#### Food Fortification. Benefits and risks of food fortification with folic acid



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- All agricultural raw materials are processed before they can be used as foods.
- In processing stages, some portion of the nutrients is destroyed.
- Enrichment addition of specific nutrients to a food (FDA, 1943).
- Restoration Replacement of nutrients loss in processing foods.
- **Supplementation** any foods or nutrients or a mixture of both used to improve the nutritive value.
- Nutrification Addition of nutrients to the food at such level as to make major contribution to food.

## What is food fortification?



Food fortification, sometimes called "enrichment", refers to the addition of one or more vitamins or minerals to food product.

It is <u>one of the most effective</u> methods to improve the nutritional quality of food and reduce the risk of certain diseases and deficiencies.

## Objectives

- To maintain the nutritional quality of foods.
- Keeping nutrients levels adequate to correct or prevent specific nutritional deficiencies in the population or in groups at risk of certain deficiencies.
- To increase the added nutritional value of a product (commercial view).
- To provide certain technological functions in food processing.

## Advantage of fortification

- Food fortification does not require people to change their eating habits thus it is socially acceptable.
- The effect of fortification is both fast and broad.
- Fortification **does not affect** organoleptic properties.
- Food fortification is the safest strategy as the added nutrient is provided in the diet is low but constant amounts.

- Fortification is the most cost effective approach to prevent nutrient deficiencies.
- It can be introduced quickly through existing marketing and distribution system.
- In addition, fortification will **reach risk groups**, such as the elderly and those who have an unbalanced diet.



#### Fortification programme design

- 24
- Identification of the target group.
- Identification of the **nutrient to be** added.
- Selection of foods to reach the target group.
- Level of nutrient to be added.
- Execution of test protocol

   laboratory testing, bioavailability
   and pilot trials.

#### Criteria for selecting the vehicle for food fortification

- Food fortification is appropriate when there is demonstrated need for increasing the intake of essential nutrients in **one or more** population groups.
- The fortified food must be consumed by a large section of the population, especially those at greatest risk of deficiency.

# • The nutrient(s) added **should not affect** the metabolism of any other nutrient.

- The nutrient's added should be sufficiently stable in the food under customary conditions of package in storage, distribution and use.
- The nutrient(s) added **should be physiologically available** from the food.
- The nutrients added should not impart undesirable characteristics to the food and should not shorten shelf life.

• The additional cost of the fortification should be reasonable for the consumers.



### **Fortification technology**

- Dry mixing: for foods like cereal flours and their products, powder milk, beverage powder etc.
- **Dissolution in water:** for liquid milk, drinks, fruit juices, bread, pastas, cookies.
- Spraying: for corn flakes and other processed foods requiring cooking or extrusion steps that would destroy vitamin activity.
- Dissolution in oil: for oily products such as margarine.



- **Addition:** for sugar fortification *vitamin A* in powder form is absorbed on to the surface of the sugar crystals when used with a vegetable oil.
- **Coating:** for rice. The vitamins sprayed over the grains must be coated to avoid losses when the grains are washed before cooking.
- **Pelleting:** for rice. The vitamins are incorporated into pellets reconstituted from broken kernels (seeds).

## Conclusion

- Vitamins are very sensitive to external factors such as humidity, heat, oxygen, pH, light, oxidizing and reducing agents.
- Some losses must therefore be expected during food processing and storage.
- A part from using a process that causes minimal losses and packaging material that gives maximum protection.



 The food industry must add extra amounts of the vitamins to compensate for those losses and to ensure that the finished products has at least the declared on the label during its normal shelf life.



# Benefits and risks of food fortification with folic acid





- Since 1998 the U.S. Food and Drug Administration (FDA) has required that all cereal grains must be fortified with 140 μg of folic acid per 100 g of grain.
- This regulation was introduced because folic acid, taken prior to conception, can prevent many neural tube defects (NTDs) and because an alarming number of women of childbearing age were not following the U.S. Public Health Service recommendation to take 400 µg/day of folic acid.

## Neural Tube Defects (NTDs)

- NTDs are some of the most common birth defects, having affected approximately 4000 pregnancies each year in U.S., and worldwide these birth defects affect 300.000 or more pregnancies annually.
- Neural tube defects include conditions such as spina bifida (a failure of closure of the neural tube surrounding the spinal cord) and anencephaly (partial absence of brain).



#### Features of Neural-Tube Development and Neural-Tube Defe<u>cts</u>



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 It is estimated that half of NTDaffected pregnancies are related to inadequate folate intake by the mother during the early weeks of pregnancy.



## Folate vs Folic acid

- Folate is the form of vitamin B that occurs naturally in foods. It must be modified by an enzyme in the intestine before it can be absorbed, and only <u>about half</u> of the folate in foods is absorbed.
- Folic acid is the synthetic form of this vitamin that is used in nutritional supplements, fortified foods and in clinical trials. It is <u>efficiently</u> absorbed by the body.

## **Folate-rich Foods**

- Orange juice, oranges
- Liver
- Brussel sprouts •
- Avocado •
- Dried beans and peas; lentils •
- Dark green leafy vegetables (spinach, mustard, turnip) •
- Broccoli
- Asparagus





#### **Recommended daily intake of folic acid**

- Women 14-70+ years 400 µg/day
  Pregnant women 14-50 years 600 µg/day
  Lactating women 14-50 years 500 µg/day

New recommendation of Food and Nutrition Board : Women capable of becoming pregnant

400 μg synthetic folic acid as fortified foods or supplements + food folate from a varied diet (200 to 300 μg/day).





Rates of neural tube defects (NTD's)



Eichholzer M.: Folic acid: a public health challenge, Lancet, 2006, 367, 1352-1361.









#### All about Europe...

 In 2008, the European Food Safety Authority (EFSA) established an EFSA Scientific Cooperation Working Group (ESCO WG) on "<u>Analysis of risks and benefits of</u> fortification of food with folic acid".

The Working Group was asked to:

- review current practice in Member States regarding the level of voluntary fortification of foods with folic acid
- consider new evidence regarding the risk of high intakes of folic acid and the need to review current guidance on safe upper levels of folic acid for all population groups.

## All about Europe...

- A range of foods are voluntarily fortified with folic acid at variable levels in most European countries.
- Mandatory fortification has not been introduced in any European country.



ESCO Report on Analysis of Risks and Benefits of Fortification of Food with Folic Acid 2009, October 6

#### **Voluntary food fortification in Europe**

- Voluntary fortification is widely practiced in the EU under the regulation 1925/2006/EC on the addition of vitamins and minerals and of certain other substances to foods.
- This regulation allows the fortification of all foods except unprocessed foods and alcoholic beverages. Foods voluntarily fortified with folic acid are widely available on the European market, except in Sweden where voluntary fortification is not practiced, and in Denmark and Norway where approval is required.

#### **Voluntary food fortification in Europe**

- Maximum levels for the addition of folic acid to foods are not yet set in European regulations.
- The levels vary widely, with the highest levels added to spreads (up to 1000  $\mu g/100$  g).



Age (years) / sex	0-1	1-3	4-6	4-8	4-9	7-9	7- 10	9. 13	10- 14	10- 15	11- 14	11- 18	14- 18	15- 17	15- 18	16- 18	19+ men	19+ women	Pregnant women	Lactatin women
Belgium	50	100	130				150	-			180	-	-		200		200	200	400	350
Denmark	50	60										-	300			-	300	300- 400 <sup>3</sup>	500	500
France	70	100	150			200				250	-			-		300/	330	300	400	400
Germany	60-80	200	300			300			400			_		-	400	330	400	400	600	600
Hungary		-	-		-	-	-	-	-	-		-	-			-	200	200		
Ireland	50	100	200		-	-	200		-		300	-	-	300			300	300	500%	400 <sup>c</sup>
Italy	50	100	130	-	-	-	150		-	-	180				200	-	200	200	400	350
Netherlands	40-60	85		150		-		225			-		300			-	300	300	400	400
Norway													300	-		-	300	300- 400 <sup>3</sup>	500	500

<sup>8</sup> In some countries folate dietary recommendations are expressed as dietary folate equivalents (DFE).

efsa European Food Safety Authority	ESCO Report on Analysis of Risks and Benefits o Fortification of Food with Folic Acia 2009, October 6
European Food Safety Authority	2009, October 6

### Folic acid and cardiovascular disease

#### • folic acid

- increases blood folate levels
- decreases homocysteine levels after folic acid flour fortification the mean plasma homocysteine concentration dropped from 18,7 µmol/l to 9,8 µmol/l which decreased cardiovascular disease and stroke.



#### Influence of folic acid and natural folate on the level of red cell folate

	levels of red cell folate µg/l
folic acid (supplements) 400µg/day	141
folic acid fortified foods contributing 400µg/day	173
foods containing natural folate equivalent to 400µg/day	28





## Folic acid and cancer



#### Colon cancer

- Folic acid intake inversely associated with colon cancer in dose-dependent way ~ 40% risk reduction in those with highest folic acid intake compared to those with the lowest folic acid intake.

#### Breast cancer

- Higher total folate intake or multivitamin use, associated with <u>lower risk of breast cancer</u> among women who regularly consumed alcohol
   Alcohol <u>increased risk of breast cancer</u> only among women with low folate intake.

### **Benefits of food fortification**

- It does not require change in the dietary habits of the population
- It can be implemented relatively quickly and can be sustained over a long period of time
- Population based approach
- Preventive
- Cost-effective



#### Folic acid fortification benefits

- Prevent birth defects (NTDs)
- Increase serum folate concentration
- Eradicate folate deficiency anemia
- Prevent heart attacks and strokes (reduce homocysteine serum concentration)
- Prevent colon cancer.



# Risk of food fortification with folic acid



- Extremely high levels of folate intake can mask changes in the nervous system that caused by vitamin B-12 deficiency, which is particularly a problem for elderly people.
- When left untreated, the anemia caused by B-12 deficiency can result in irreversible neurological problems, such as numbness, balance problems, weakness and paralysis.

# Can we get too much?





# THANK YOU