



**REGIONAL TRAINING ON SCIENTIFIC BASIS
OF CODEX WITH FOCUS ON
DATA GENERATION AND SUBMISSION
FOR STANDARDS SETTING**

23-25 July 2025 • Zanzibar, Tanzania



**Food Consumption Information
Impact on Exposure Assessment**

Day 3: 25 July 2025

Review of a Risk Assessment Approach...

Foundations of Exposure Assessment

Consumption Data

Sources, Limitations



Dietary Intakes/Dietary Exposure Assessment

**Occurrence of
Food Chemicals**



**Food
consumption**



Dietary Intakes/Exposure Assessment

Amount brought by each food		Amount Consumed (g/day)		Occurrence data (µg/g)		Body weight (kg)		Intake / Exposure (µg/kg/day)	
Overall Diet		=	141,9	X	0,0093	/ 65	=	0,020	
	+ 	=	198,4	X	0,0009	/ 65	=	0,003	
	+ 	=	191,5	X	0,0076	/ 65	=	0,022	
	+ 	=	541,4	X	0,0025	/ 65	=	0,021	
	+ 	=	315,0	X	0,0007	/ 65	=	0,003	
						Total	=	0,070 (µg/kg/day)	

Stepwise Approach For Dietary Intakes/Dietary Exposure Assessments

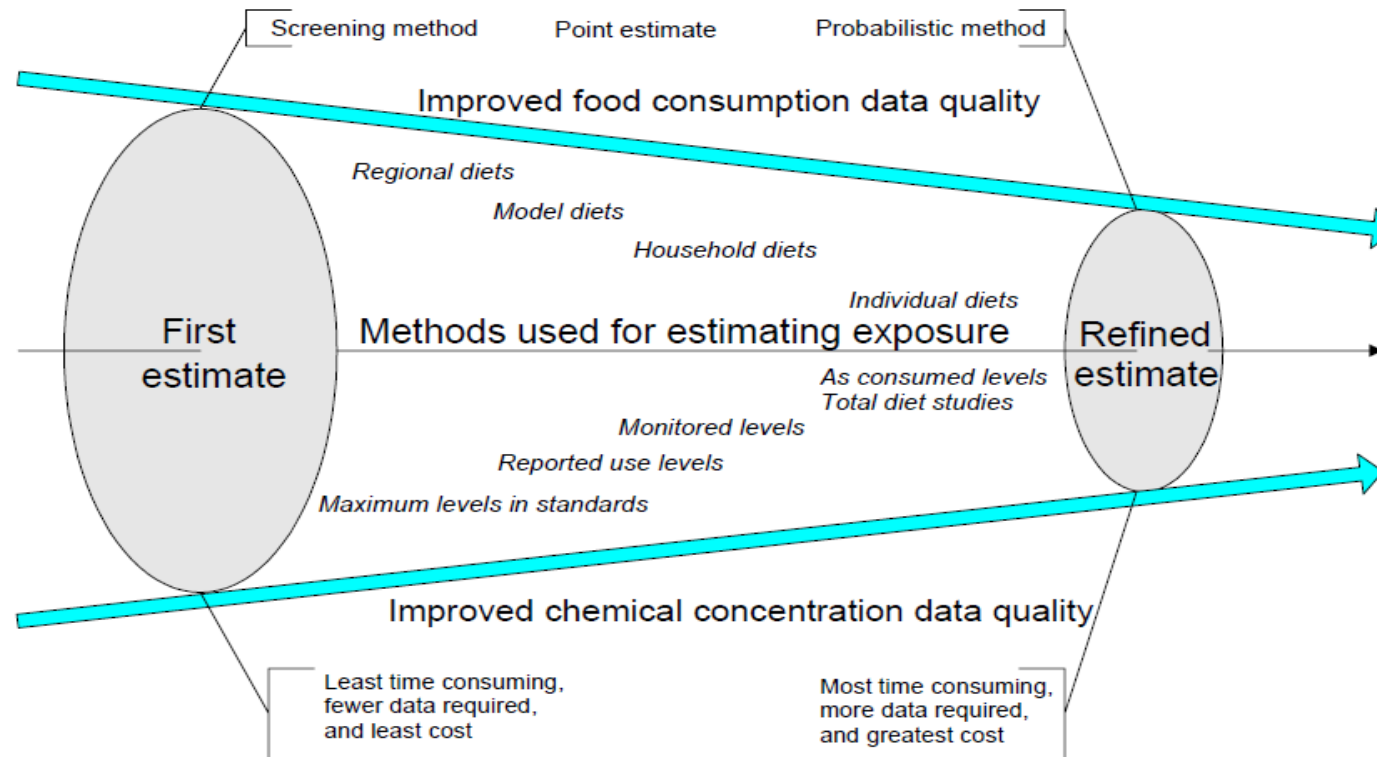


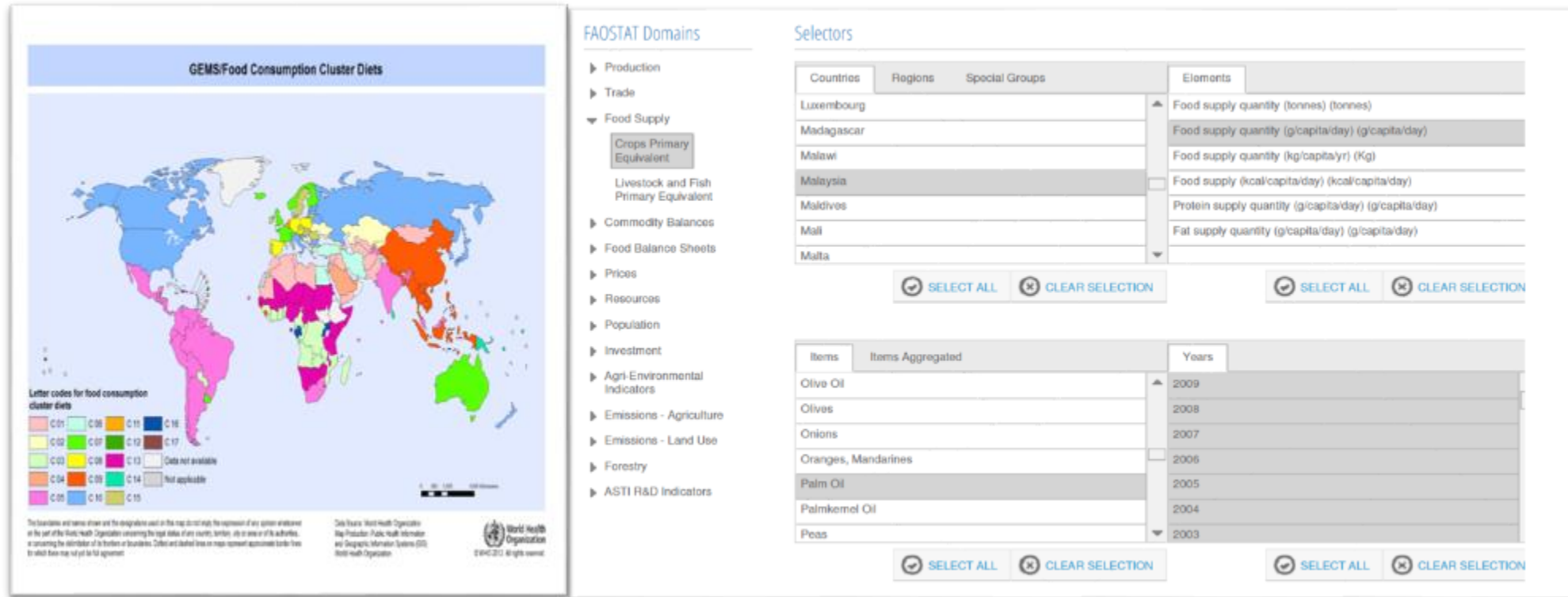
Figure 1 Stepwise approach to obtaining realistic dietary exposure assessments

Note: Data and methods selected from the right-hand side of the diagram are likely to result in a more realistic dietary exposure estimate or "refined estimate"; however, it may not be the "refined estimate" in terms of the "most appropriate" one to suit the purpose of a specific dietary modelling exercise.

Overview: Types of Food Consumption Data – Pros and Cons

Méthods	Data	Consumption Estimates	Food Chain Level	Drawbacks
Population-based methods	❑ Food Balance Sheets ▪ Total food available for consumption as a physical residual in the market. ▪ Total supply = total demand ❑ Time scale: year	❑ Median, mean	❑ Raw, semiprocessed products	❑ No information on distribution of consumption ❑ No information on individual exposure and subgroups at risk ❑ High level of uncertainty
Household-based methods: Always available, generated on a regular basis by national institute of statistics	❑ Purchase or expenditures records ▪ Values and quantities of food purchased, own produced and received at household level ❑ Large sample size ❑ Time scale: weeks	❑ Mean ❑ High Percentile	❑ Raw, semiprocessed and processed products	❑ No intra-household distribution ❑ Not individual food intakes ❑ Food eaten outside home difficult to capture
Individual-based methods	❑ Food record survey ❑ 24-hour recall survey ❑ Food frequency questionnaire ❑ Meal-based diet history survey ❑ Food habit questionnaire ❑ Small sample size ❑ Time scale: days	❑ Mean ❑ High percentile	❑ Raw, semiprocessed and processed products	❑ Expensive, time and resource consuming ❑ Susceptible of under- or over reporting

Long Term Food Consumption: National Per Capita



Database available : Based on *per capita* data submitted to FAO/Stat (Consumption by year) <http://faostat3.fao.org/faostat-gateway/go/to/home/E>

Per Capita Consumption: GEMS/Food Cluster Diets

- ❑ Based on FAO Food Balance Sheets
- ❑ Average per capita consumption:
 - <http://www.who.int/foodsafety/chem/gems/en/index1.html>
- ❑ Used for long term dietary exposure assessment
- ❑ 1989: Five regional diets
- ❑ 1997: Thirteen cluster diets
- ❑ 2012: Review of the cluster diets based on new statistical approach
 - Non-negative Matrix Factorization



**Food and Agriculture
Organization of the
United Nations**

Long Term Food Consumption: Clustered Per Capita

↓ Map - Countries by Cluster - 2012

📄 jpg, 605kb

↓ List - Countries by Cluster - 2012

📄 pdf, 297kb

↓ Data - Consumption - 2012

📄 xls, 1.58Mb

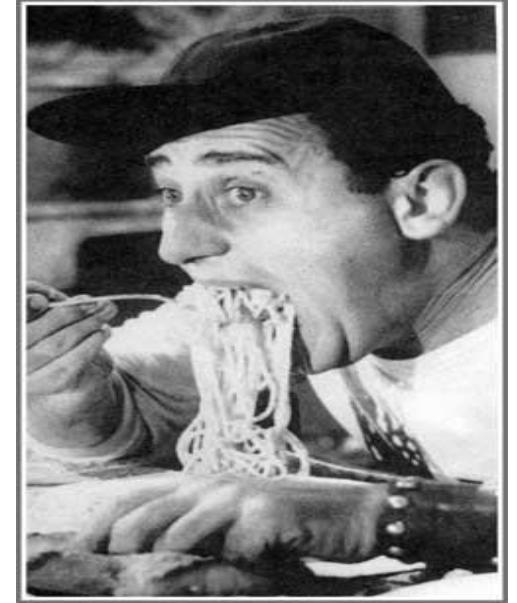


❑ Database available

- https://www.who.int/nutrition/landscape_analysis/nlis_global_food/en/

Average vs. High Consumption

- ❑ Within a risk assessment process, mean consumption levels are often not sufficient
- ❑ It is fundamental to consider also non-average individuals, in particular **high consumers**
 - Those who consume relatively large quantities of foods



Short Term Exposure

- ❑ Based on National individual food consumption data submitted to GEMS/Food
- ❑ **Consumption during a day or an eating occasion**
- ❑ **Generally 97.5th percentile for consumers only**
- ❑ Necessary to check the number of consumers



Target Populations



Adult population



Pregnant women



Small children



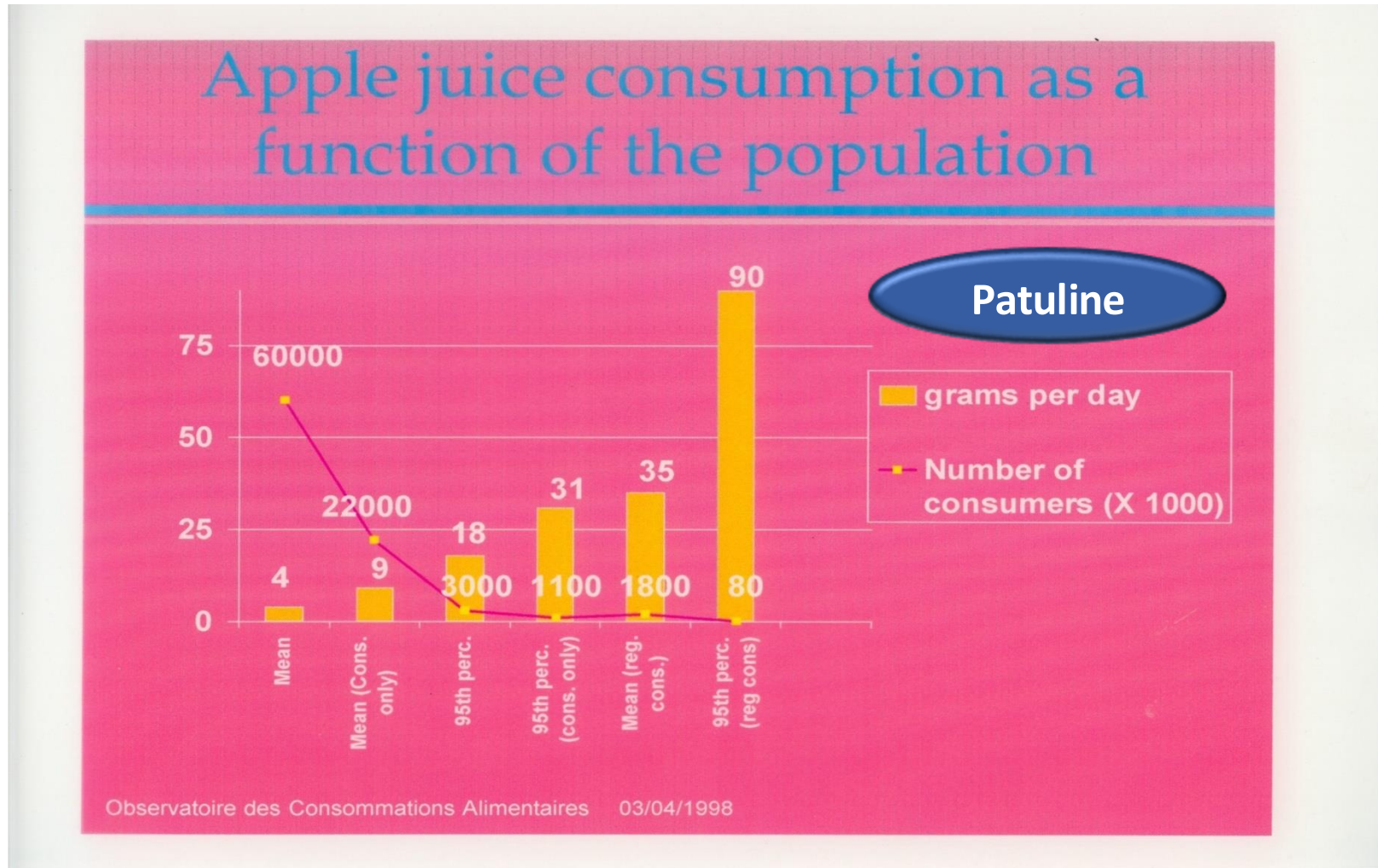
Infants



Elderly

Special groups:
vegetarians,
diabetics, ethnic
groups and different
socio-economic
strata ...

Apple Juice Consumption



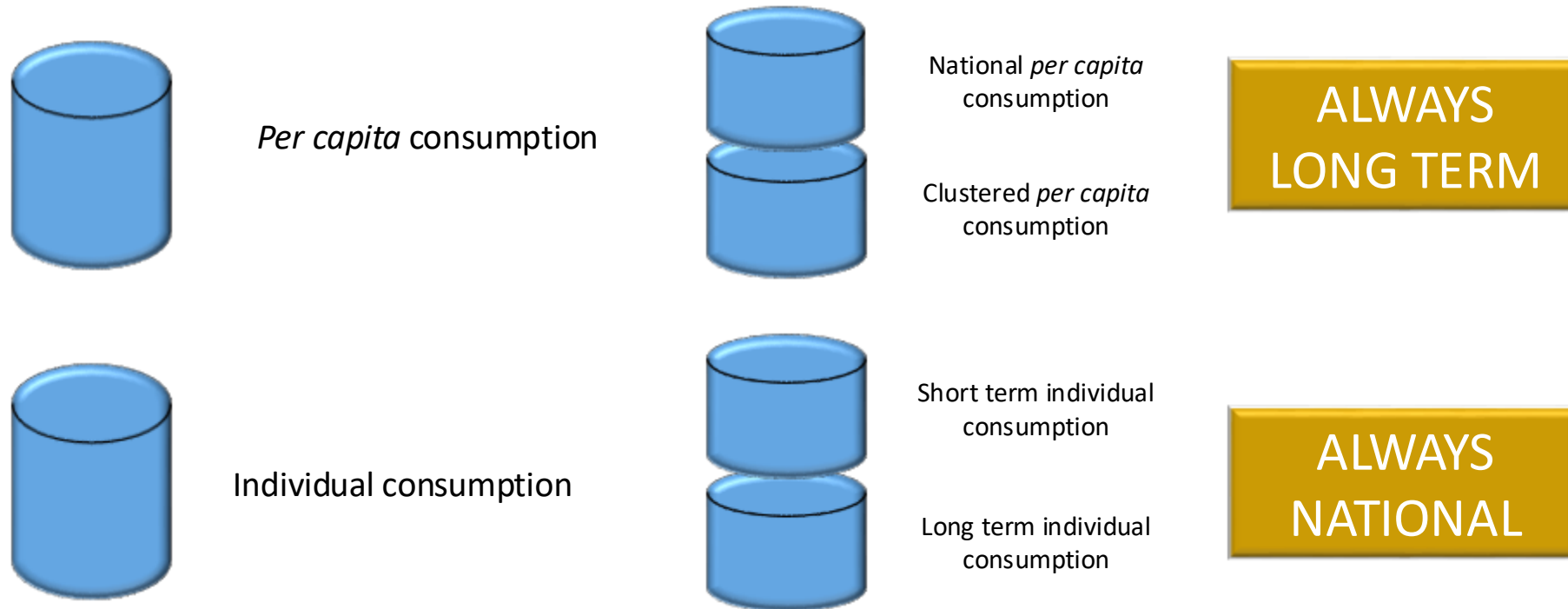
Foundations of Food Consumption Data Gathering

*For Use in Exposure Assessment -
Deterministic and Probabilistic Approaches*



Data Available Used In FAO/WHO Risk Assessment

Chemical Substances



Food Classification is Required

Level 1	Level 2	Level 3	Code
Milk and dairy products (excl. milk fats)	Milks (no other ingredient)	Buffalo milk	ML 0810 #
		Camel milk	ML 0811 #
		Cow milk	ML 0812 #
		Goat milk	ML 0814 #
		Sheep milk	ML 0822 #
		Other and nes milks	ML 0606**
	Dairy products (excl. milk fats)	Milk powder and cream powder (plain)	01.5.1 # #
		Fermented milks (plain)	01.2.1 # #
		Cheese	01.9*
		Ice cream	01.1.2.1*
		Dairy products, nes	AO3 0001**

Codex code for raw agricultural commodities

Codex code for processed food

* Made-up code, no existing reference

** Existing code but designation adapted

National Per Capita vs. Individual Food Consumption Data

Food Group Commodities	Cluster E (France) Mean Consumption (g/d)	French Individual Food Consumption in g/d (mean/97,5th percentile)
Cereals	222	218/501
Sugar	114	38/116
Fat and oil	35	18/47
Fish	25	32/119
Fruits	190	126/506
Meat	135	119/274

CIFOCOss

FAO/WHO Chronic Individual Food Consumption database Summary Statistics



World Health
Organization



Food and Agriculture
Organization of the
United Nations

- ❑ Individual levels of food consumption for average and high consumers based on national surveys.
- ❑ Use to provide chronic dietary intakes/dietary exposure assessments.
 - EFSA (<http://www.efsa.europa.eu/en/datexfoodcdb/datexfooddb.htm>)
 - USA, Australia, Brazil, China, Japan, South Korea, Thailand, Turkey, Bangladesh, Philippines, Uganda, Burkina Faso
 - Countries data integrated in the database since 2018: Ethiopia, Zambia, Zimbabwe, Kenya, Egypt, Malawi

Chronic Food Consumption Database

- ❑ Database gathering all chronic individual food consumption data collated by FAO and WHO

Population	Descriptors (g/pers/day and g/kg bw/day)	Food
❑ Children ❑ General population	❑ Mean with STD ❑ 5th percentile ❑ Median ❑ 90th percentile ❑ 95th percentile ❑ 97.5th percentile	❑ Level 2: 62 food groups ❑ Level 3: 555 food items

- ❑ Each row corresponds to the consumption of a food item for an age class in a country

Cluster	Ageclass	country	Level 2 Code	WHO Code	WHO Name	Total Mean (g/d)
11	Elderly	Belgium	70	11.5	Honey	1.745945946
10	General population	South Korea	70	11.5	Honey	0.289593000

Distribution of Food Consumption : Uganda



Chronic Individual Food Consumption Summary Statistics

CIFOCos



Uganda

Capture Plein écran

Country	Food name
☐ Argentina	☒ 01.7 - Dairy-based desserts (e.g.,
☐ Australia	☒ 02.1.2 - Vegetable fats (excl. oil)
☐ Bangladesh	☒ 04.2.2 - Other vegetables, nes, o
☐ Belgium	☒ 04.2.2h - Processed nuts, includi
☐ Brazil	☒ 06.2.1 - Flours, nes
☐ Bulgaria	☒ 07.2.1 - Cakes, cookies and pies
☐ Burkina Faso	☒ 09.2.5 - Smoked, dried, fermente
☐ China	☒ 11.1 - Sugar, nes
☐ Cyprus	☒ 11.3 - Sugar cane juice
☐ Czech Republic (t	☒ 12.5.1 - Ready-to-eat soups and
☐ Denmark	☒ 12.6a - Sauces and like products
☐ Finland	☒ 14.1 - Isotonic drink
☐ France	☒ 14.2.1 - Beer and malt beverage
☐ Greece	☒ 14.2.6 - Distilled spirituous bever
☐ Hungary	☒ 16 - Other processed products (g)

Food name	Age class	Number of subjects	Number of consumers	Percentage of consumers
01.7 - Dairy-based desserts (e.g., pudding, Adult women		176	1	0.57
02.1.2 - Vegetable fats (excl. oil), nes Adult women		176	3	1.70
04.2.2 - Other vegetables, nes, other proce Adult women		176	2	1.14
04.2.2h - Processed nuts, including coated Adult women		176	4	2.27
06.2.1 - Flours, nes Adult women		176	128	72.73
07.2.1 - Cakes, cookies and pies (e.g., fruit Adult women		176	10	5.68
09.2.5 - Smoked, dried, fermented, and/or s Adult women		176	41	23.30
11.1 - Sugar, nes Adult women		176	129	73.30
11.3 - Sugar cane juice Adult women		176	2	1.14
12.5.1 - Ready-to-eat soups and broths, in Adult women		176	20	11.36
12.6a - Sauces and like products, nes Adult women		176	2	1.14
14.1 - Isotonic drink Adult women		176	4	2.27
14.2.1 - Beer and malt beverages, nes Adult women		176	11	6.25
14.2.6 - Distilled spirituous beverages conti Adult women		176	3	1.70

Distribution of food consumption in Uganda (g/kg bw/day)

Chart Table

Distribution of Food Consumption : Uganda (2)

Distribution of food consumption in Uganda (g/kg bw/day)

Food	Age class	Total Mean	Total STD	Total P5	Total P50	Total P90	Total P95	Total P975	Consumers mean	Consumers STD	Consumers P5	Consumers P50	Consumers P90	Consumers P95	Consumers P975
01.7 - Dairy-based desserts (e.g., p	Adult women	0.0210	0.2786	0.0000	0.0000	0.0000	0.0000	0.0000	3.6964		3.6964	3.6964	3.6964	3.6964	3.6964
02.1.2 - Vegetable fats (excl. oil), n	Adult women	0.0014	0.0118	0.0000	0.0000	0.0000	0.0000	0.0000	0.0800	0.0525	0.0283	0.1083	0.1114	0.1118	0.1118
04.2.2 - Other vegetables, nes, othe	Adult women	0.0266	0.2527	0.0000	0.0000	0.0000	0.0000	0.0000	2.3393	0.5962	1.9600	2.3393	2.6766	2.7187	2.7318
04.2.2h - Processed nuts, including	Adult women	0.0064	0.0575	0.0000	0.0000	0.0000	0.0000	0.0000	0.2803	0.3007	0.0579	0.1794	0.5721	0.6440	0.6718
06.2.1 - Flours, nes	Adult women	3.4819	3.1884	0.0000	3.3635	7.8283	9.4920	10.7579	4.7876	2.7763	0.4317	4.3507	8.4863	10.4221	11.0118
07.2.1 - Cakes, cookies and pies (e.	Adult women	0.0205	0.0930	0.0000	0.0000	0.0000	0.0593	0.4577	0.3614	0.1769	0.0784	0.4522	0.5010	0.5056	0.5071
09.2.5 - Smoked, dried, fermented, z	Adult women	0.0333	0.0984	0.0000	0.0000	0.1077	0.1989	0.2521	0.1428	0.1623	0.0233	0.0765	0.2523	0.4850	0.5718
11.1 - Sugar, nes	Adult women	0.4611	0.4387	0.0000	0.3765	1.0894	1.2853	1.4916	0.6292	0.3957	0.0993	0.5446	1.1768	1.3696	1.5318
11.3 - Sugar cane juice	Adult women	0.0404	0.4329	0.0000	0.0000	0.0000	0.0000	0.0000	3.5552	2.7928	1.7778	3.5552	5.1350	5.3325	5.4318
12.5.1 - Ready-to-eat soups and bri	Adult women	0.1399	0.5324	0.0000	0.0000	0.3835	0.7927	1.8578	1.2309	1.0941	0.3293	0.7797	2.5206	2.7480	3.6718
12.6a - Sauces and like products, n	Adult women	0.0015	0.0141	0.0000	0.0000	0.0000	0.0000	0.0000	0.1330	0.0077	0.1281	0.1330	0.1373	0.1379	0.1381
14.1 - Isotonic drink	Adult women	0.0601	0.4033	0.0000	0.0000	0.0000	0.0000	0.0000	2.6462	0.6028	2.0028	2.6555	3.1934	3.2765	3.3118
14.2.1 - Beer and malt beverages, n	Adult women	0.4162	2.4047	0.0000	0.0000	0.0000	1.6805	4.1381	6.6586	7.4482	1.5176	4.1252	13.9201	20.1674	23.2118
14.2.6 - Distilled spirituous beverage	Adult women	0.0191	0.1510	0.0000	0.0000	0.0000	0.0000	0.0000	1.1194	0.3849	0.7397	1.3093	1.3598	1.3661	1.3661
16 - Other processed products (exc	Adult women	0.0080	0.0835	0.0000	0.0000	0.0000	0.0000	0.0000	0.7029	0.4936	0.3888	0.7029	0.9822	1.0171	1.0318
16.2 - Plant based composite food, i	Adult women	0.0024	0.0222	0.0000	0.0000	0.0000	0.0000	0.0000	0.2077	0.0355	0.1851	0.2077	0.2278	0.2303	0.2318
16.7 - Egg-based composite food	Adult women	0.0369	0.1904	0.0000	0.0000	0.0000	0.0000	0.6493	0.8126	0.4306	0.2814	0.8645	1.3054	1.3540	1.3718
16.9 - Animal-based composite food	Adult women	0.0186	0.1172	0.0000	0.0000	0.0000	0.0000	0.2760	0.5460	0.3674	0.2238	0.4658	0.9136	1.0706	1.1418
17 - Other foods (foods which canr	Adult women	0.0309	0.1925	0.0000	0.0000	0.0000	0.0306	0.3839	0.6041	0.6488	0.1380	0.4020	1.2824	1.7280	1.9518
CF 1211 - Wheat flour	Adult women	0.0480	0.1837	0.0000	0.0000	0.0360	0.3137	0.6645	0.4698	0.3710	0.1731	0.3201	0.7390	0.9619	1.3218
CF 1255 - Maize flour	Adult women	1.1352	1.4877	0.0000	0.4458	3.3308	4.2623	4.8108	2.0181	1.4670	0.3193	1.6304	4.1077	4.7033	5.7718
CF 3200 - Millet flour	Adult women	0.2442	0.5209	0.0000	0.0000	1.0165	1.3371	1.4713	0.8597	0.6551	0.2054	0.6431	1.4330	1.8533	2.0518
CP 0179a - Wheat white bread	Adult women	0.0614	0.1825	0.0000	0.0000	0.3131	0.4464	0.6433	0.4909	0.2377	0.2786	0.3749	0.7888	0.8146	1.0018
FA 0818 - Lard (of pigs)	Adult women	0.0014	0.0173	0.0000	0.0000	0.0000	0.0000	0.0006	0.0348	0.0859	0.0004	0.0007	0.0982	0.1638	0.1918
FC 0004 - Orange, sweet, sour + or	Adult women	0.0616	0.3242	0.0000	0.0000	0.0000	0.1064	0.8395	1.2046	0.8665	0.4473	0.9804	2.2019	2.5815	2.7718
FI 0326 - Avocado	Adult women	0.2383	0.6525	0.0000	0.0000	0.9603	1.6515	2.2910	1.3979	0.9446	0.4091	1.1749	2.7257	3.2084	3.6418
FI 0327 - Banana	Adult women	1.6136	2.7711	0.0000	0.0000	4.6166	6.2785	8.5706	3.3411	3.1870	0.4624	2.3594	6.3685	8.8521	12.1118

Calculation Models to Assess Dietary Exposure & Statistical Assumptions

"Deterministic" approach (i.e: screening method, point estimates, TDS)

☐ Occurrence:

- Maximum observed value , MRL, usages authorization or fortification, ML...
- Consumers and occurrence surveys are independent

☐ Average, median, P95, P97.5 **for both consumption and occurrence / contamination**

- Statistics consumption observed on population, households or individuals
- Statistics occurrence data observed on raw commodities or processed foods

☐ **Over a lifetime**, we may calculate how the individual is to be exposed at

- maximum, mean or median of occurrence data and / or consumption.

☐ Approach mainly used in risk assessment to chemicals in food at national/European and international level



Deterministic Modelling: Long Term Estimates

	Meat	Wine	Cereal	Bread	Coffee	Fruit and Veg.	Dry	Rice	Alcohol		
IDENTI	viande	vin	cereal	pain	cafe	fruitleg	sec	riz	alcool		
1000101	400	770	1000	1030	67	0	200	400	0		
1000102	1020	0	200	700	67	0	100	600	0		
1000103	150	0	585	120	0	0	320	200	0		
1000201	609	4360	260	2386	357	0	990	0	0		
1000301	740	0	515	1095	0	0	0	0	0		
1000302	30	0	90	410	22	0	0	0	0		
1000401	195	0	450	980	70	0	80	1200	0		
1000402	195	0	375	1145	70	0	80	1200	0		
1000403	185	0	75	1140	15	0	0	1550	0		
1000404	270	0	586	790	70	0	0	910	0		
1000501	320	200	120	1150	148	525	200	0	0		
1000502	175	800	260	1040	126	500	0	0	0		
1000601	275	0	100	840	51	0	0	100	0		
1000701	280	0	335	1494	121	0	320	0	0		
1000702	193	0	400	1114	175	0	320	0	0		
1000703	460	0	365	2838	26	0	320	0	0		
1000801	200	0	610	880	94	615	0	150	0		
1000802	188	0	705	600	0	175	0	100	0		
1000901	430	5520	0	1680	82	0	0	150	0		
1000902	360	0	250	670	0	0	200	150	0		
1002501	363	0	0	1048	44	0	0	0	0		

Mean Contamination in X

0.313
0.135
0.611
0.728
0.984
0.193
0.446
0.533
0.075

Meat
wine
Cereal
Bread
Coffee
Fruit and Veg.
Dry
Rice
Alcohol

IDENTI	POIDS	Exposition
1000101	69	28.4
1000102	70	19.7
1000103	46	16.1
1000201	100	34.7
1000301	56	24.0
1000302	54	7.1
1000401	58	30.9
1000402	60	31.1
1000403	44	40.3
1000404	24	65.5
1000501	71	19.4
1000502	42	30.9
1000601	58	14.9
1000701	89	18.4
1000702	52	27.5
1000703	60	43.4
1000801	58	23.6
1000802	26	39.0
1000901	69	32.8
1000902	75	12.3
1002501	85	10.8

Each consumption is multiplied by the mean contamination (of the Commodity), then summed together and divided by the body weight

Calculation Models to Assess Dietary Exposure & Statistical Assumptions

"Probabilistic" approach

❑ Parametric

- Direct combination of consumption and occurrence distributions by random selection according to the parameters of the estimated distribution law or adjusted

❑ Non-parametric

- Direct combination distributions of consumption and contamination/occurrence by random selection according to the **observed empirical distribution**

❑ Hypothesis :

- Over a lifetime, the individual **will be exposed to the same level of chemical composition and / or consumption**. Consumers and occurrence surveys are independent
- It is importance to characterize and record data sources, the approach used to generate dietary intakes/exposure figures along with uncertainties in the database and assumption taken



Probabilistic Modeling

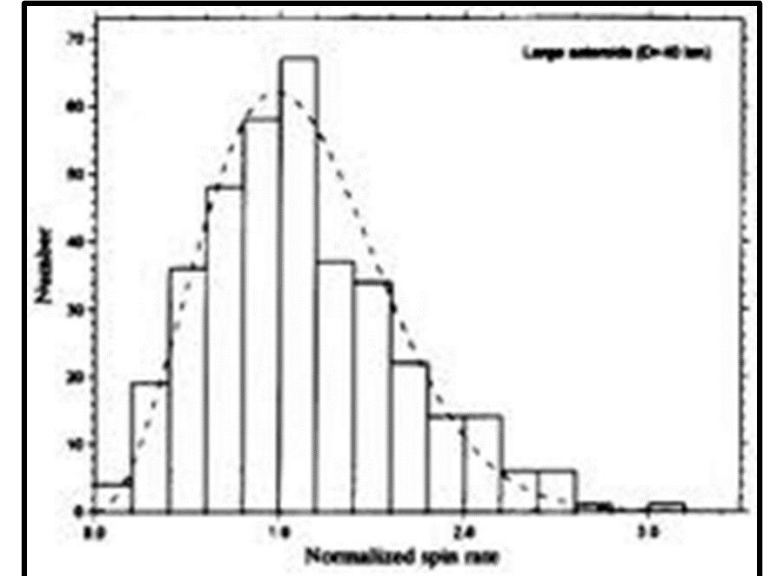
Random Runs

IDENTI	viande	vin	cereal	pain	cafe	fruitleg	sec	riz	alcool
1000103	150	0	585	120	0	0	320	200	0
1000302	30	0	90	410	22	0	0	0	0
1000802	188	0	705	600	0	175	0	100	0
1000902	360	0	250	670	0	0	200	150	0
1000102	1020	0	200	700	67	0	100	600	0
1000404	270	0	586	790	70	0	0	910	0
1000601	275	0	100	840	51	0	0	100	0
1000801	200	0	610	880	94	615	0	150	0
1000401	195	0	450	980	70	0	80	1200	0
1000101	400	770	1000	1030	67	0	200	400	0
1000502	175	800	260	1040	126	500	0	0	0
1000601	275	0	100	840	51	0	0	100	0
1000301	740	0	515	1095	0	0	0	0	0
1000702	193	0	400	1114	175	0	320	0	0
1000403	185	0	75	1140	15	0	0	1550	0
1000402	195	0	375	1145	70	0	80	1200	0
1000601	275	0	100	840	51	0	0	100	0
1000701	280	0	335	1494	121	0	320	0	0
1000901	430	5520	0	1680	82	0	0	150	0
1000201	609	4360	260	2386	357	0	990	0	0
1000703	460	0	365	2838	26	0	320	0	0

X

viande	vin	cereal	pain	cafe	fruitleg	sec	riz	alcool
0.75	0.55	0.5	0.2	1	0.2	0.5	0.5	0.05
0.2	0.01	0.5	2.7	1	0.05	0.5	0.5	0.05
0.5	0.01	0.5	0.5	1	0.19	0.1	0.5	0.05
0.2	0.89	0.5	0.5	1	0.06	0.5	1.4	0.05
0.5	0.01	0.5	0.2	0.04	0.5	1.6	0.5	0.05
0.2	0.01	0.5	0.5	0.04	0.05	0.04	0.5	0.05
0.34	0.01	0.5	0.5	1	0.02	0.1	0.5	0.05
0.2	0.01	0.5	0.2	0.04	0.5	0.5	0.5	0.05
0.2	0.01	0.5	0.2	0.04	0.07	0.5	0.5	0.05
0.1	0.01	0.5	0.9	1	0.44	0.5	0.5	0.05
0.2	0.04	0.05	0.3	0.2	0.13	0.04	0.5	0.05
0.5	0.01	0.5	0.5	0.1	0.46	0.2	0.5	0.05
0.2	0.01	0.5	0.5	1.6	0.24	0.5	0.5	0.05
0.2	0.01	1	0.2	0.2	0.1	0.5	0.5	0.05
0.2	0.01	0.5	0.5	0.08	0.06	0.5	0.5	0.05
0.2	2.89	1	0.2	0.05	0.05	0.5	0.5	0.05
0.2	1.48	0.5	0.5	0.88	0.08	0.2	0.5	0.05
0.2	0.01	0.5	0.5	0.066	0.5	0.5	0.5	0.05
0.2	0.21	0.5	1.2	1	0.2	0.1	0.5	0.05
0.5	0.01	0.8	0.5	0.05	0.05	0.5	0.5	0.05
0.2	0.01	0.5	0.5	3.2	0.11	0.5	0.5	0.05

Product term by term and dividing by the body weight



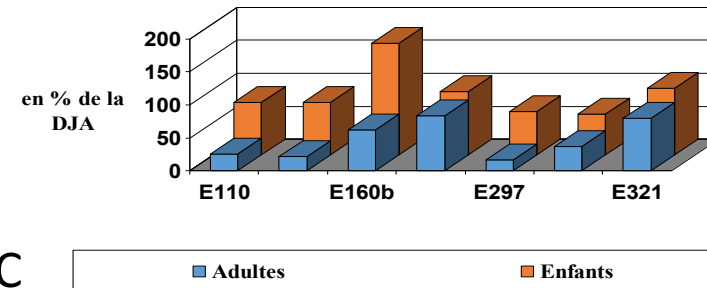
Screening Tools (Budget Method) – Food Additive Exposure



□ **Q = 3 kg solid food + 6.0 liters beverages**

- Based on maximum physiological limits with 0,50g/kgbw/d for solid food and 0,100ml/kg bw/d for beverages **for an 60kg adult** (equivalent to 3kg foods and 6 liters beverages) (EHC 240, 2010)
- With **arbitrarily default proportion** factor for solid foods and beverages that may contain the substance

□ **C = Maximum permitted level for a food additive**



Based on theoretical maximum levels both for **Q** and for **C**

□ **E = Q * C**

- **If E < ADI**

Acceptable additive (exposure is favorable)

Budget Method vs Food Consumption

Table 1: Summary of anticipated exposure to Brilliant Blue FCF using the tiered approach (EC, 2001) in children and the adult population.

	Adult UK population (>18 years old)	Children UK & Expochi population (1-10 years old, 15.8-29 kg body weight)
	mg/kg bw/day	mg/kg bw/day
Tier 1. Budget method	8.1	13.1
Tier 2. Maximum Permitted Level		
• Mean exposure	0.9	0.5 – 3.4
• Exposure 95 th *or 97.5 th percentile**	3.3	1.2 – 7.2
Tier 3. Maximum reported use levels		
• Mean exposure	0.6	0.2 – 2.1
• Exposure 95 th *or 97.5 th percentile**	3.0	0.6 – 4.8

Margin of Exposure (MOE)

- ❑ Ratio between selected point of departure (on dose-response curve from animal or epidemiological study) and the estimated human intake
- ❑ Takes potency and exposure into account
- ❑ Can be used to prioritize different contaminants if consistent approach is applied
- ❑ A MOE below 10 000* may indicate a human health concern and a MOE over 10 000 indicate a low concern

$$\text{MOE} = \frac{\text{Low dose producing tumors in animals}}{\text{human exposure dose}}$$

A word cloud featuring the phrase "Thank You" in numerous languages and scripts. The central text is "thank you" in a large, blue, lowercase font. Surrounding it are various translations, including "gracias" (Spanish), "merci" (French), "danke" (German), "arigatō" (Japanese), "고맙습니다" (Korean), "شكراً لك" (Arabic), "धन्यवाद" (Hindi), "terima kasih" (Indonesian), "sukriya" (Urdu), "obrigado" (Portuguese), "dziękuję" (Polish), "hvala" (Croatian), "spasibo" (Russian), "tesekkür ederim" (Turkish), "ngiyabonga" (Xhosa), "tapadh leat" (Irish), "mochchakkeram" (Tamil), "maith agat" (Malayalam), "raibh go" (Scottish Gaelic), "dakujem" (Czech), "merci" (Swedish), "shukriya" (Persian), "dhanyavadagalu" (Kannada), "diolch" (Welsh), "grazie" (Italian), "tanemirt" (Finnish), "rahmet" (Turkmen), "najis tuke" (Pashto), "kam sah hamnida" (Dzongkha), "didi madloba" (Lingala), "mèsi" (Lingala), "sagolun" (Lingala), "sobodi" (Lingala), "dèkuji" (Lingala), "nannni" (Lingala), "nandri" (Lingala), "bayarlalaa" (Mongolian), "kiitos" (Finnish), "dhanyavad" (Sinhala), "hvala" (Slovak), "mauriuru" (Māori), "kösönöm" (Hungarian), "faafetai lava" (Samoan), "barka" (Hausa), "blessings" (English), "welalin" (Yoruba), "tack" (Swedish), "spas" (Slovak), "mersi" (Arabic), "kia ora" (Māori), "vinaka" (Samoan), "spasibo" (Slovak), "blagodaram" (Slovak), "dank je" (Dutch), "misaotra" (Malagasy), "matondo" (Slovak), "paldies" (Lithuanian), "grazzi" (Italian), "mahalo" (Hawaiian), "xhala" (Slovak), "asante" (Slovak), "manana" (Slovak), "obrigada" (Portuguese), "tenki" (Slovak), "chokrane" (Slovak), "murakoze" (Slovak), "mamnun" (Slovak), "dijere dieuf" (Slovak), "tau" (Slovak), "mochchakkeram" (Slovak), "maith agat" (Slovak), "raibh go" (Slovak), "dakujem" (Slovak), "merci" (Slovak), "shukriya" (Slovak), "dhanyavadagalu" (Slovak), "diolch" (Slovak), "grazie" (Slovak), "tanemirt" (Slovak), "rahmet" (Slovak), "najis tuke" (Slovak), "kam sah hamnida" (Slovak), "didi madloba" (Slovak), "mèsi" (Slovak), "sagolun" (Slovak), "sobodi" (Slovak), "dèkuji" (Slovak), "nannni" (Slovak), "nandri" (Slovak), "bayarlalaa" (Slovak), "kiitos" (Slovak), "dhanyavad" 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