Chapter 2
Food Additive Intake Assessment
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INTRODUCTION

• Both international organizations and local governments generally evaluate the safety of food additives.

• The goal of local assessment is:
  1. to take into account local food supply
  2. and cultural differences in dietary habits

that may influence the intake of food additives.
Food additive intake assessment has three major goals:

1. **Monitoring** the intake of chemicals and relating it to the acceptable daily intake (ADI) values

2. **Identifying consumer groups** that may be at risk for food additive intake close to or higher than the ADI values

3. Provide information for the **regulatory bodies** for **reassessing** the food **additive regulations** in case of high intake in all or some consumer groups
The major aim of the intake assessment is to protect consumer health and to assist in developing food additive regulations.

The safety evaluation of food additives is based on:
1. the assessment of toxicity of the chemicals added to food.
2. And determine the extent to which ADI values may be exceeded.
• The **ADI value** is determined by the Joint FAO/WHO Expert Committee on Food Additives (JECFA).

• **ADI value**: is an estimate of the amount of food additives, expressed on a body weight basis, that can be ingested over a lifetime without appreciable health risk *(WHO, 1987)*. It is measured in milligrams per kilogram of body weight.
How is the ADI for an additive determined?

- It is usually derived from long-term animal feeding studies.

First, the **No Adverse Effect Level** is determined, which is: the highest dose of an additive that can be fed to the most sensitive animal species on a daily basis with no toxic effects.

A large safety factor is then added or determined—usually by dividing the level in animals by 100— to arrive at a safe level for humans.

For example, if the no effect level in animals is found to be 100mg/kg, then the human ADI would be set at 1mg/kg.
• The safety factor is built in partly to account for the:

1. **differences** between animals and humans,

2. and **also** to allow for the **variability** between different people, such as age and health.
• The ADI is **not a level of toxicity** – it is a level that has been **found to be safe**.

• Consuming more than this on **occasions** is unlikely to cause health problems, **as long as the average daily intake is below the ADI**.

• It should always be compared with average consumption **levels over long periods**.
- ADI has been proved to be the best practical tool available for legislators.

- It has contributed to a uniform approach around the world to express the safety of a substance in relation to human consumption levels of additives.
METHODS OF ESTIMATING DIETARY INTAKE OF ADDITIVES

• Methods of estimating dietary food additive intake can be classified as either:

A. one-phase:

A one-phase method uses information from one data source, usually concerning food additive production and usage.
B. or two-phase:

A two-phase method combines information from two data sources; these usually concern additive concentrations in foods and food consumption.

• In the two-phase the investigator is required to decide how to combine the two different types of data to estimate the food additive intake.
• *In duplicate meal studies*, both these types of information are collected from one source, which increases the accuracy of this method of intake estimation over the others.
A. One-Phase Methods

1. Estimation Based on Production and Foreign Trade:

• One estimation of food additive usage in a given country can be calculated from the amounts of food additives:
  o produced,
  o exported,
  o and imported by that country
• This **value** of additive usage by the food industry can then be divided by the total population to estimate an **average food additive intake**.

• It may also be necessary to take into account any **alternative uses** of the additives;
2. Surveys of Food Industry Usage

• **Records** of the **purchase** or **use** of food additives by the **food industry** can be collected

• to estimate the total usage of additives.

• **Dividing** this amount **by** the **number** of **consumers** yields an **estimate** of the average intake of that food additive.
• The individual average daily intake of each additive was estimated by:

1. **Multiplying** the total substance **concentration** used in foods of each category **by** the **average** consumption of such foods on each eating occasion.

2. This figure was in turn multiplied **by the frequency** with which the foods were consumed over the **14-day survey period**, 

3. and the result was divided **by 14** to obtain the **average daily intake**.
In other method described by Buchet and Lauwerys (1983),

1. the **housewife** was the **reference person** who stored **duplicate** meals of all the foods she ate.

2. The **sample** meals were stored in the domestic **refrigerator** until they were transported to the **laboratory** for analysis.
• The use of **duplicate meal samples** from large establishments, such as **hospitals**, may also be considered

because of the ease with which the preparation and collection of meal samples can be organized.
• Advantages to using this experimental protocol.

1. it provides accurate estimates of food additive intakes of individuals and realistic variations of these intakes.

2. Also, food consumption data and analytical data on single food items are unnecessary for such a study.
3. This experimental procedure could therefore be used to **assess** the **accuracy** of the other methods of estimating food additive intakes and thus be used to **validate** their results.

4. Furthermore, a duplicate meal study can be used to **ascertain** whether any significant **losses** or **gains** in additive content of foods occur during the **preparation** of those foods in the home.
B. Two-Phase Methods

1. Assumption of Maximum Permitted Levels

2. Market Basket Method
1. Assumption of Maximum Permitted Levels:

• This survey method was used by WHO to investigate the potential intakes of 54 additives;

• And the result was that only three were found to exceed their corresponding ADIs.
This method is based on the assumption that the concentration of the food additive in each food item is the permitted maximum.

• The estimated daily intake is therefore calculated by:

1. multiplying the maximum permitted level of additive in the food item by the average consumption of various food items (g/day).
2. This calculation is carried out for all the food items that may contain the additive, and the sum of the results gives a total intake.

3. Subsequent studies using analytical methods revealed that actual consumption of various food additives rarely exceeds their ADIs.

• This leads to the conclusion that the use of maximum permitted additive concentrations in food overestimates the intakes because:
1. Additives are **seldom** used in all the foods for which they have been approved.

2. Even when they are used, their concentrations are usually below the maximum permitted levels.

- Therefore the **maximum permitted additive concentrations method** should be used for the estimation of additive intakes **only** when **analyzed additive concentrations** are not available.
2. Market Basket Method

• The market basket method, also referred to as a total diet study,

• Carried as the following:

1. **selection** of food items representing the typical pattern of food consumption.

   1. The foods are **purchased** from shops and are then **prepared and cooked** (with herbs, spices, dressings, etc.) **to** incorporate the usual gains and losses of food additives.
3. The food items are then **sorted** into food groups (cereals, fats, fish, fruits, meats, oils, vegetables, etc.),

4. and the items of each group are **combined** according to the proportions in which they occur in the diet as indicated by **food consumption statistics**.

5. the **concentrations** of food additives in each food group are **determined**
6. The daily food additive intake for the food group is estimated by multiplying the measured concentrations of additives by the average consumption of foods in that food group.

7. An estimate of the total intake is the subsequent sum of the intakes calculated for each food group.
The accuracy of the information obtained in this type of study is dependent on:

1. the accuracy of determining the initial construction of the typical diet.

2. In addition, the accuracy of these estimates of additive intakes for the population of a country can be increased by:
   a) taking into account any regional differences in food consumption,
   b) And by incorporating seasonal variations of food consumption into the study
• So in such studies, some factors must be taken into considerations:

1. dietary habits,
2. the effect of age distribution in the population,
3. the degree of urbanization,
4. and the type of shops available for the purchase of food samples need to be considered