Development of risk-based standard on aflatoxin in peanuts

Virachnee Lohachoompol
National Bureau of Agricultural Commodity and Food Standards
Ministry of Agriculture and Cooperatives
Bangkok, Thailand
Risk analysis in the context of standard development

Risk assessment
- Codex Alimentarius standards on Contaminants
- Exposure assessment
- Risk characterization

Risk management
- Standard development on aflatoxin in Thai peanuts
- Thai laws and regulations

Risk communication
Risk Analysis

Risk assessment policy

- Risk evaluation
- Option assessment
- Implementation
- Monitoring/review

Risk Assessor

- hazard ID
- hazard characterization
- exposure assessment
- risk characterization

- scientific based result
- uncertainties

Risk Manager

- consumer benefits
- impacts on economy and society
- stakeholder input

* Risk communication at all steps
Is there any significant risk from aflatoxin in agricultural commodities?

Will it help reduce the risk if we reduce the maximum level from 20 ppb to 15 ppb as Codex’s recommendation?

Any other method to reduce the risk from aflatoxin?
Risk assessment

- Hazard identification
- Hazard characterization
- Exposure assessment
- Risk characterization
Codex standard for contaminants

JECFA: risk assessor
- Risk assessment/safety evaluation of food additives, processing aids, flavouring agents, residues of veterinary drugs in animal products, contaminants, natural toxins
- Exposure assessment
- Specifications and analytical methods, residue definition, MRL proposals (veterinary drugs)
- Development of general principles

CCCF: risk manager
- To establish or endorse permitted maximum levels or guidelines levels for contaminants and naturally occurring toxicants in food and feed
- To prepare priority lists of contaminants and naturally occurring toxicants for risk assessment by the Joint FAO/WHO Expert Committee on Food Additives
- To consider methods of analysis and sampling for the determination of contaminants and naturally occurring toxicants in food and feed
- To consider and elaborate standards or codes of practice for related subjects
Codex standard for contaminants

Definition of contaminants

- any substance not intentionally added to food
- Present in such food as a result of the production (including operations carried out in crop husbandry, animal husbandry and veterinary medicine), manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food or as a result of environmental contamination
- The term does not include insect fragments, rodent hairs and other extraneous matter
Codex General Standard for Contaminants and Toxins in Food and Feed (CODEX STAN 193-1995)

- Mycotoxins
  - Aflatoxins, Total
    - Aflatoxin M1
    - Ochratoxin A
    - Patulin
  - Heavy Metals
    - Arsenic
    - Cadmium
    - Lead
    - Mercury
    - Methylmercury
    - Tin

- Radionuclides
- Others
  - Acrylonitrile
  - Chloropropanols
  - Melamine
  - Vinylchloride monomer
### Aflatoxins, Total


#### Commodity/Product Code

<table>
<thead>
<tr>
<th>Commodity/Product Code/Name</th>
<th>Level ug/kg</th>
<th>Suffix</th>
<th>Type</th>
<th>Reference</th>
<th>Notes/Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO 0507 Peanut</td>
<td>15</td>
<td>ML</td>
<td></td>
<td></td>
<td>The ML applies to peanuts intended for further processing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For sampling plan, see Annex 1 below</td>
</tr>
<tr>
<td>TN 0660 Almonds</td>
<td>15</td>
<td>ML</td>
<td></td>
<td></td>
<td>The ML applies to almonds intended for further processing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For sampling plan, see Annex 2 below</td>
</tr>
<tr>
<td>Brazil nuts</td>
<td>10</td>
<td>ML</td>
<td></td>
<td></td>
<td>The ML applies to shelled ready-to-eat Brazil nuts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For sampling plan, see Annex 2 below</td>
</tr>
<tr>
<td>Brazil nuts</td>
<td>15</td>
<td>ML</td>
<td></td>
<td></td>
<td>The ML applies to shelled Brazil nuts destined for further processing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For sampling plan, see Annex 2 below</td>
</tr>
<tr>
<td>TN 0666 Hazelnuts</td>
<td>15</td>
<td>ML</td>
<td></td>
<td></td>
<td>The ML applies to hazelnuts intended for further processing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For sampling plan, see Annex 2 below</td>
</tr>
<tr>
<td>TN 0675 Pistachios</td>
<td>15</td>
<td>ML</td>
<td></td>
<td></td>
<td>The ML applies to pistachios intended for further processing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For sampling plan, see Annex 2 below</td>
</tr>
<tr>
<td>TN 0660 Almonds</td>
<td>10</td>
<td>ML</td>
<td></td>
<td></td>
<td>The ML applies to almonds “ready-to-eat”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For sampling plan, see Annex 2</td>
</tr>
<tr>
<td>TN 0666 Hazelnuts</td>
<td>10</td>
<td>ML</td>
<td></td>
<td></td>
<td>The ML applies to hazelnuts “ready-to-eat”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For sampling plan, see Annex 2</td>
</tr>
<tr>
<td>TN 0675 Pistachios</td>
<td>10</td>
<td>ML</td>
<td></td>
<td></td>
<td>The ML applies to pistachios “ready-to-eat”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For sampling plan, see Annex 2</td>
</tr>
</tbody>
</table>

Aflatoxins are a group of highly toxic mycotoxins produced by fungi of the genus Aspergillus. The four main aflatoxins found in contaminated plant products are B1, B2, G1 and G2 and are a group of structurally related difuranocoumarin derivatives that usually occur together in varying ratios, AFB1 usually being the most important one. These compounds pose a substantial hazard to human and animal health. IARC (1992) classified aflatoxin B1 in Group 1 (human carcinogen) and AFM in Group 2B (probable human carcinogen). The liver is the primary target organ.
Group 1 Carcinogenic to humans

There is sufficient evidence of carcinogenicity in humans. Exceptionally, an agent may be placed in this category when evidence of carcinogenicity in humans is less than sufficient but there is sufficient evidence of carcinogenicity in experimental animals and strong evidence in exposed humans that the agent acts through a relevant mechanism of carcinogenicity.
Survey of average aflatoxin content in various foods during 2006-2007
Survey of average aflatoxin content in various foods during 2011

<table>
<thead>
<tr>
<th>Food</th>
<th>Aflatoxin B1 (ug/kg)</th>
<th>Total aflatoxin (ug/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground peanut</td>
<td>115.34</td>
<td>46.65</td>
</tr>
<tr>
<td>Roasted/fried peanut</td>
<td>99.20</td>
<td>29.59</td>
</tr>
<tr>
<td>Raw peanut</td>
<td>39.91</td>
<td>1.89</td>
</tr>
<tr>
<td>Dried chilli</td>
<td>34.50</td>
<td>1.48</td>
</tr>
<tr>
<td>Job's tears</td>
<td>1.87</td>
<td>0.04</td>
</tr>
<tr>
<td>Rice</td>
<td>1.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Other</td>
<td>0.60</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Thai ML: 20
Codex ML: 15
Exposure Assessment of Aflatoxin

\[
\text{Dietary Exposure} = \sum \text{Chemical level in a Food} \times \text{Consumption of a Food}
\]
ข้อมูลการบริโภคอาหารของประเทศไทย

FOOD CONSUMPTION DATA OF THAILAND

สำนักงานมาตรฐานสินค้าและระบบคุณภาพ
สำนักงานมาตรฐานสินค้าเกษตรและอาหารแห่งชาติ
กระทรวงเกษตรและสหกรณ์
ISBN 974-403-423-8
http://consumption.acfs.go.th/index.php

### Ingredient query

**Intake:** Per Capita  
**Reported as:** Mean  
**Age:** > 3

**Question 1:** Ingredient consumption from all food codes (g/person/day)

**Ingredient code:** BL 030003  
(e.g. CG 010001)  
[Query]

**Ingredient Code:** BL 030003  
**Ingredient Name:** ต้มยำกุ้ง

<table>
<thead>
<tr>
<th>Food Code</th>
<th>Food Name</th>
<th>Food consumption (g/person/day)</th>
<th>Ingredient consumption (g/person/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0316</td>
<td>ต้มยำกุ้ง (ต้มยำ)</td>
<td>3.9700</td>
<td>2.2629</td>
</tr>
<tr>
<td>1010</td>
<td>แบงก์ดิบเครื่องบด (กินแบบเผา)</td>
<td>0.0200</td>
<td>0.0168</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>3.9900</strong></td>
<td><strong>2.2797</strong></td>
</tr>
</tbody>
</table>
## Dietary exposure

### ตาราง Dietary exposure ของ aflatoxin B1 ผู้ไทย

<table>
<thead>
<tr>
<th>สารอาหาร</th>
<th>ปริมาณบริโภค (g/kg/วัน)</th>
<th>aflatoxin B1 intake (ug/kg/วัน)</th>
<th>% total intake</th>
<th>aflatoxin B1 intake 97.5 perc (ug/kg/วัน)</th>
<th>% total intake</th>
<th>aflatoxin total intake (ug/kg/วัน)</th>
<th>% total intake</th>
<th>total aflatoxin intake 97.5 perc (ug/kg/วัน)</th>
<th>% total intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>ข้าวผัด</td>
<td>0.74</td>
<td>6.93</td>
<td>28.538</td>
<td>0.0218</td>
<td>10.08</td>
<td>0.20534</td>
<td>13.38</td>
<td>0.02553</td>
<td>19.01</td>
</tr>
<tr>
<td>ข้าวผัดปอน</td>
<td>1.28</td>
<td>8.09</td>
<td>96.201</td>
<td>0.12816</td>
<td>58.43</td>
<td>0.80154</td>
<td>52.21</td>
<td>11.343</td>
<td>57.87</td>
</tr>
<tr>
<td>ข้าวผัดปอน (ด่างยาว)</td>
<td>1.31</td>
<td>12.84</td>
<td>36.913</td>
<td>0.06226</td>
<td>24.95</td>
<td>0.51248</td>
<td>33.38</td>
<td>46.559</td>
<td>23.56</td>
</tr>
<tr>
<td>ข้าวผัดกุ้ง</td>
<td>203.5</td>
<td>203.5</td>
<td>0.034</td>
<td>0.00692</td>
<td>0.18</td>
<td>0.00692</td>
<td>0.45</td>
<td>0.00733</td>
<td>2.67</td>
</tr>
<tr>
<td>ข้าวผัดกุ้ง (ด่างยาว)</td>
<td>1.84</td>
<td>1.84</td>
<td>1.831</td>
<td>0.00346</td>
<td>1.89</td>
<td>0.00346</td>
<td>0.23</td>
<td>3.858</td>
<td>2.78</td>
</tr>
<tr>
<td>ข้าวผัดกุ้ง (ด่างยาว)</td>
<td>0.38</td>
<td>0.38</td>
<td>1.024</td>
<td>0.00038</td>
<td>0.18</td>
<td>0.00038</td>
<td>0.03</td>
<td>1.490</td>
<td>0.22</td>
</tr>
<tr>
<td>ข้าวผัดกุ้ง (ด่างยาว)</td>
<td>14.98</td>
<td>14.98</td>
<td>0.028</td>
<td>0.00025</td>
<td>0.18</td>
<td>0.00025</td>
<td>0.03</td>
<td>0.00345</td>
<td>0.18</td>
</tr>
<tr>
<td>ข้าวผัดกุ้ง (ด่างยาว)</td>
<td>31.25</td>
<td>31.25</td>
<td>0.077</td>
<td>0.00241</td>
<td>1.11</td>
<td>0.00241</td>
<td>0.16</td>
<td>0.00390</td>
<td>0.18</td>
</tr>
<tr>
<td>ข้าวผัดกุ้ง (ด่างยาว)</td>
<td>16.06</td>
<td>16.06</td>
<td>0.020</td>
<td>0.00015</td>
<td>0.07</td>
<td>0.00015</td>
<td>0.01</td>
<td>0.00015</td>
<td>0.06</td>
</tr>
<tr>
<td>ข้าวผัดกุ้ง (ด่างยาว)</td>
<td>4.71</td>
<td>4.71</td>
<td>0.340</td>
<td>0.00016</td>
<td>0.74</td>
<td>0.00016</td>
<td>0.10</td>
<td>0.00150</td>
<td>0.63</td>
</tr>
<tr>
<td>ข้าวผัดกุ้ง (ด่างยาว)</td>
<td>54.93</td>
<td>54.93</td>
<td>0.005</td>
<td>0.000027</td>
<td>0.13</td>
<td>0.000027</td>
<td>0.02</td>
<td>0.000027</td>
<td>0.01</td>
</tr>
<tr>
<td>ข้าวผัดกุ้ง (ด่างยาว)</td>
<td>4.72</td>
<td>4.72</td>
<td>0.110</td>
<td>0.000052</td>
<td>0.24</td>
<td>0.000052</td>
<td>0.03</td>
<td>0.000052</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Intake (ng/person/day): 217.30, 1595.21, 4.08, 28.87
Intake (ng/kgbw/day): 1.218, 8.932, 0.041, 0.257
Comparison of total intake between average consumption and 97.5\textsuperscript{th} percentile consumption of Thai population in 2011

<table>
<thead>
<tr>
<th></th>
<th>Average Consumption</th>
<th>97.5 Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aflatoxin B1 Intake (ng/kgBW/day)</td>
<td>4.06</td>
<td>28.67</td>
</tr>
<tr>
<td>Total Aflatoxin Intake (ng/kgBW/day)</td>
<td>4.76</td>
<td>33.45</td>
</tr>
</tbody>
</table>
Ratio of Aflatoxin B1 (%) consumers received from average consumption of various foods

Aflatoxin B1 from various foods

92.6% of aflatoxin intake comes from peanut
Ratio of Aflatoxin B1 (%) consumers received from 97.5\textsuperscript{th} percentile consumption of various foods

99\% of aflatoxin intake comes from peanut
Estimated risk of liver cancer in Thai consumers from Aflatoxin B1

- Estimated potency of liver cancer using JECFA model (1997)

Potency (cancer/year/100,000 people)

\[ \text{Potency} = 0.01 \times \text{Aflatoxin B1 intake (ng/kgbw/day)} \]

for population without Hepatitis B surface antigen

\[ = 0.30 \times \text{Aflatoxin B1 intake (ng/kgbw/day)} \]

for population with Hepatitis B surface antigen

http://whqlibdoc.who.int/trs/WHO_TRS_884.pdf
Estimated Potency of Liver Cancer in 2011 (cancer/year/100,000 people)

- Average consumption: 0.16
- High peanut consumption (97.5th Perc.): 1.12
Estimated Potency of Liver Cancer from different years (cancer/year/Thai population)
Estimated Potency of Liver Cancer in 2011 (cancer/year/Thai population)

Comparison between present situation and removing of 50% peanut contaminated with Aflatoxin B1 at level higher than 15 and 20 ppb

- Present situation: 103
- Remove 50% peanut > 15 ppb: 71
- Remove 50% peanut > 20 ppb: 71
Risk management

- Weighing policy alternatives, in consultation with all interested parties
- Considering risk assessment and other factors relevant to the health protection of consumers and for the promotion of fair trade practices
- Selecting appropriate prevention and control options
Standard development of aflatoxin in Thai peanuts

- Risk Assessment of Aflatoxin for Thai Population
- Cost-benefit analysis of all stakeholders---farmer, trader, sheller, processor, consumer, competent authority, etc.
  - Change in productivity and replacement cost of farmers
  - Cost of sampling and lab analysis of the manufacturer
  - Cost of rejected materials of traders
  - Cost of illnesses of consumers
- Enforcement problems with small businesses
<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Cost</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary producer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70% of producer under GAP</td>
<td>Not applicable</td>
<td>1,130</td>
</tr>
<tr>
<td>50% of producer under GAP</td>
<td>Not applicable</td>
<td>810</td>
</tr>
<tr>
<td>Shelling plant and peanut manufacturer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector, shelling plant manufacturer</td>
<td>3</td>
<td>94-136</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>1-4</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Consumer</td>
<td></td>
<td>81-117</td>
</tr>
<tr>
<td>Value of removed contaminated peanuts</td>
<td>28</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Total</td>
<td>1-35</td>
<td>175-250</td>
</tr>
</tbody>
</table>
How to resolve issues on aflatoxin?

- Establish standards for the whole food chain
- Promote standards to farmers, shellers, manufacturers, etc.
- Certify producers
- Certify products
- Educate consumers
- Anything else???
Elaboration of standard

1) Prioritization of issues or items be standardized

2) Appoint a technical committee to consider draft

3) Set up the draft standard

4) Propose to the technical committee for consideration

5) Hearing of opinion from all stakeholders

6) Submit to the Agricultural Standards Committee

7) Notify to WTO notify other countries (in case of mandatory standards)

8) Declare in the Royal Gazette

Consider review of the standard when appropriate
Irrigation to ensure adequate soil moisture during the last 4-6 weeks of crop growth should minimize pre-harvest aflatoxin contamination of peanuts.

It is very important to harvest the crop at optimum maturity, as excessive numbers of over-mature or very immature pods at harvest can be reflected in high levels of aflatoxin in the product.

Delayed harvest of already infected peanuts may cause significant increase in aflatoxin content of the crop.

Sorting for quality removes a large part of the aflatoxin present at harvest.
Feed production and disposition of AFB1 contaminated animal feeds

- If aflatoxin B₁ is detected, consider one or more of the following options. In all cases ensure that the aflatoxin B₁ level of the finished feed is appropriate for its intended use (i.e. maturity and species of animal being fed) and is consistent with national codes and guidelines or qualified veterinary advice.
  - Consider the restriction of AFB₁ contaminated feed to a percentage of the daily ration such that the daily amount of AFB₁ ingested would not result in significant residues of AFM₁ in milk.
  - If feed restriction is not practical, divert the use of highly contaminated feedingstuffs to non-lactating animals only.
Establishment of standards for entire food chain

- Farm
  - Peanut shelling plant
    - Raw peanuts
      - Processing plant
        - Final product

- Import of raw peanut
- Import of raw peanut
Setting up standards on peanut

1. Establishment of voluntary standards for entire food chain
   - Thai Agricultural Standard on Good Agricultural Practices for Peanut (TAS4900-2010) covers all steps in the primary production practiced by farmers especially the steps affecting the contamination of aflatoxin e.g. drying, pod sorting, storage, etc.
Thai Agricultural Standard on Good Manufacturing Practices for Peanut Shelling Plant (TAS 4901-2012) covers all steps affecting the contamination of aflatoxin in the shelling plant e.g. raw material storage, shelling, sorting, etc.

Thai Agricultural Standard on Dried Peanut (TAS4700-2011) covers minimum requirements/quality criteria including specification of moisture content and total aflatoxin, sampling and analysis of aflatoxin, etc.
2. Consideration of ways to promote/enforce the standard on producers and consumers including certification of system and product

3. Development of **mandatory standard** on Peanut kernel: maximum level of aflatoxin
Control of moisture content and Sorting
Thai laws and regulations

- Ministry of Public Health (MOPH)
  - Bureau of Food, FDA,
    - Notifications under the MOPH or FDA

- Ministry of Agriculture and Cooperatives (MOAC)
  - ACFS
    - Thai Agricultural Standards under the Agricultural Standards Act B.E. 2551 (2008)
  - Department of Livestock Development (DLD)
    - Notifications under the MOAC
Main regulations on contaminants

- Notification under MOPH (No. 98) B.E. 2529 (1986) entitled Contaminants in Foods
  - Tin, Zinc, Copper, Lead, Arsenic, Mercury, Aflatoxin
- Notification under MOAC B.E. 2537 (1994) entitled Property of deteriorated feed
  - Aflatoxin

- the increased level of official controls on imports of certain feed and food of non-animal origin

<table>
<thead>
<tr>
<th>Feed and food</th>
<th>Country of origin</th>
<th>Hazard</th>
<th>Frequency of physical and identity checks (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spices, i.e. <em>Capsicum</em> spp., nutmeg, ginger, turmeric</td>
<td>India</td>
<td>Aflatoxins</td>
<td>50</td>
</tr>
<tr>
<td>Chilli, chilli products, curcuma and palm oil</td>
<td>All third countries</td>
<td>Sudan dyes</td>
<td>20</td>
</tr>
<tr>
<td>Vegetables, fresh, chilled or frozen i.e. yard long beans, aubergines, <em>Brassica</em> vegetables</td>
<td>Thailand</td>
<td>Organo-phosphorus pesticide residues</td>
<td>50</td>
</tr>
</tbody>
</table>
Risk communication

- Interactive exchange of information and opinions throughout the risk analysis process among risk assessors, risk managers, consumers, industry, the academic community and other interested groups.

- Concerning hazards and risk, risk-related factors, risk perceptions, the explanation of risk assessment findings and the basis of risk management decisions.
The Rapid Alert System for Food and Feed (RASFF)

There were much less notifications about aflatoxins in spices given that the situation as regards the presence of aflatoxins in spices originating in India was much improved in 2011 (41 notifications) compared to 2010 (97 notifications). This significant improvement has resulted in reduction of the required control frequency at import. There was a further decrease in aflatoxins notifications for the product category nuts, nut products and seeds for the third year in a row. This is related to the change of legislation in 2010 whereby the maximum levels for aflatoxins in almonds, hazelnuts, pistachios and Brazil nuts have been aligned with Codex Alimentarius maximum levels and the significantly improved situation as regards non-compliance of certain commodities from certain countries (e.g. peanuts from Argentina). This was however counterweighted by a rise in notifications for aflatoxins in feed materials. This was mostly due to the recurrent findings of very high levels of aflatoxins in groundnuts for bird feed from India (106 notifications), of which 83 were reported by the United Kingdom as border rejections.

Table 5 – Aflatoxins

<table>
<thead>
<tr>
<th>product category</th>
<th>aflatoxins</th>
<th>DON</th>
<th>fumonisins</th>
<th>ochratoxin A</th>
</tr>
</thead>
<tbody>
<tr>
<td>cereals and bakery products</td>
<td>13</td>
<td>11</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>feed</td>
<td>119</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fruits and vegetables</td>
<td>78</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>herbs and spices</td>
<td>51</td>
<td></td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>nuts, nut products and seeds</td>
<td>320</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other</td>
<td>4</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>585</td>
<td>11</td>
<td>4</td>
<td>35</td>
</tr>
</tbody>
</table>
การเตือนภัยสัตว์กินถั่ว (ACFS Early Warning) เป็นหนึ่งในบริการข้อมูลที่มีประโยชน์ต่อเกษตรกร เพื่อให้สามารถนำข้อมูลเตือนภัยสัตว์กินถั่วไปใช้ในการวางแผนการผลิต และกำกับดูแลการเจริญเติบโตของพืชได้อย่างมีประสิทธิภาพ ทั้งในด้านการผลิต และการส่งออก ได้อย่างมีประสิทธิภาพ เงินทุนมีการได้รับ และส่งเสริมการผลิตและบริการให้ต่างประเทศ ซึ่งทำให้เกิดประโยชน์ต่อเกษตรกรทั่วไป ทั้งนี้ ACFS Early Warning จะให้บริการ e-mail ที่มีข้อมูลเตือนภัยสัตว์กินถั่วที่เกี่ยวข้อง
ACFS Early Warning
Questions and comments ??

National Bureau of Agricultural Commodity and Food Standards

www.acfs.go.th

virachnee@acfs.go.th