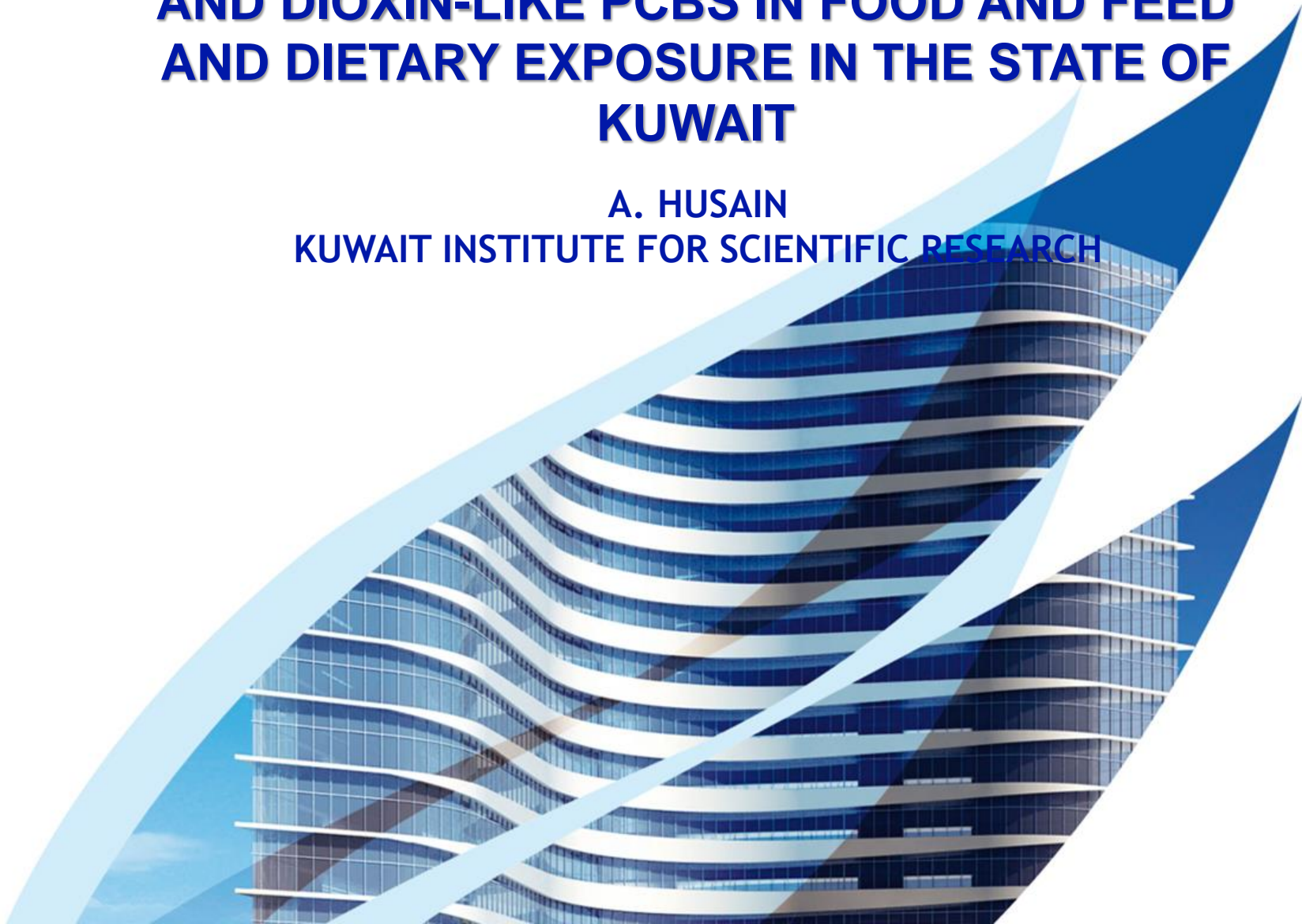


DETERMINATION OF THE LEVELS OF DIOXINS AND DIOXIN-LIKE PCBS IN FOOD AND FEED AND DIETARY EXPOSURE IN THE STATE OF KUWAIT

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Introduction

Dioxins & PCBs

- Dioxins and PCBs are widely recognized environmental and food contaminants.
- Food is the main source of human exposure to dioxins and PCBs (< 90% of total daily intake).
- In Kuwait no data on the levels of these contaminants in consumed foods, nor the methodologies for detection have been developed yet.

Dioxins & PCBs Health Effects

- Several health effects were reported on laboratory animals (body weight changes, hepatotoxicity, chloracne, endocrine and neurotoxicity).
- Human health effects are cancer, immune deficiency, reproductive and developmental abnormalities, diabetes, thyroid disorders and increased serum cholesterol and triglycerides.

Dioxins & PCBs Incidents

- Dioxins & PCBs contamination incidents:
 - ✓ Japan, 1968, Yusho (rice oil) (1860 individuals).
 - ✓ Taiwan, 1979, Yucheng.
 - ✓ Belgian, 1999, chicken and eggs.
 - ✓ Germany, 2011, chicken and eggs.

Dioxins & PCBs Reduction in Foodstuffs

- Dioxins & PCBs are lipophilic and they accumulate in the food chain.
- Reduction of Dioxins & PCBs in food is possible.
- Reduction can be accomplished by removal of affected food products from the market, trim excess fat and consumption of low fat food items (fruits, vegetables, whole grains, seafood, low fat & fat free milk products lean meat and poultry (USAD, 2010).

Monitoring in Foods & Feedstuffs

- GC/HRMS is the method of choice.
- GC/HRMS is time consuming.
- GC/HRMS is an expensive equipment.
- GC/HRMS must be operated by well trained staff.
- DR CALUX is an alternative method capable of analyzing a large number of samples at very low level (10^{-15} grams) and less expensive.

Objectives

- To determine the levels of PCDD/Fs and dl-PCBs in selected samples of animal origin such as lamb, beef, dairy products, chicken, eggs, and fish which are sold in the State of Kuwait.
- To estimate the dietary intake of PCDD/Fs and dl-PCBs in these foodstuffs consumed by the Kuwaiti population.

Methodology

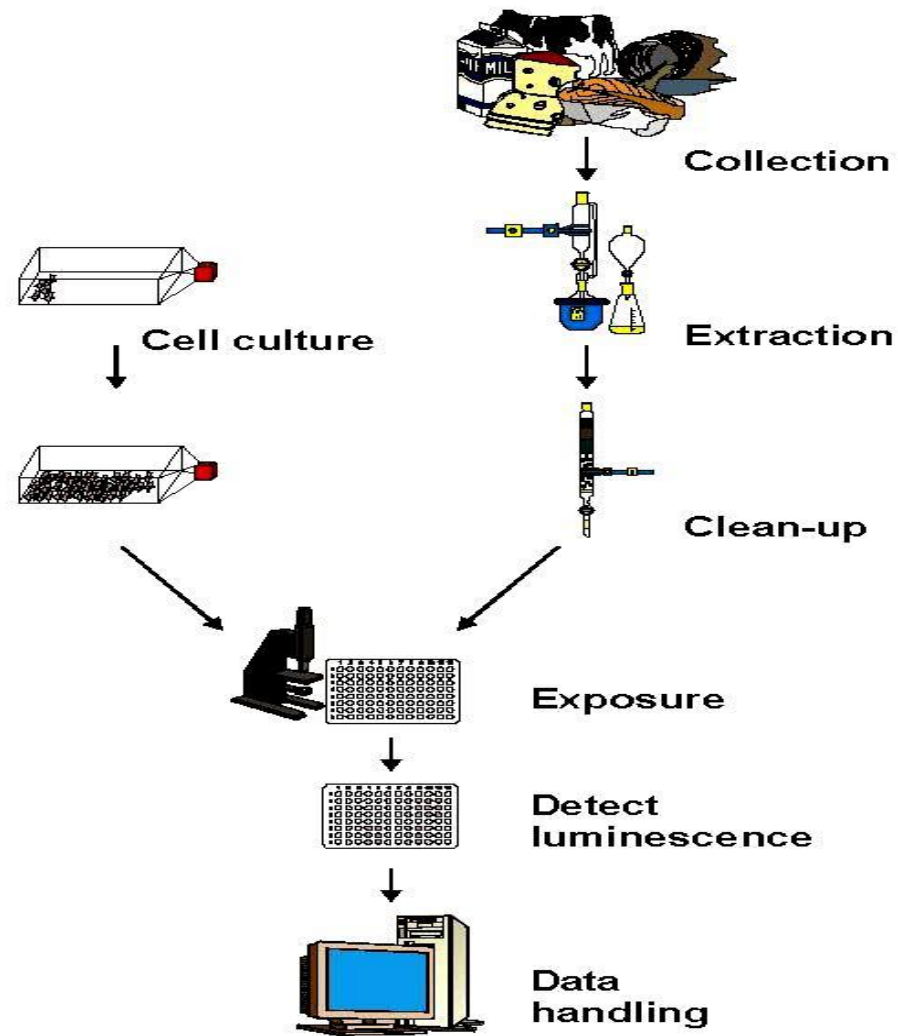
Sample Collection

- 318 (85 local and 233 imported) bovine and sheep meat, poultry meat, milk, eggs, and fish were collected from supermarkets in Kuwait.
- 35 animal feed samples were collected from local wholesalers in Kuwait.

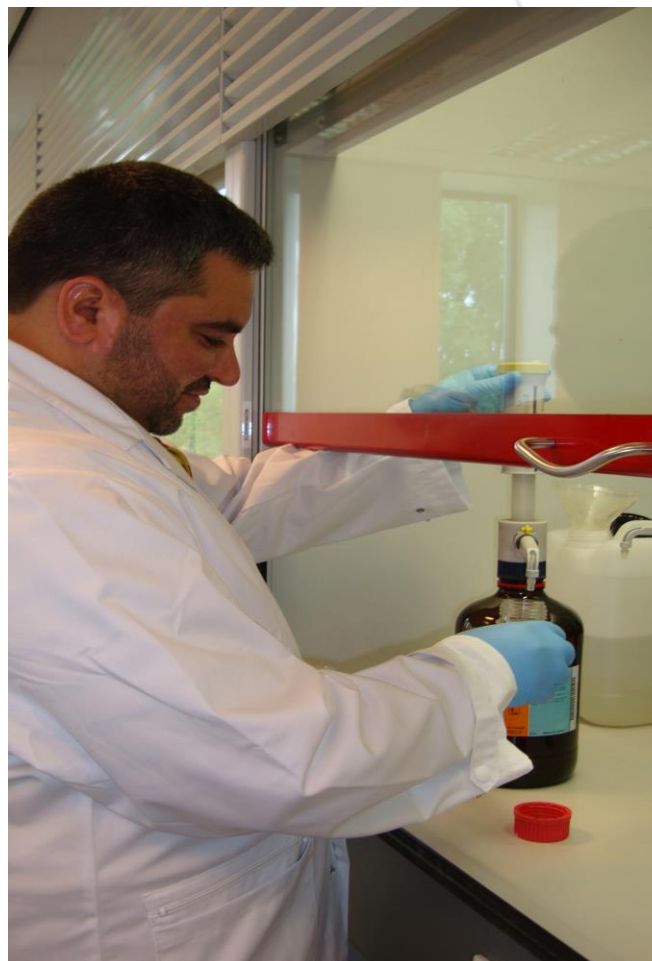
Types and Number of Foodstuffs

Sample	Number of samples
Beef	50
Lamb	18
Chicken	100
Milk	80
Eggs	17
Fish	18
Animal feed	35
Total	318

DR CALUX Method



1. Extraction of food and feed samples



2. Cell culture



3. Luminometer RLU measurement



4. GC-HRMS confirmation

- Confirmation analysis was carried out by Eurofins GfA, Hamburg, Germany according to an ISO 17025:2005 accredited methods.
- For the GC/HRMS analysis, the WHO-TEF (2005) values were applied for calculation of TEQs in food and feed samples.
- The TEQs were calculated by including all not detected 17 PCDD/F and 12 dl-PCBs congeners with the full value of their LOQ (upper bound TEQs).

5. Food consumption data

- Food consumption data and average body weights by gender and age of the Kuwaiti population were drawn from the 2010 National Nutrition Program for the State of Kuwait.
- A 24-h dietary recall was used in the survey of a representative sample of Kuwaiti nationals (545 households; 1830 household members; 48% males & 52 % females) .
- Target age groups were 6-9, 10-19, 20-49 & ≥ 50 years, males & females.

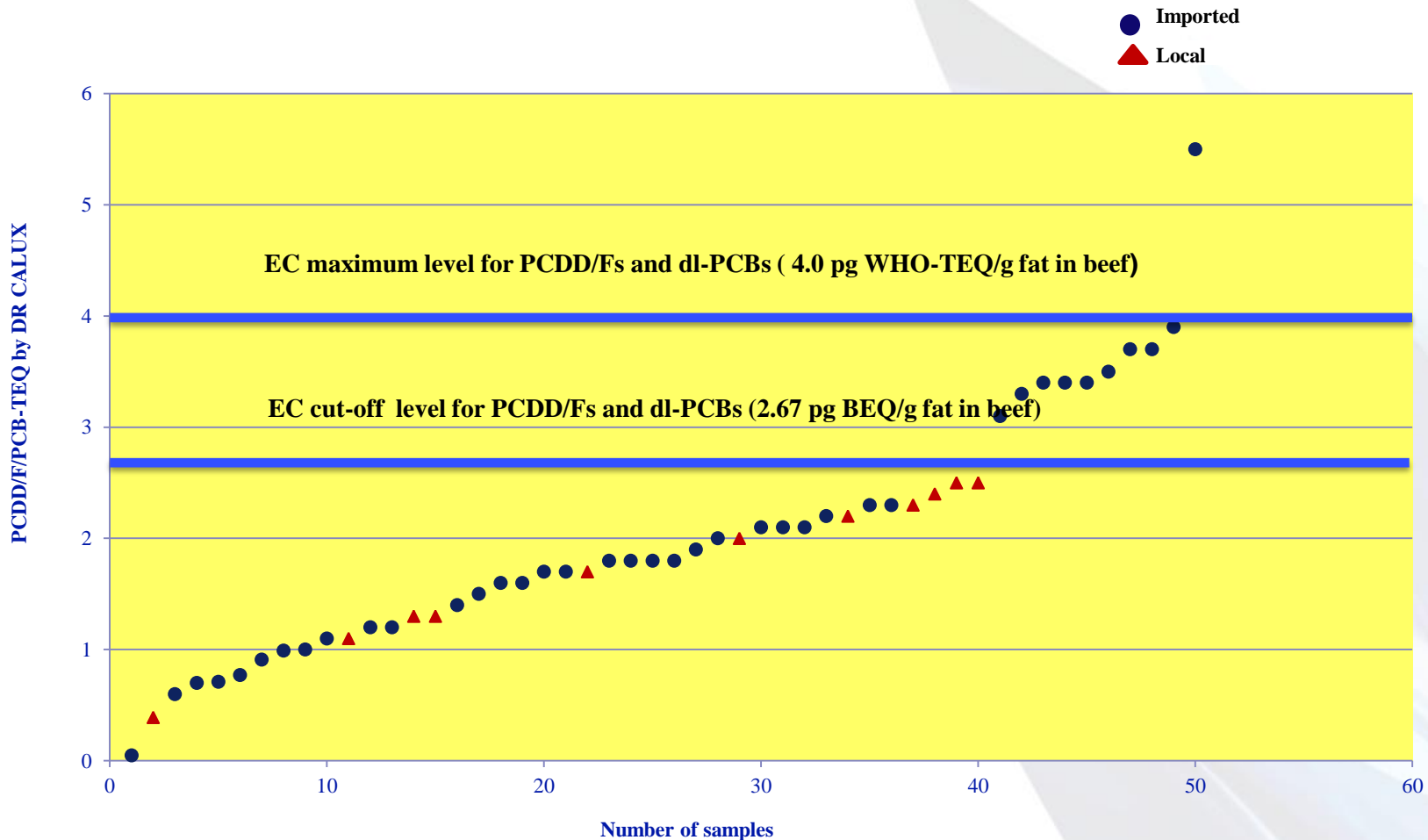
6. Estimation of average total daily intakes of PCDD/Fs & dl-PCBs

- Average daily intakes of PCDD/Fs & dl-PCBs were estimated by multiplying the measured concentrations of PCDD/Fs & dl-PCBs by the average daily consumption of the food divided by body weight.
- The average daily intakes of PCDD/Fs & dl-PCBs were reported as pg DR CALUX BEQ kg⁻¹ per day.

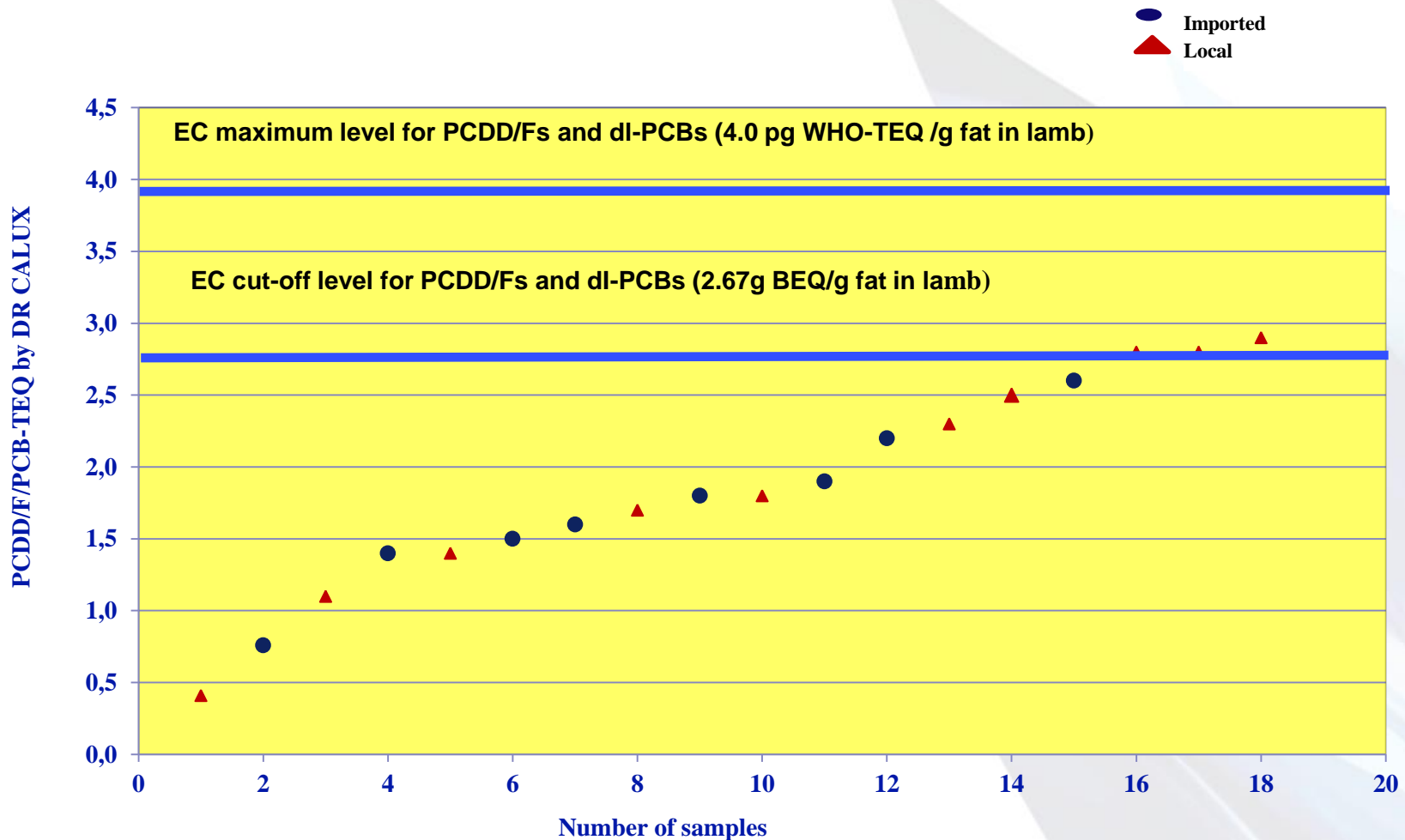
Results and Discussion

**please see for more info at
Ecotoxicology and Environmental Safety 100
(2014) 27–31.**

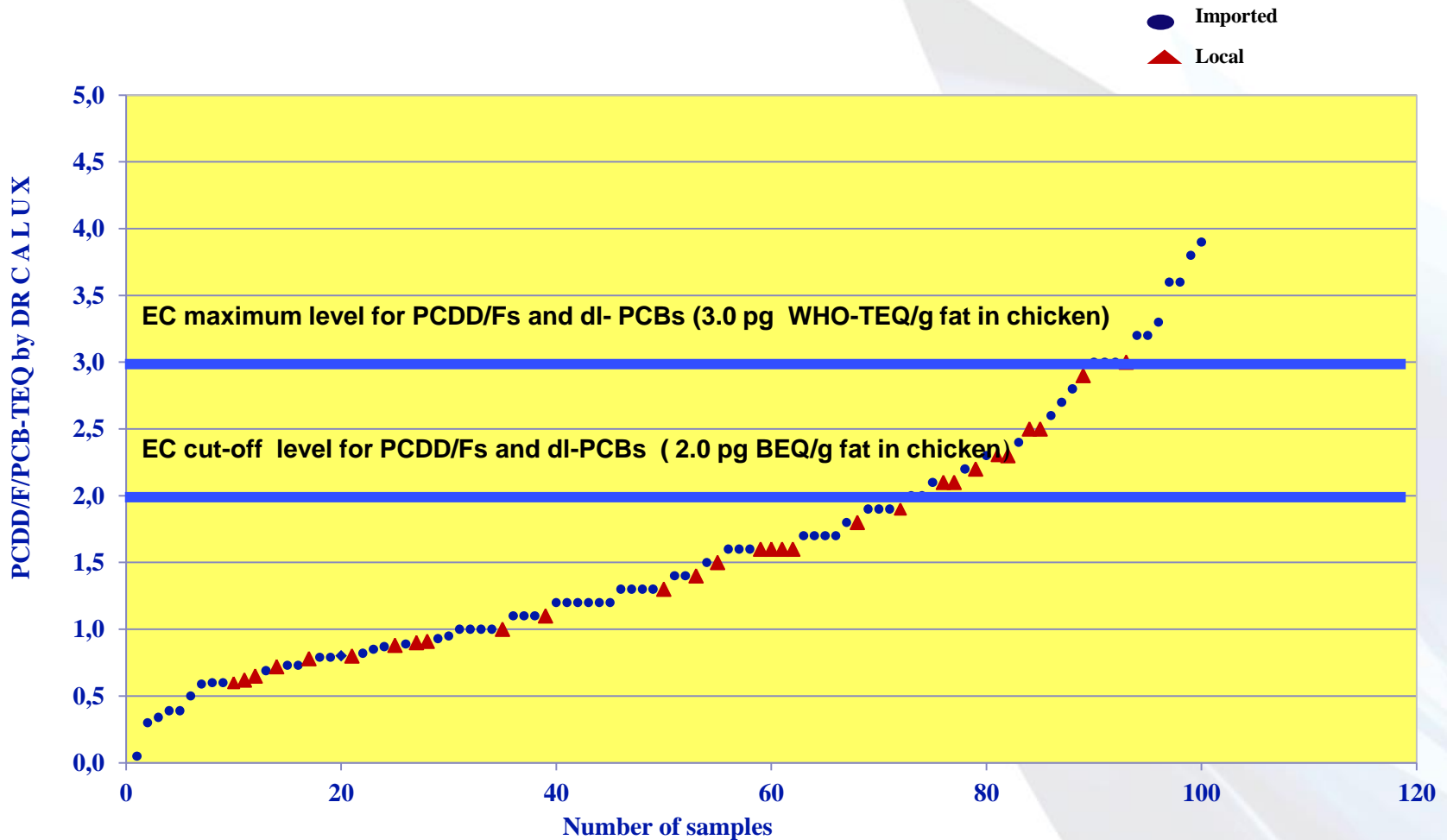
Distribution of the PCDD/F/PCB-TEQ by DR CALUX for beef samples in Kuwait (pg PCDD/F/PCB-TEQ/g fat)



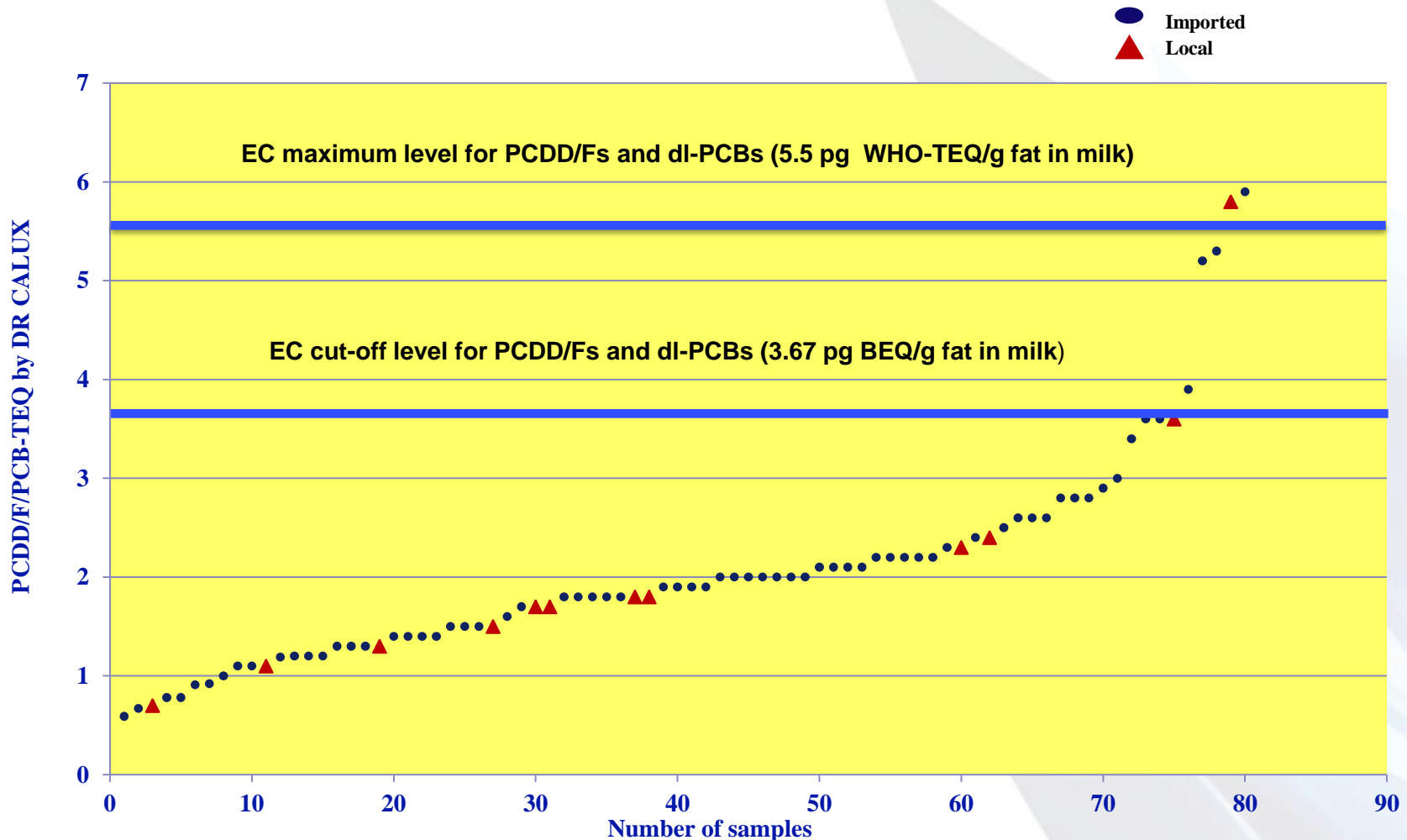
Distribution of the PCDD/F/PCB-TEQ by DR CALUX for lamb samples in Kuwait (pg PCDD/F/PCB-TEQ/g fat)



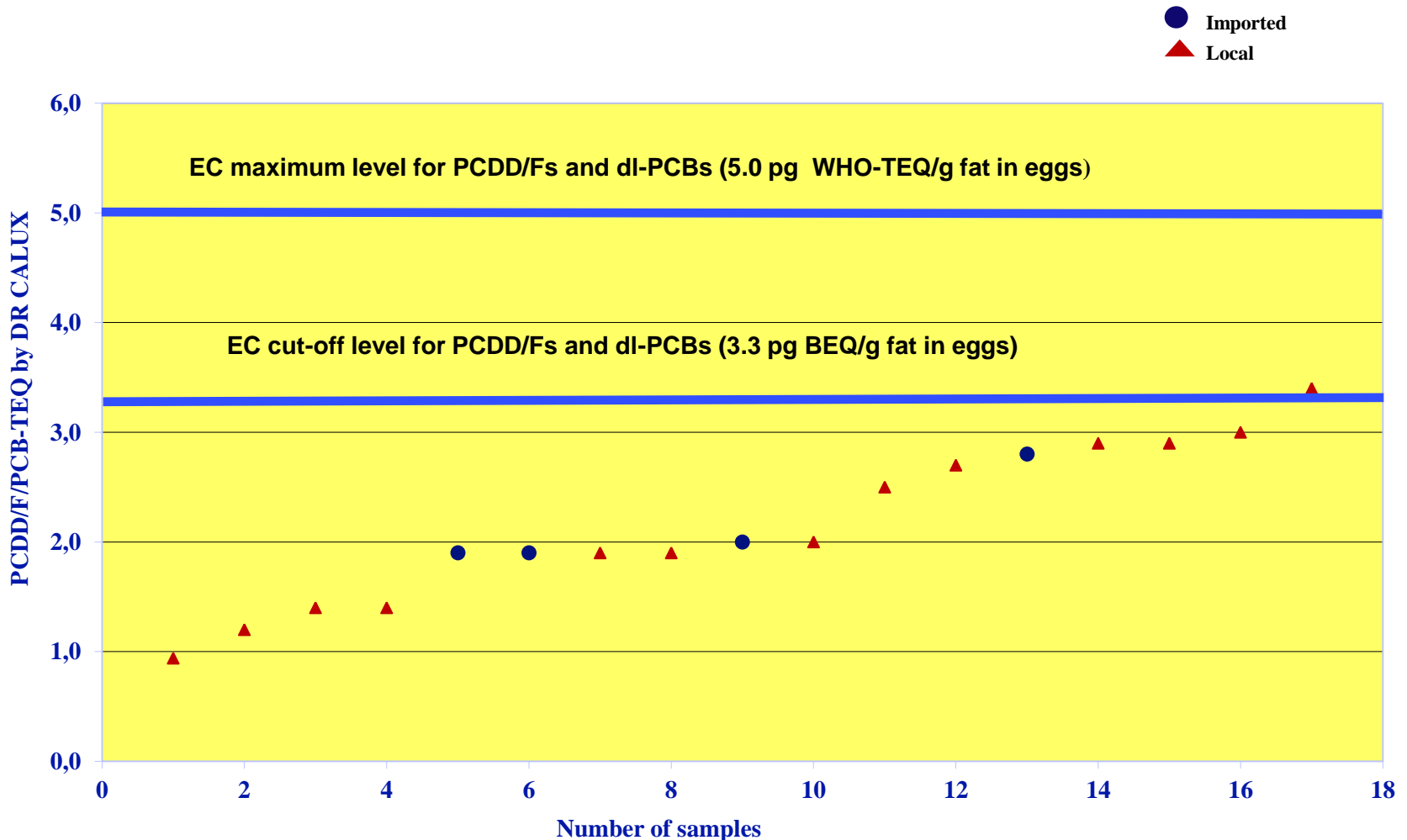
Distribution of the PCDD/F/PCB-TEQ by DR CALUX for chicken samples in Kuwait (pg PCDD/F/PCB-TEQ/g fat)



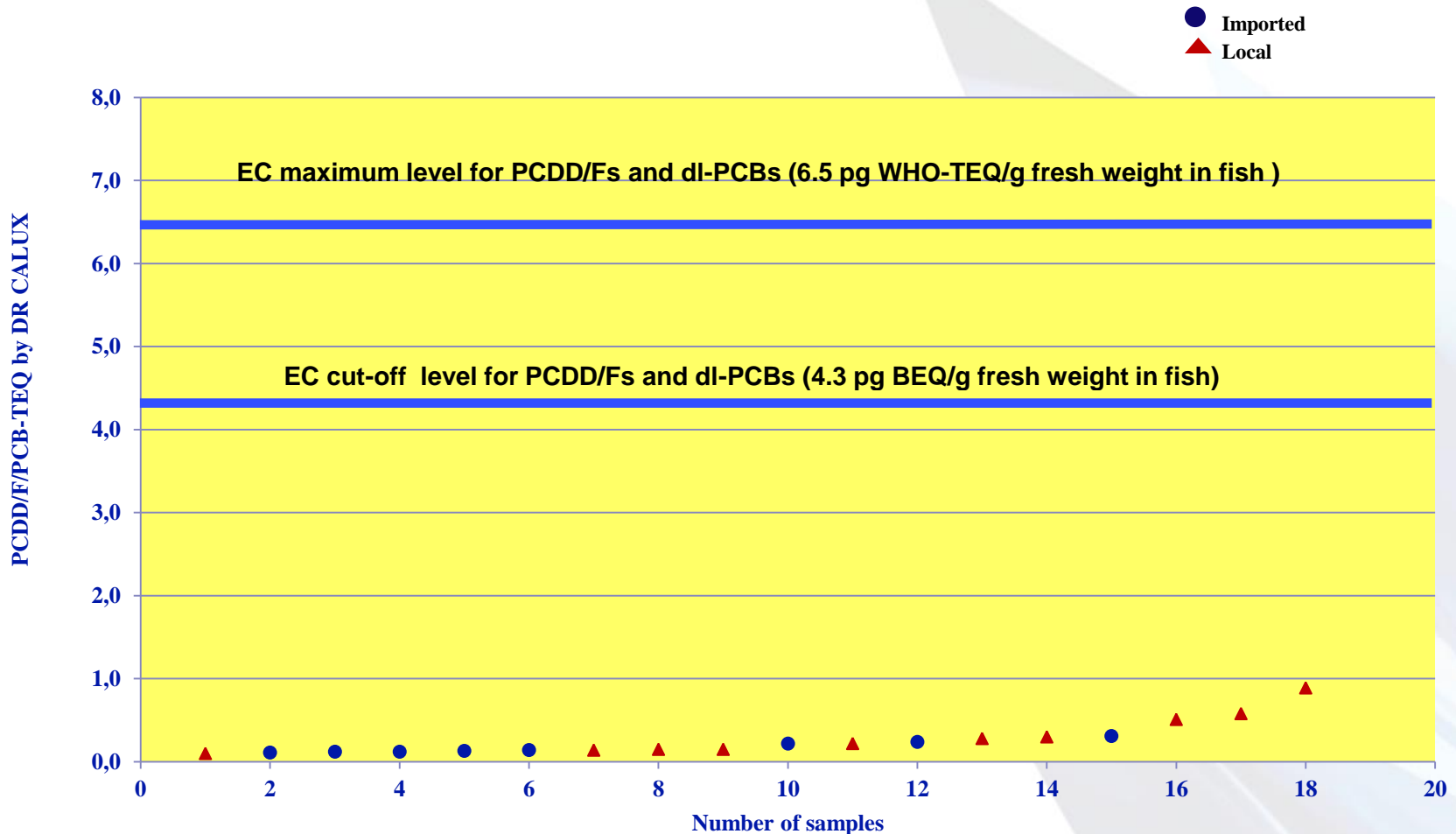
Distribution of the PCDD/F/PCB-TEQ by DR CALUX for milk samples in Kuwait (pg PCDD/F/PCB-TEQ/g fat)



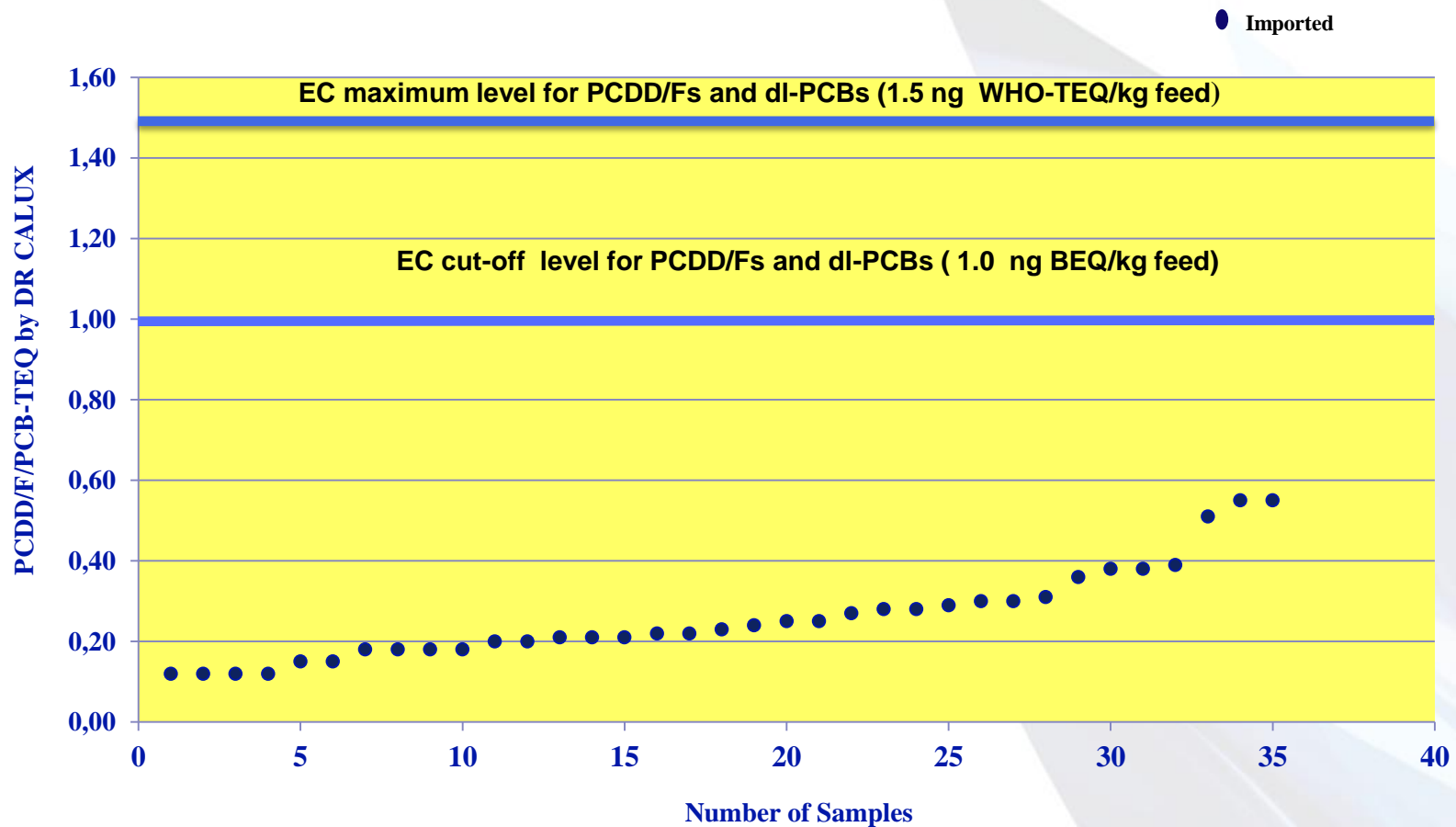
Distribution of the PCDD/F/PCB-TEQ by DR CALUX for egg samples in Kuwait (pg PCDD/F/PCB-TEQ/g fat)



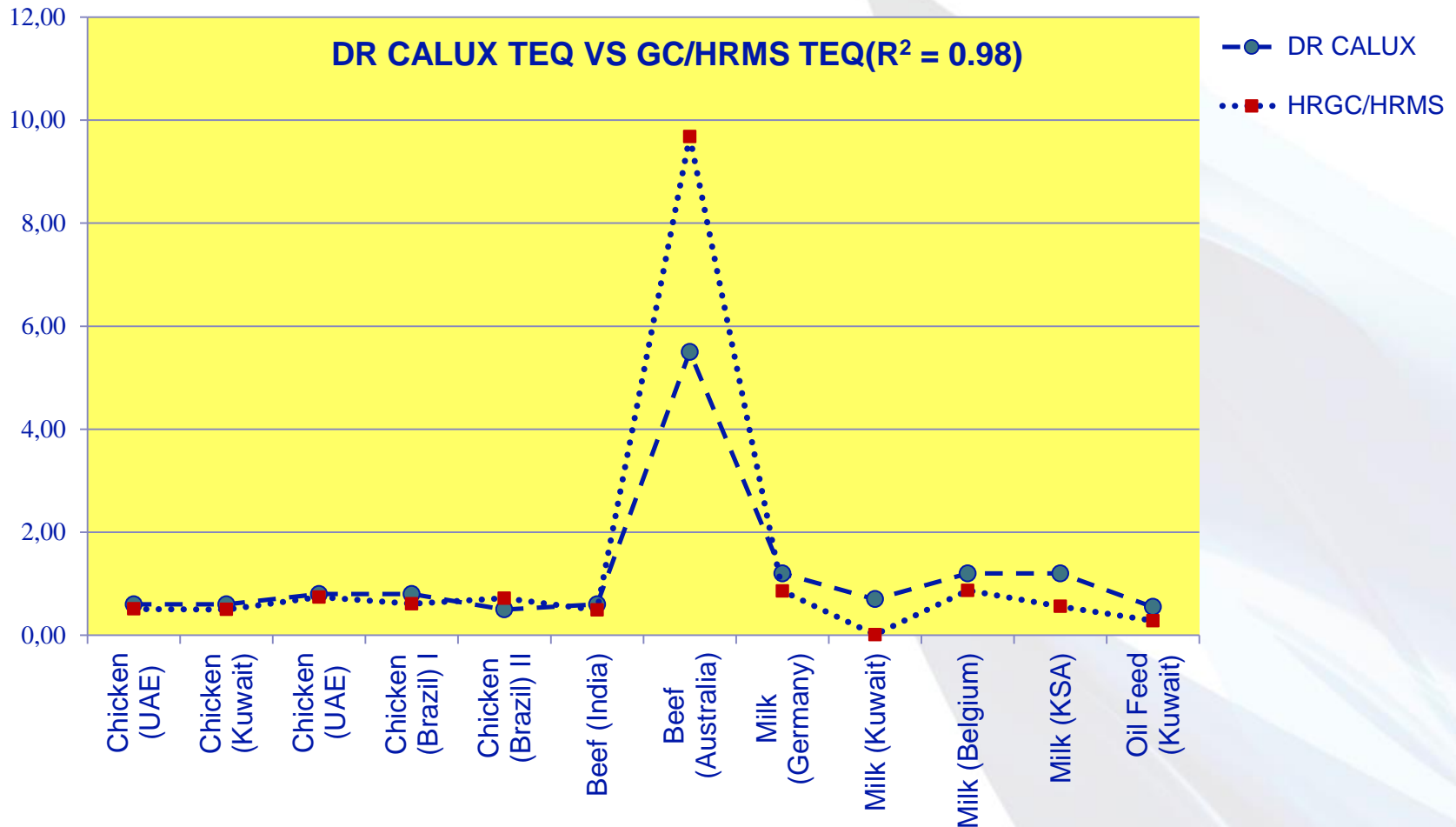
Distribution of the PCDD/F/PCB-TEQ by DR CALUX for fish samples in Kuwait (pg PCDD/F/PCB-TEQ/g fat)



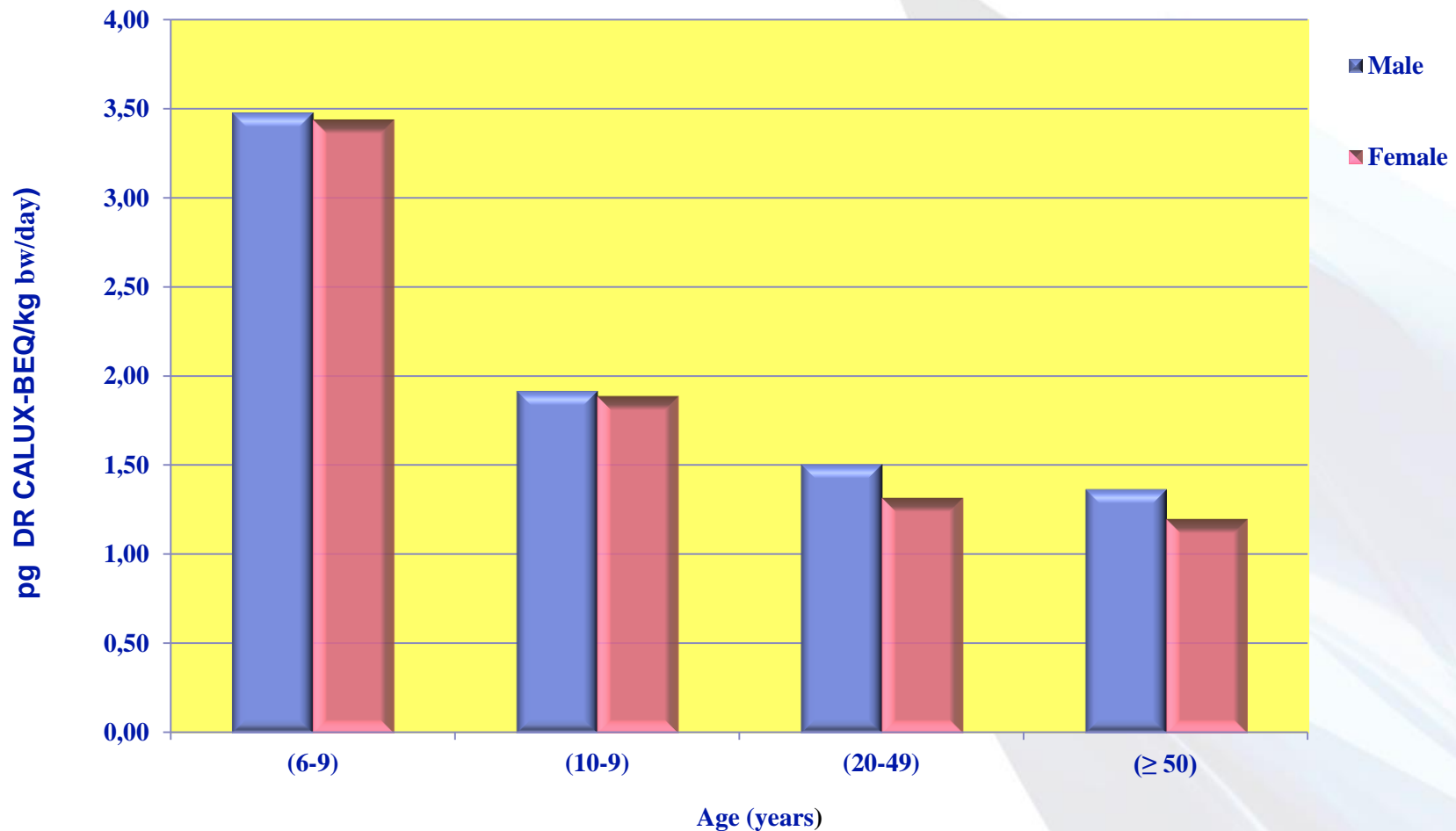
Distribution of the PCDD/F/PCB-TEQ by DR CALUX for feed samples in Kuwait (ng PCDD/F/PCB-TEQ/kg dw)



DR CALUX TEQ vs GC/HRMS TEQ ($R^2=0.98$) from various food/feed samples in Kuwait (pg Total-TEQ/g)



Average daily intake of PCDD/Fs and dl-PCBS by Kuwaiti Population (pg DR CALUX-BEQ/kg bw/day)



Conclusion and Recommendations

- To include dioxin and dioxin-like PCBs among the contaminants of the total diet study that should be conducted periodically by the State of Kuwait to assess public health risks.
- To establish a surveillance system to monitor the levels of dioxins and dioxin-like PCBs in foodstuffs and feed to be implemented by enforcement laboratories in the State of Kuwait.

- To establish a GCC maximum permissible limits of dioxins and dioxin-like PCBs in foodstuffs and feed.
- To promote among the Kuwaiti food consumers awareness concerning consumption of low fat diet and trim excess fat in order to further diminish dioxin and dioxin-like PCBs intake.

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Thank You

