



Food Protein enrichment – a case study of PEM

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- **Fortification** is the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals (including trace elements) in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health.
- **Enrichment** is synonymous with fortification and refers to the addition of micronutrients to a food irrespective of whether the nutrients were originally in the food before processing or not



- **Dietary Recommended Intake (DRI)** is a quantitative estimate of a nutrient intake that is used as a reference value for planning and assessing diets for apparently healthy people. Examples include AIs, EARs, RDAs and ULs
- The **Average Intake (AI)** is a recommended intake value based on observed or experimentally determined approximations or estimates of nutrient intake by a group or groups of apparently healthy people that are assumed to be adequate.
- **Estimated Average Requirement (EAR)** is the average (median) daily nutrient intake level estimated to meet the needs of half the healthy individuals in a particular age and gender group. The EAR is used to derive the Recommended Dietary Allowance.

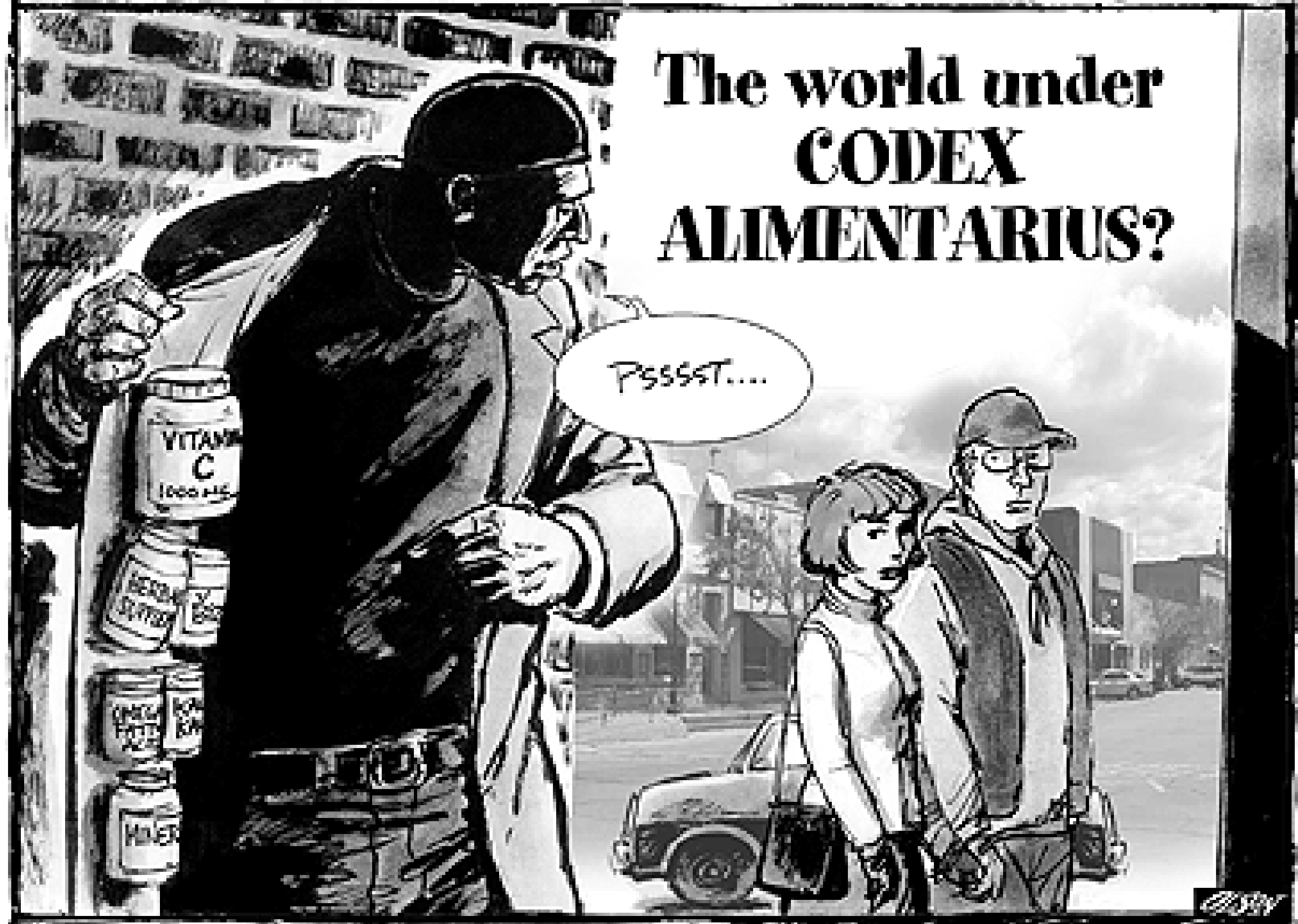


- **RDA Recommended Dietary Allowances (RDAs)** are defined by the United States Food and Nutrition Board and are conceptually the same as the Recommended Nutrient Intake (RNI), but may have a slightly different values for some micronutrients RNI Recommended Nutrient Intake.
- The **Recommended Nutrient Intake (RNI)** is the daily intake that meets the nutrient requirements of almost all apparently healthy individuals in an age and sex-specific population group. It is set at the Estimated Average Requirement plus 2 standard deviations.
- **UL Tolerable Upper Intake Level (UL)** is to the highest average daily nutrient intake level unlikely to pose risk of adverse health effects to almost all (97.5%) apparently healthy individuals in an age- and sex-specific population group.



- HACCP Hazard analysis critical control point
- NRV **Nutrient Reference Values (NRVs)** are dietary reference values defined by the Codex Alimentarius Commission with the aim of harmonizing the labeling of processed foods. It is a value applicable to all members of the family aged 3 years and over. These values are constantly reviewed based on advances in scientific knowledge.
- **Nutritional equivalence** is achieved when an essential nutrient is added to a product that is designed to resemble a common food in appearance, texture, flavour and odour in amounts such that the substitute product has a similar nutritive value, in terms of the amount and bioavailability of the added essential nutrient.

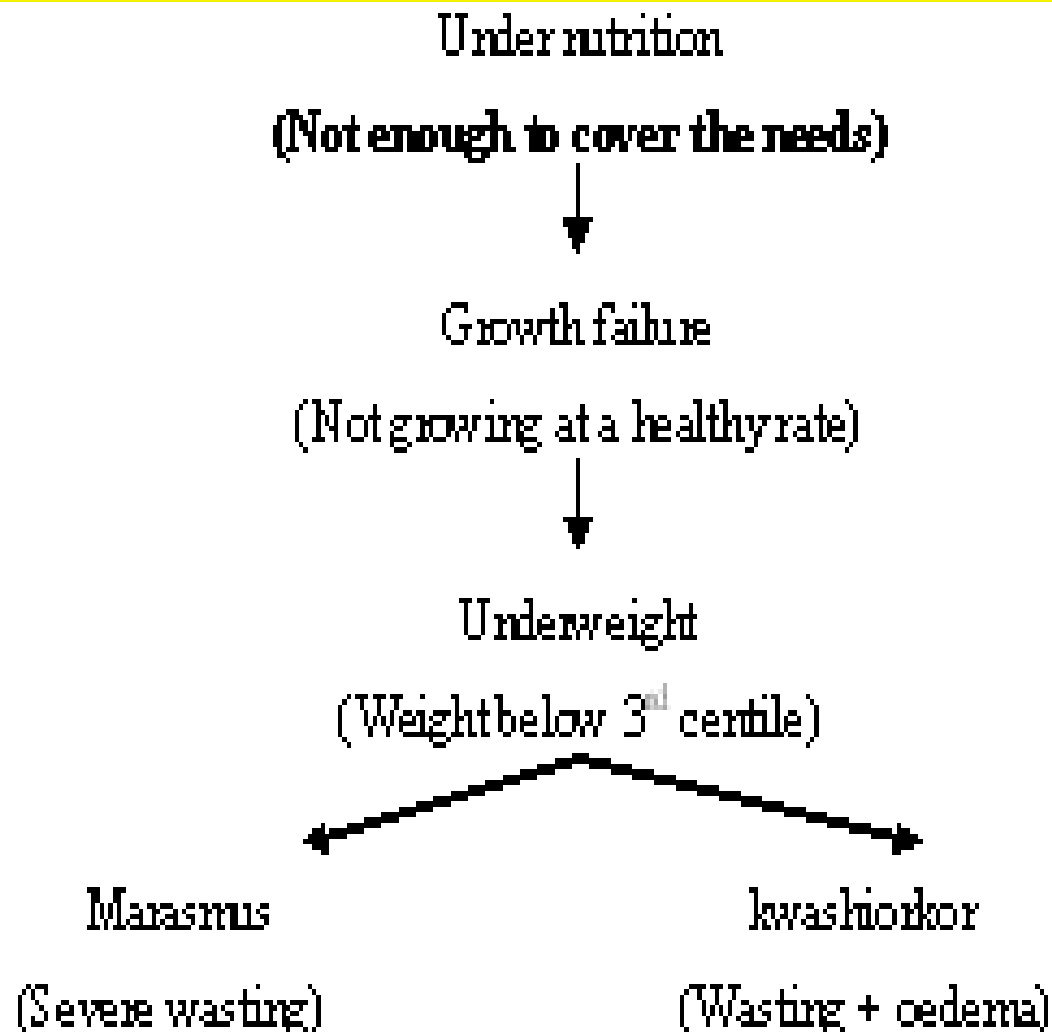
RBV Relative bioavailability



- www.kospublishing.com/images/cartoon.gif



- PEM Protein–energy malnutrition
- There 3 type of PEM
- Marasmus : Due food deprivation
- Kwashiorkor: Mainly due to Insufficient Protein intake.
- Marasmic Kwashiorkor: Nutrients and protein (intermediate to Marasmus)
- PEM also affects plasma zinc. A landmark for compromised immunity to diseases.

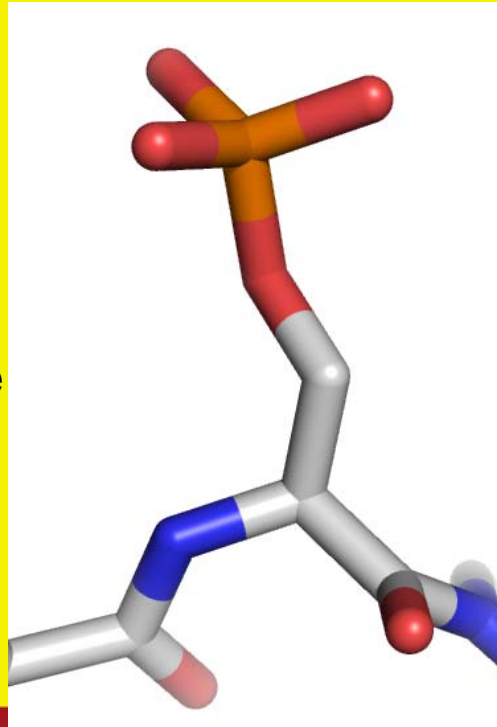




www.cs.stedwards.edu



www.uhlich-online.de



A phosphorylated [serine](#) residue

Phosphorylation: *the introduction of a phosphate group (PO₄) into an organic molecule*

<http://en.wikipedia.org/wiki/Phosphorylation>



- protein phosphorylation can be an important regulatory event where many enzymes and receptors are switched off or on.
- EG. Title: Production and Utilization of Phosphorylated Soy Protein Ingredients in Food and Industrial Applications. By K. C. Rhee. <http://www.tamu.edu/food-protein/>



Protein enrichment

- Protein quality
- Stability
- Bioavailability
- Process of enrichment:
 - 1) Food matrix (interaction b/w macro/micro molecules in the target food.
 - 2) Availability of the source
 - 3) Cost.



Process of protein enrichment practicalities

- Calculate amount of protein (essential) protein needs of the target people. Note that part of the total proteins are converted into energy (4.5 kcal/g at food level and 4 kcal/g at body consumption level)
- Therefore correct conversion ratio at water coefficient should be used.

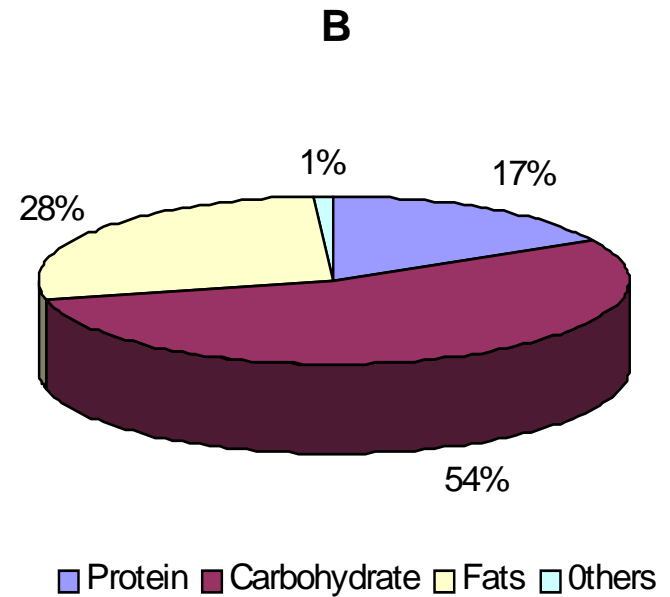
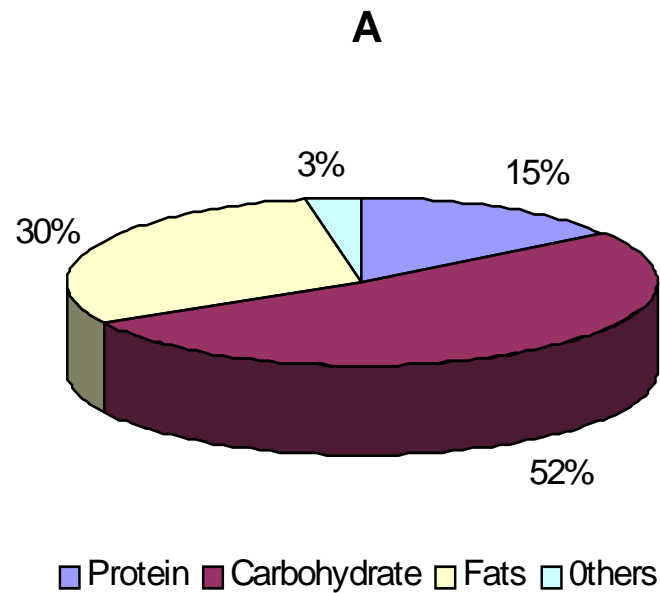
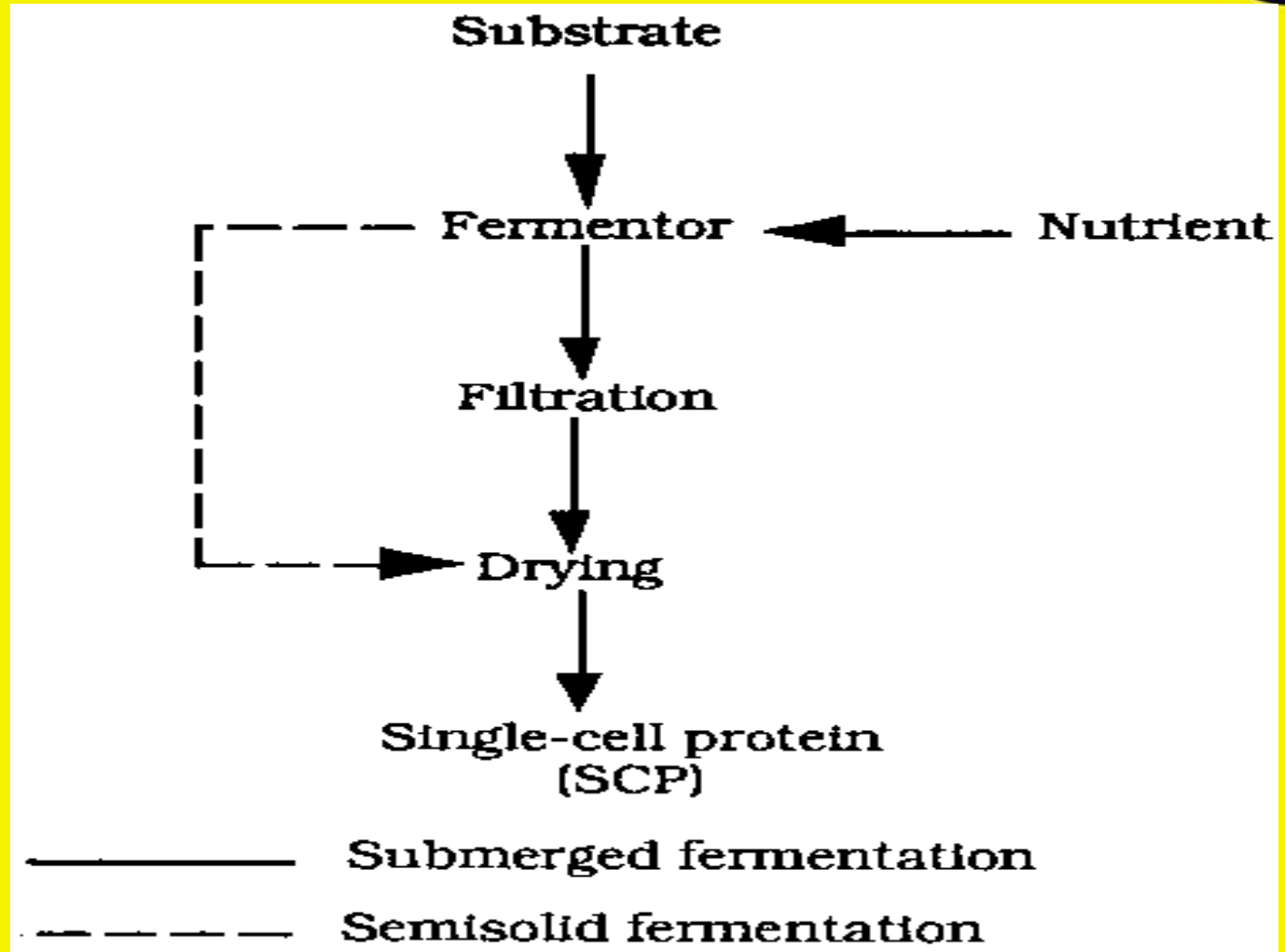


Fig 2: Macronutrients composition of the bush meals from wild (A), Comparing to the nutritional standards (B) for the lunch time (USRDA, 2000).



Process of protein enrichment practicalities cont..

- Genetically manipulation (GMO foods)
 - Mechanical blending (CSB used in emergency feedings by UN and NGOs).
 - Bio-processes. Like fermentation and
- Single Cell Protein: A protein extracted from cultured algae, yeasts, or bacteria and used as a substitute for protein-rich foods. Single cell protein must be dried to about 10 % moisture, or condensed and acidified to prevent spoilage from occurring, or fed shortly after being produced





Soya Use in PEM

Stable food in Africa in 70s and 80s when PEM was prevalent was maize and/or Cassava Millet.

The natural cultigens of maize is known to be deficient in one of the essential amino acids (lysine)

Soya is rich with lysine hence was used to produce the CSB (Corn Soya Blend -**80 percent maize and 20 percent soy beans**) product for this purpose. PEM mitigated.

A good example will be the US made CSB (see at:www.fsa.usda.gov/Internet/FSA_File/csb10.pdf)



Wheat Soya Blend

ITEM ¹	Minimum	Maximum
Moisture, %	--	11.0
Protein (Nx6.25), %	20.0	--
Crude Fat, %	6.0	--
Ash, %	--	6.6
Crude Fiber, %	--	2.5
Lysine, %	0.9	--
Total Bacteria Count per gram	--	50,000