dairy feed.

Aflatoxin transmission from feed to milk



Aflatoxin B_1

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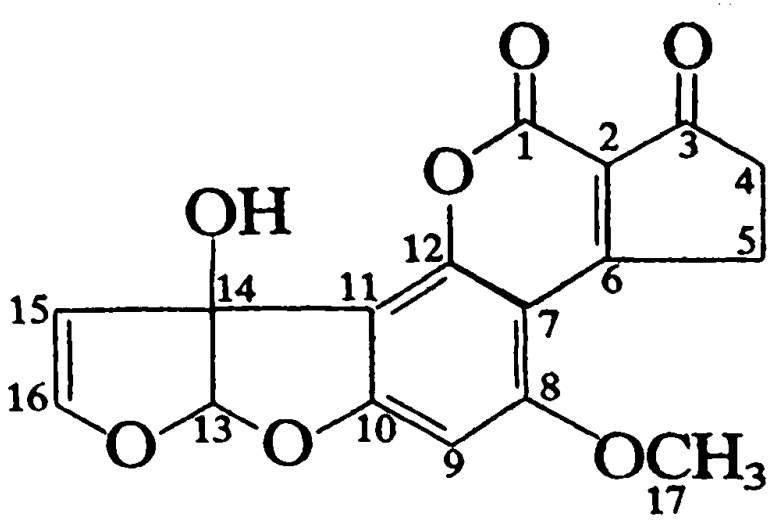


Aflatoxin M_1

Aflatoxin carries-over into milk, so controls on animal feed are needed.

Task 1 - The HACCP team

The HACCP team was assembled.

- a HACCP specialist
- a mycotoxicologist
- an oilseeds specialist
- a socio-economist
- a mycologist
- a drying engineer
- representatives of the coconut oil industry

Tasks 2 and 3 - Product Description and Intended Use

Name of Product	Copra cake or copra meal
Description	Coconut flesh residue after oil expelling (cake) or after additional solvent extraction (meal)
Customer specification	≤12% m.c., pelletised <20 ppb aflatoxin B_1
Conditions of storage	Ambient temperature in processors warehouse (25-35°C).
Shelf Life	Up to 12 months at ≤12% m.c.
Intended use	Animal feed component for incorporation into poultry and ruminant feed, particularly dairy feed
Packaging	Bulk, hold of ship
Target Consumer	Feed compounders in the EC

Tasks 4 and 5 - The Commodity Flow Diagram

- The CFD was established using information provided by the HACCP team.

- The CFD was verified by visiting major copra production centres and oil mills, interviewing the key players and observing their practices.

Commodity flow diagram

Step

1) Coconut Farm. Harvesting/ dehusking
2) Coconut Farm. Splitting
3) Coconut farm. Drying
4) Primary Trader. Accumulating/ Drying
5) Secondary / City traders. Storage
6) Oil Mills. Procurement
7) Oil Mills. Expelling/ Extracting/ Pelleting
   to yield copra cake/ meal
8) Export. Ship copra cake/ meal

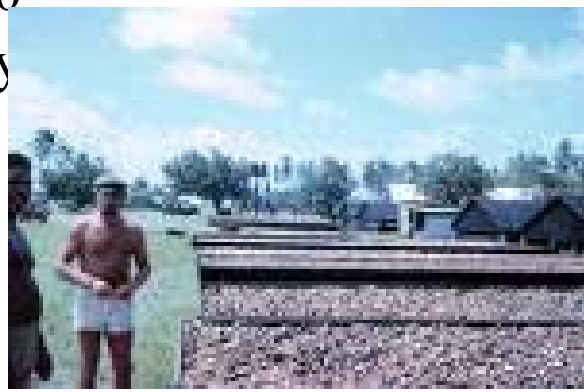
Task 6: Mycotoxin hazard analysis and identification of possible control measures

a) Identification of mycotoxin hazard

- Aflatoxin B1 regulations (were) 5 µg/kg in dairy feed, 20 µg/kg in copra by-products and 0.05 µg/Litre in milk.

b) Identification of steps in the CFD where contamination is most likely to occur

- It was found that aflatoxin was produced within 10 days of splitting the coconut, when the water activity was >0.82 and aflatoxin producing moulds could grow.



- This situation occurred during the drying process, at steps 3 (farm) and/ or step 4 (Primary Trader).

Task 6: Mycotoxin hazard analysis and identification of possible control measures

b) Identification of steps in the CFD where contamination is most likely to occur. (cont)

- Reject nuts from the desiccated coconut industry were often prematurely split and represented a special case.
- Risk of aflatoxin contamination was low in subsequent steps, apart from Step 7 where pellets could be produced at too high a moisture and be susceptible to mould and mycotoxin contamination.

Task 6: Mycotoxin hazard analysis and identification of possible control measures

c) Possible Mycotoxin Control Measures

- Drying uniformly to a ‘safe’ moisture content within 48 hours of splitting the nut was found to be by far the most important control measure.
- Surveillance studies strongly indicated that traditional smoke drying was correlated with low-aflatoxin copra.

Task 6: Mycotoxin hazard analysis and identification of possible control measures

c) Possible Mycotoxin Control Measures (cont)

- Aflatoxin was found to be high in sun-dried copra. Four or five full days are required to attain the 'safe' moisture content and farmers usually only dried for 2 or 3 days.
- Lengthening the drying time was not a complete solution because the copra could easily still be in the 'unsafe' moisture content window for >48 hours and contamination could still occur during drying.
- If drying is slowed by cloudy weather, or interrupted by rain, then there is a high risk that high levels of aflatoxin B1 will result.
- Therefore, discouraging sun-drying was considered a control measure.

Task 6: Mycotoxin hazard analysis and identification of possible control measures

c) Possible Mycotoxin Control Measures (cont.)

- An incentive was required for farmers and traders to produce low-aflatoxin copra.
- This was provided in an amended Government grading scheme which introduced grading on the basis of percentage yellow-green mould. It also increased the premiums for dry copra, so that it made it worthwhile to dry to a ‘safe’ moisture content.

Tasks 7 to 10: Development of a HACCP Plan

Step 1: Farm, harvesting and dehusking – CCP1

This step was classified as a critical control point with a control measure to eliminate the use of nuts found to be split during harvesting and dehusking. This CCP would eliminate any aflatoxin already present.

The critical limit was set at zero cracked nuts and it was monitored by trained harvesters or dehuskers.

The CCP was validated by determining the aflatoxin content of batches of accepted nuts.

Tasks 7 to 10: Development of a HACCP Plan

Step 2: Farm, splitting nuts – GAP

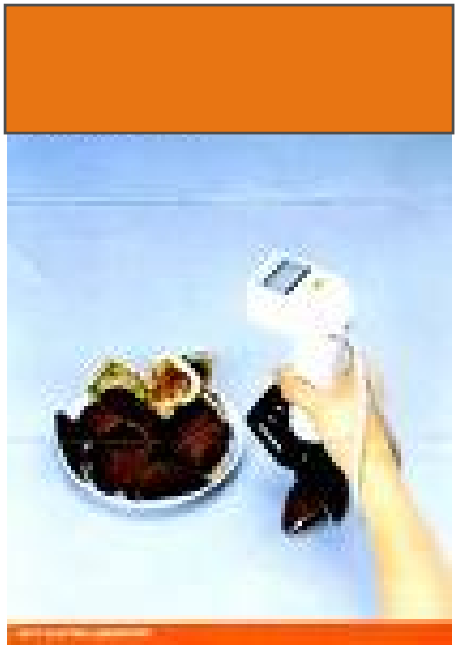
Coconuts are split into halves, or sometimes smaller pieces, immediately prior to drying. It is advisable to ensure that the coconut meat is protected from contact with soil, which is a rich source of inoculum. This is considered GAP.

Tasks 7 to 10: Development of a HACCP Plan

Step 3: Farm, drying – CCP2

This was classified as a CCP with drying to a safe moisture content within 48 hours being the control measure. This CCP will prevent the growth of mould and production of aflatoxin.

- The critical limits are monitored by timing the drying period and the scheduled turning or moving of the copra on the drying bed.
- Validation of the CCP is achieved by measuring the moisture content of the product.



Tasks 7 to 10: Development of a HACCP Plan

Step4: Primary trader, procurement and drying – GMP/ GSP

A national grading system was introduced, giving a premium price for Grade 1 copra (<1% yellowgreen mould and <12% moisture).

It is considered GMP for Primary traders to purchase grade 1 copra, and keep it separate from lower grade copra.

Tasks 7 to 10: Development of a HACCP Plan

Step 5: Secondary traders, procurement and storage – GMP/ GSP

Procurement of Grade 1 copra is also GMP at this step. The Grade 1 copra must be kept separate from other grades and marketed as low-aflatoxin copra.

Good storage practice, such as palleted with good ventilation and a sound roof, will prevent re-wetting and subsequent contamination with mould and aflatoxin.

Tasks 7 to 10: Development of a HACCP Plan

Step 6: Oil mills, procurement – GMP

Procurement of Grade 1 copra is essential to produce copra by-products containing acceptable levels of aflatoxin, and this is considered to be GMP.

Oil millers tend to buy and store large stocks of copra. Provided that the copra is at, or below, a moisture content of 12%, then aflatoxin will not be produced with good storage practice in place.

It is important to have adequate aeration, however, because 'hot spots' can develop and these can even result in spontaneous combustion.

Tasks 7 to 10: Development of a HACCP Plan

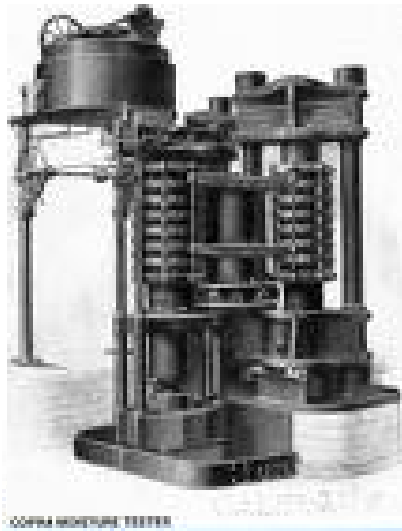
Step 7: Oil mill, expelling/ extracting/ pelleting – CCP3

No aflatoxin control measures are necessary during expelling of oil and solvent extraction because of the high temperature.

The pelleting process within Step 7 was classified as a CCP, with a critical limit of 12% moisture in the cooled pellets. For a given process, the critical limits will be the dwell time in the cooling tower and the air-flow.

These critical limits will be monitored by timing the dwell time and measuring the air-flow.

The CCP will be validated by regularly determining the moisture content of the cooled pellets.



Tasks 7 to 10: Development of a HACCP Plan

Step 8: Shipment – GMP/ GSP

No increase in aflatoxin contamination is likely during shipping (for reasons that were explained). A number of shipments were monitored and no increase in aflatoxin levels were found.

Tasks 11 and 12

Task 11: Establish verification procedures

Validation procedures were established for each of the CCPs, as indicated above, and overall verification was provided by the aflatoxin results on the pre-loading samples, taken immediately prior to export.

The HACCP Plan was audited quarterly and amended as necessary.

Task 12: Establish documentation and record keeping

The HACCP Plan was fully documented, including appropriate records at the farmer and Primary trader steps.

Commodity flow diagram and CCPs

Step	Classification
1) Coconut Farm Harvesting/ dehusking	**CCP1**
2) Coconut Farm Splitting	GAP
3) Coconut farm Drying	**CCP2**
4) Primary Trader Accumulating/ Drying	GMP
5) Secondary/ City traders Storage	GMP
6) Oil Mills Procurement	GMP
7) Oil Mills Expelling/ Extracting/ Pelleting to yield copra cake/ meal	**CCP3**
8) Export Ship copra cake/ meal	GSP

A simple, logical process based on analysis and data

- define the process
- define the problem
- analyse the problem and get data
- pin-point the CCPs
- place controls in place
- set specifications for the controls
- verify that they are successful
- monitor process and update HACCP plan as required

References for this case study

Andanar, W. (1991). 'Improvements in coconut growing and processing methods in the Philippines'. *CBI News Bulletin* **180** 23-4

Anon. (1993). 'Aflatoxin project in the Philippines' *Cocomunity* **23**, 6.

Head, S. W., Swetman, A. A., Nagler, M. J. (1999). 'Studies on deterioration and aflatoxin contamination in copra during storage'. *OCL* **6** (3)