

Dry Chain Is a Social Preventive Intervention Tool for Liver Cancer by Minimizing Aflatoxins in Dry Foods

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Aim

To bring global awareness about the primary preventive nutrient sensitive “dry chain” strategy to minimize liver cancer linked to aflatoxins in dry food products.

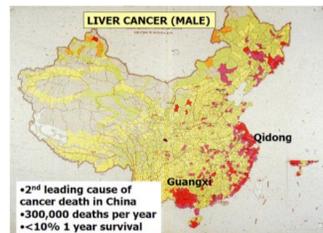
Introduction

Better food safety, security, nutrition and health are global concerns as the population increases to 10 billion by 2050. Agriculturalists have focused on increasing crop yields to meet growing demand for food. However, FAO estimates that about one-third of the total food produced, including dry foods, is lost or wasted, creating food safety and security concerns. Natural disasters like floods and earthquakes also pose quality management problems for food stakeholders. Medical research has called for improvement in dry food product storage to minimize dietary exposure to mycotoxins (aflatoxins) that lead to poor nutrition and health problems including liver cancer. Low moisture content (MC) has long been identified as critical factor that has enabled safe product storage in pharmaceutical, processed food and seed industries in developed countries. However, an integrated approach to manage dry food products to minimize dietary exposure to carcinogenic aflatoxins in humid regions/seasons is urgently needed in developing countries.

Methods

Moisture contents of dry food products were measured before the rainfall in breadbasket regions of India, Nepal and Thailand. Airport weather data were also analyzed for India, Pakistan, China, Thailand, several African and South American countries. Use of a regenerable desiccant was tested for drying horticultural and some agronomic seeds in south Asia and Africa known to have aflatoxin and insect prevalence. Natural drying was also tested in Punjab and Telangana (India), south Nepal and north Thailand.

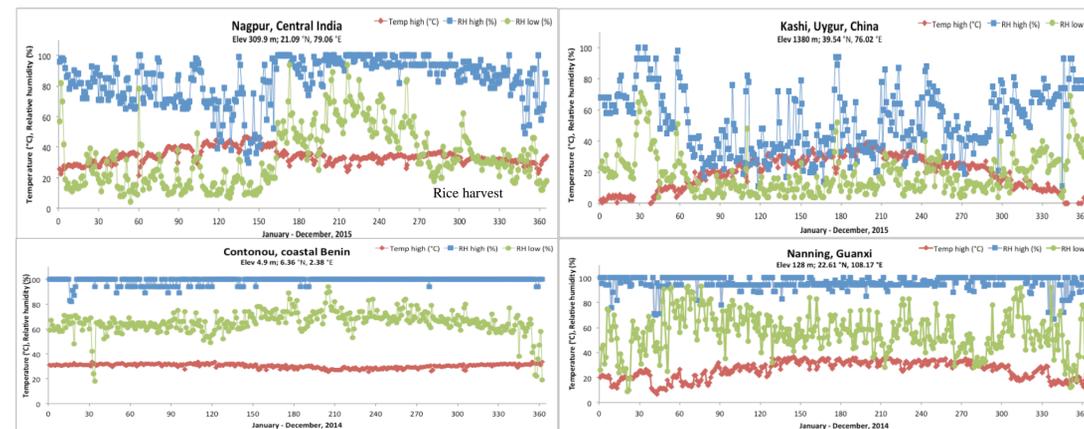
Note the prevalence of liver cancer cases in humid regions of Peoples Republic of China.



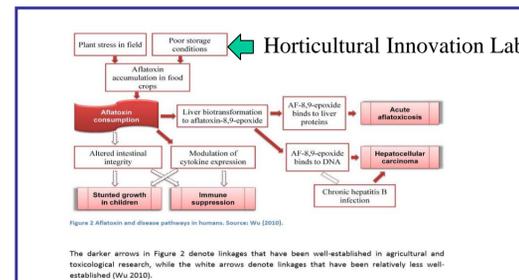
Cohort Study of Liver Cancer in P.R.C.: Viral-Chemical Interactions

BIOMARKERS	HBV AND URINARY AFLATOXINS	RELATIVE RISK FOR LIVER CANCER
NO BIOMARKERS DETECTED		1.0
HBV (YES) AFLATOXIN (NO)		7.3
HBV (NO) AFLATOXIN (YES)		3.4
HBV (YES) AFLATOXIN (YES)		60.0

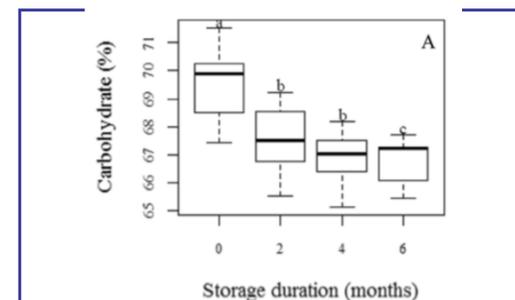
<http://www.nutritioninnovationlab.org/event-post/2013-scientific-symposium/>



Upper panels: Low daytime humidity suitable for drying food products were observed in the long dry season in breadbasket regions and hinterland locations. Lower panels: Continuous high humidity was observed during rainy seasons and in coastal locations causing high MC in stored dry foods. Biennial rainfall patterns in Sub Saharan Africa (not shown) could complicate drying of dry food products.

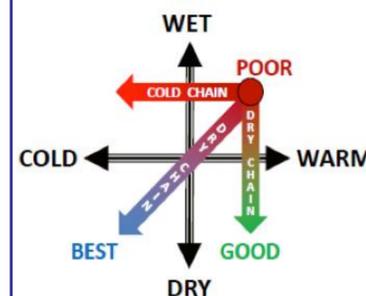


Medical research, IARC and IFPRI have asked to improve food management including storage to minimize aflatoxins as a primary preventive strategy to reduce liver cancers. About 94% of pregnant women in Sarlahi, Nepal had detectable aflatoxin markers in blood serum (Groopman et al., 2014).



Initial MC at farms in Ethiopia ranged from 19-25% which declined to 11-13% during 4 month storage concomitant with decline in carbohydrate. *J Stored Prod Res.* 2017; 70: 7-17.

Nutrient sensitive pesticide-free Dry Chain concept scaled out while using desiccants



Cold Chain: High moisture and continuous cooling needed to extend shelf life

Dry Chain: Dry to “Processing moisture content” and pack into hermetic containers

Storing cold after drying is best to minimize quality/nutrient loss, but warm conditions also work for medium term hermetic storage

When drying is feasible in dry seasons, food products could be dried during daytime (low RH) and covered with a tarp at nights (high RH) until achieving safe or processing MC and then be packaged into hermetic containers until processed or consumed.

Results

Dry food loss in storage occurs due to infestation by molds and insects. Toxicogenic fungi can grow in storage and cause food safety concerns in humid seasons/regions. High moisture content of foods favors such damage, pointing to moisture as the primary storage culprit. Pharmaceutical, processed food and seed industries protect dry products from moisture during storage and transport. A unifying Dry Chain concept is presented that uses natural and artificial drying followed by moisture-proof packaging to minimize mycotoxin prevalence in the food/feed value chain.

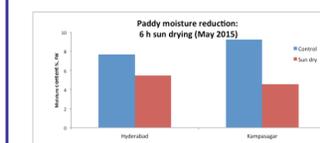
Molds and insects cause extensive dry food loss



India Problems of packaging in porous containers Thailand

Repeated sun drying reduced wheat MC from 10% to 6% before monsoon at south Nepal. Seed viability would be predicted to increase by 16-fold without using dehumidified cold stores.

Sun drying also reduced rice and soybean MC in Telangana, India. Note: International Rice Research Institute asks to store rice seed at 12% MC and food at 14% MC.



Dry Chain

Moisture mantra in pesticide-free Dry Chain

Dry food products sooner to ‘suitability’ for traditional processing MC (13-15%) and use hermetic (air tight) packaging

Monitor quality/aflatoxins in food/feed value chain



Conclusions

Moisture, not temperature, is the main culprit for infestation of stored dry foods by toxicogenic molds and insects. Porous packaging should be replaced by hermetic containers to maintain desired MC. When food products are dry at harvest (i.e., at or below processing moisture content), hermetic packaging alone is sufficient. During rainfall/humid seasons, artificial (heated air or desiccant) drying followed by hermetic packaging is needed to minimize quality loss and prevent aflatoxin accumulation in the dry products. Implementation of the pesticide-free dry chain could reduce the incidence of liver cancer for the 4.5 billion people with aflatoxins in their diets.

Acknowledgments



Bibliography

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Further Information

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