Folate Status of the Population in the EC and Strategies for Change – Expert Discussion Forum, 11/12 Jannuary 2007, BfR, Berlin, Germany

Folate intake in the European population

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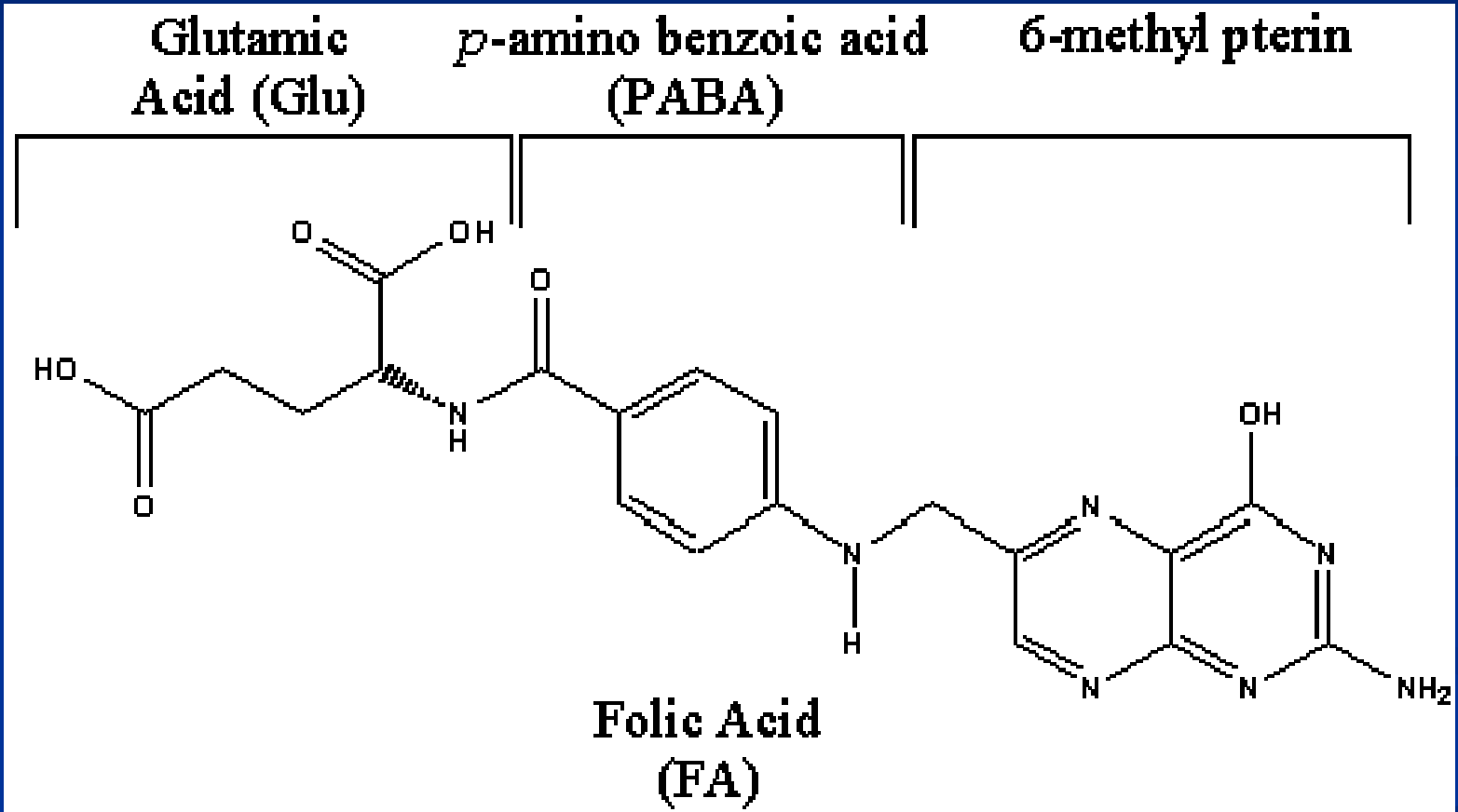
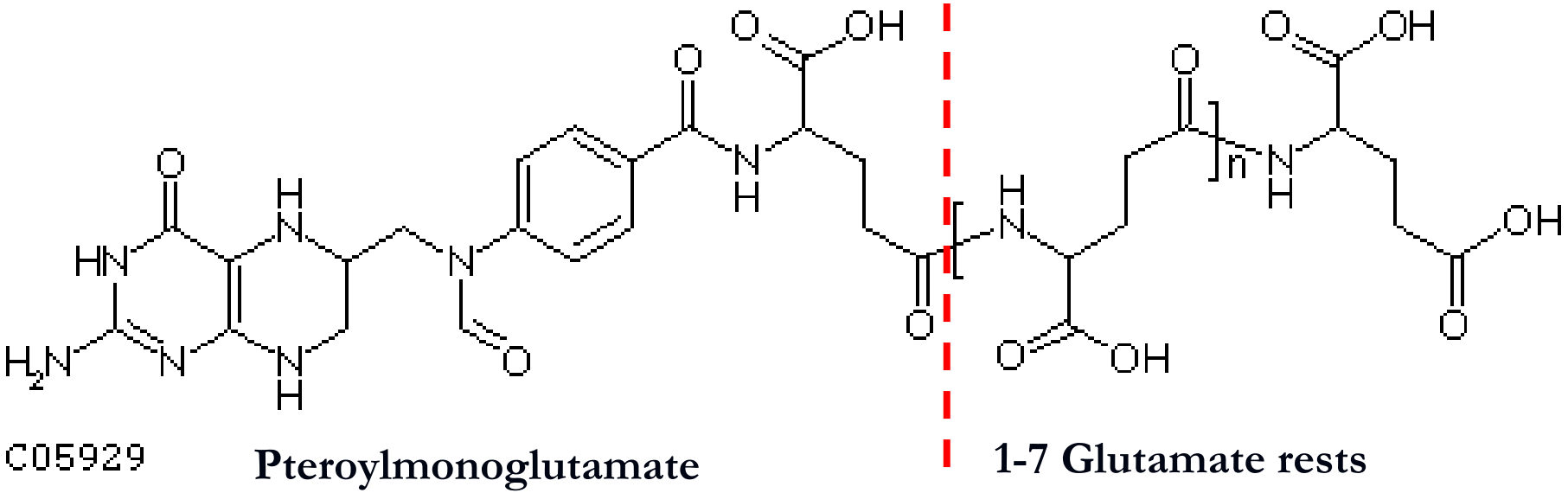
Folic Acid (Pteroylmonoglutamate)



Food Folate (Pteroylmonoglutamate and Pteroylpolyglutamate)



Pteroylmonoglutamate

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Food sources for food folate (µg / 100g)

	Total folate		Total folate
Kale	212	Beans*	128
Brussels sprouts	179	Lentils*	103
Green peas	159	Rye*	143
Spinach	145	Wheat*	91
Broccoli	111	Whole rye bread*	14
Strawberries	65	Crispbread (rye)*	88
Oranges	42	Beef liver, cooked	226

Sources: Elmadfa & Leitzmann, 2004; * Müller, Z. Lebensm Unters Forsch 1993, 197 (6): 573-577.

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Proportion of pteroylmonoglutamate in total food folate (in %)

	monoglutamate in total folate (%)		monoglutamate in total folate (%)
Kale	47	Strawberries	63
Brussels sprouts	44	Oranges	67
Green peas	32	Pulses	73
Spinach	23	Cereal	77
Broccoli	52	Bread	66

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Absorption of folate

Food:

different forms of folate (pteroylmono- und polyglutamate, different conjugates and oxidation states

Digestive tract:
Polyglutamates are hydrolyzed by the enzyme polyglutamate hydrolase

Absorption:
actively for pteroylmonoglutamates

Dietary folate equivalents (DFE)

- Differences in bioavailability exist between the folate forms occurring in food.
- While pteroylmonoglutamate is considered to be absorbed completely, polyglutamates have to be hydrolized. Thus their bioavailability is 50% on average.
- This led to the introduction of DFE:

1 µg DFE = 1 µg food folate = 0.5 µg pteroylmonoglutamate

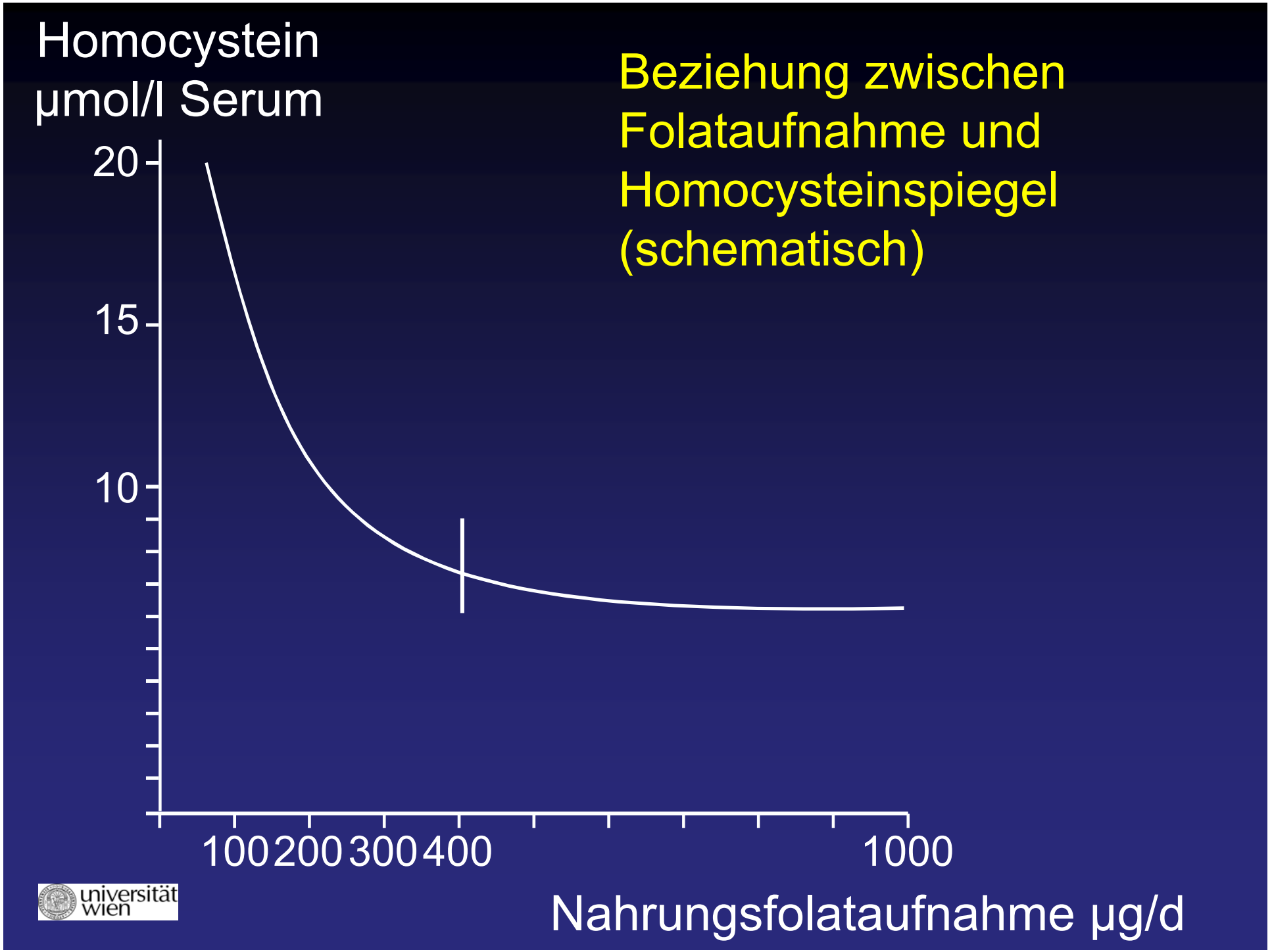
RDA-Values for Vitamins (males, 25-51 y)

Vitamin	NNR[1] 2004	DRI[2] 1997-	UK[3] 1991	SCF[4] 1992	D-A-CH[5] 2000
A [µg]	900	900	700	700	1000
D [µg]	7.5	5	-	-	5
E [mg]	10	15	-	-	14
C [mg]	75	90	40	45	100
B1 [mg]	1.4	1.2	1.0	1.1	1.2
B2 [mg]	1.7	1.3	1.3	1.5	1.4
Niacin [mg]	19	16	17	18	16
B6 [mg]	1.6	1.3	1.4	1.5	1.5
Folate [µg]	300	400	200	200	400
B12 [µg]	2.0	2.4	1.5	1.4	3.0

1 Nordic Nutrition Recommendations 2004
2 Dietary Reference Intakes (USA, Canada) 1997-
3 Dietary Reference Values (GB) 1991
4 Report of the Scientific Committee for Food of the EU 1992
5 D-A-CH-Referenzwerte für die Nährstoffzufuhr 2000

Folatmangelstadien

- Serumfolat ↓ / Erythrozytenfolat ↓
  (< 15 nmol/l) (< 500 nmol/l)
- Blutbildänderung
  Hypersegmentierung der Neutrophilen ↑
  (Lobes average < 3.2/Zelle,
  im Mangel: > 3.6/Zelle)
- Homocysteinspiegel (Serum) ↑
  > 10 µmol/l bei
  weniger als 400 µg Nahrungsfolat/d



Beziehung zwischen Folataufnahme und Homocysteinspiegel (schematisch)

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Tolerable Upper Intake Level for Folate

Folic acid 1 mg/d

An upper safe level is set for (synthetic) folic acid (PGA) on the basis of findings in PA patients treated with high doses of folic acid. There is no evidence for risk associated with high intakes of natural, reduced folates, and thus no data to set an UL for natural folate.

Although there is no conclusive evidence in humans, the Committee concludes that the risk of progression of the neurological symptoms in vitamin B12-deficient patients as a result of folic acid supplementation cannot be excluded and should be considered the most serious adverse effect.

Table 1. Folate intake in EU countries (µg/day)

Country	*Population*	*Mean intake*	*High intake*
Austria[1]	M + F (20-60 y) (n = 2488)	398	1795 (P-97.5)
Germany[2]	M (26-50 y)	255	-
	F (26-50 y)	210	-
Ireland[3]	M (n = 662) (18-64 y)	332	662 (P-97.5)
	F (n = 717) (18-64 y)	260	638 (P-97.5)
Italy[4]	M + F (n = 2734)	287	550 (P-97.5)
The Netherlands[5]	M + F (n = 5958)	251	412 (P-97.5)

[1] Elmadfa I *et al*. (1998). Austrian Study on Nutritional Status, Österreichischer Ernährungsbericht.
[2] DGE (1996). Ernährungsbericht.
[3] IUNA (2000). Irish Universities Nutrition Alliance). Food Safety Promotion Board, Dublin.
[4] Turrini A (1994-1996). National Survey, INRAN, Rome.
[5] Hulshof KFAM *et al*. (1997-1998). 3rd Dutch National Food Consumption Survey.

SCF, 2000

EUROPEAN NUTRITION & HEALTH REPORT

Coordinated by

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Nutrition and Health Reports – selected examples

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Ranges of Mean Nutrient Intake in European Adults

Nutrient	Adults (18-64 years)		Recommended Intake*	
	M	F	M	F
Folate, µg FE/d	195 – 376	194 – 359	400**	
Vitamin B12 µg/d	4.5 – 10.6	3.6 – 9.2	1.4* / 3***	

**SCF, 1993; **Eurodiet, 2000, ***DACH 2000*

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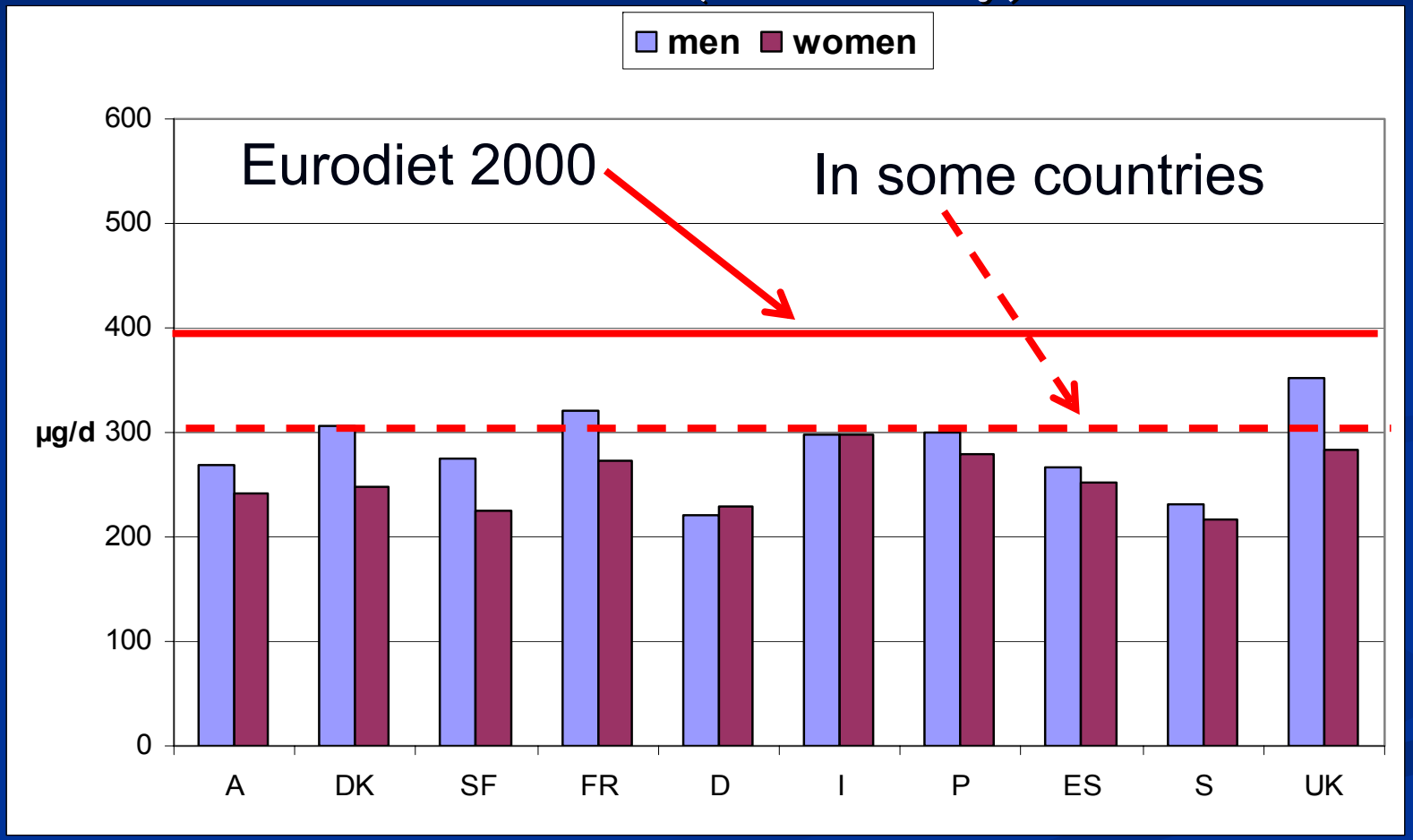
Mean folate intake in adults from different European countries

mean values (18 to 65+ y)



European Nutrition and Health Report 2004

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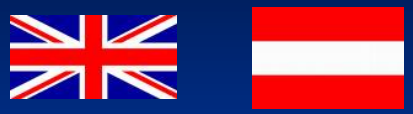
Percent contributions made by important food groups to folate in the diet of Austrian, and UK adults



Food group:	contrib. %	
Cereal products	33	31
Vegetable (excl. potatoes)	22	17
Fruits and nuts	19	12
Potatoes and savoury snacks	15	17
Milk and products	5	9
Meat and products	4	3
Egg and egg dishes	3	5

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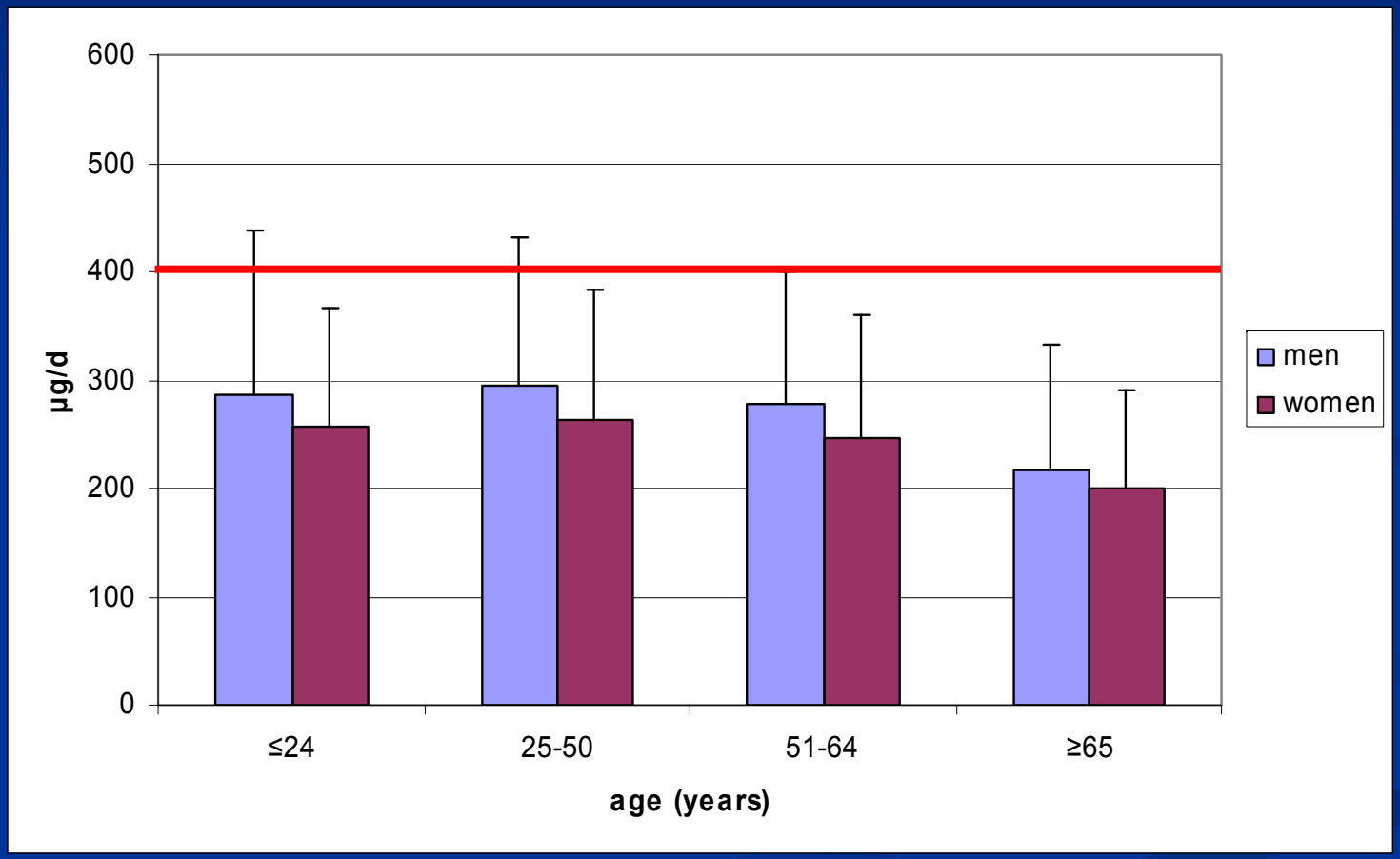
Daily folate intake in Austrian adults (18 to ≥ 65 years)



Data are mean ± SD.

Reference value: 400 µg/d (Eurodiet 2000)

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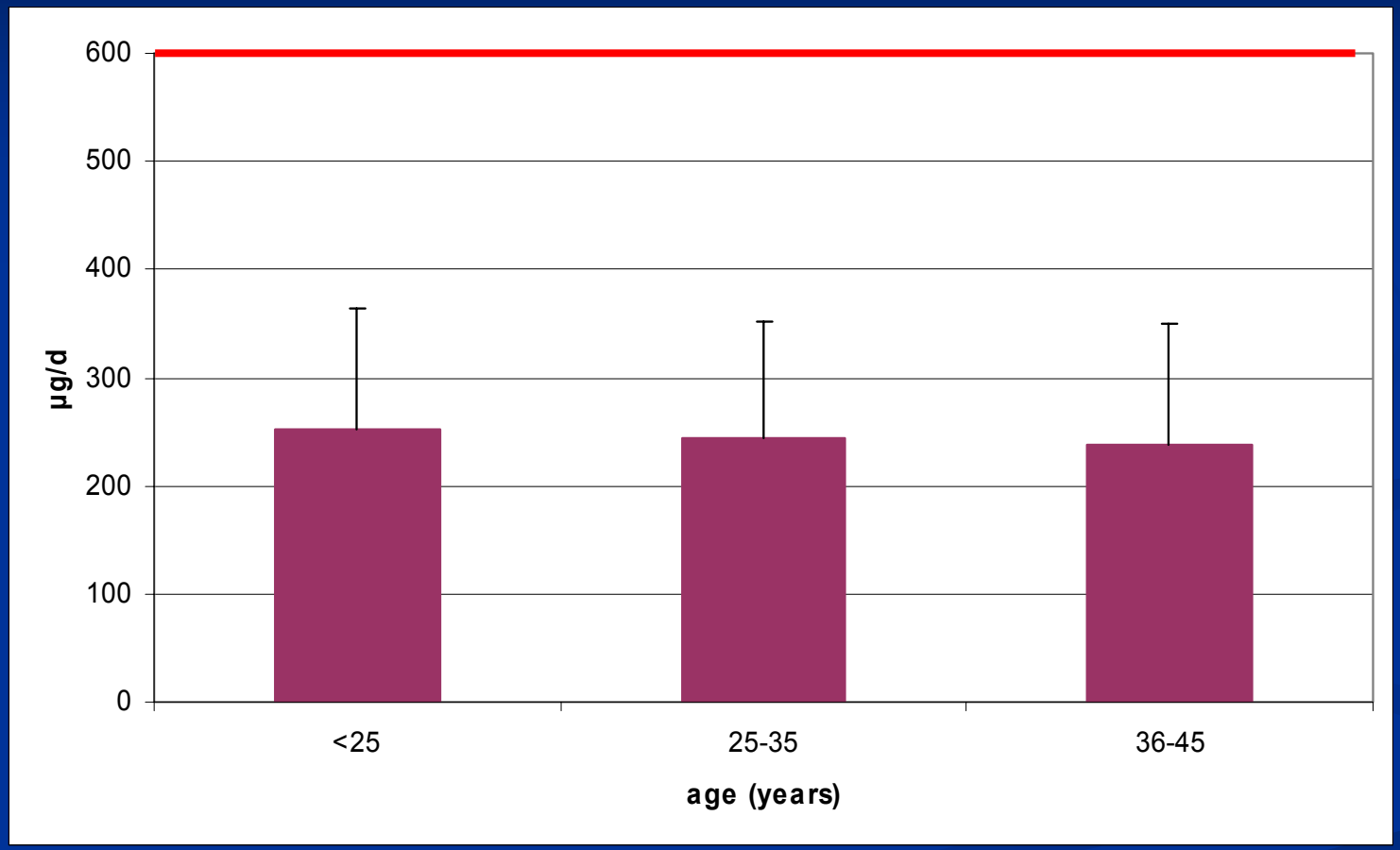
Folate intake of pregnant Austrian women (<25 to 45 years)



Data are mean ± SD.

Reference value: 600 µg/d (DACH 2000)

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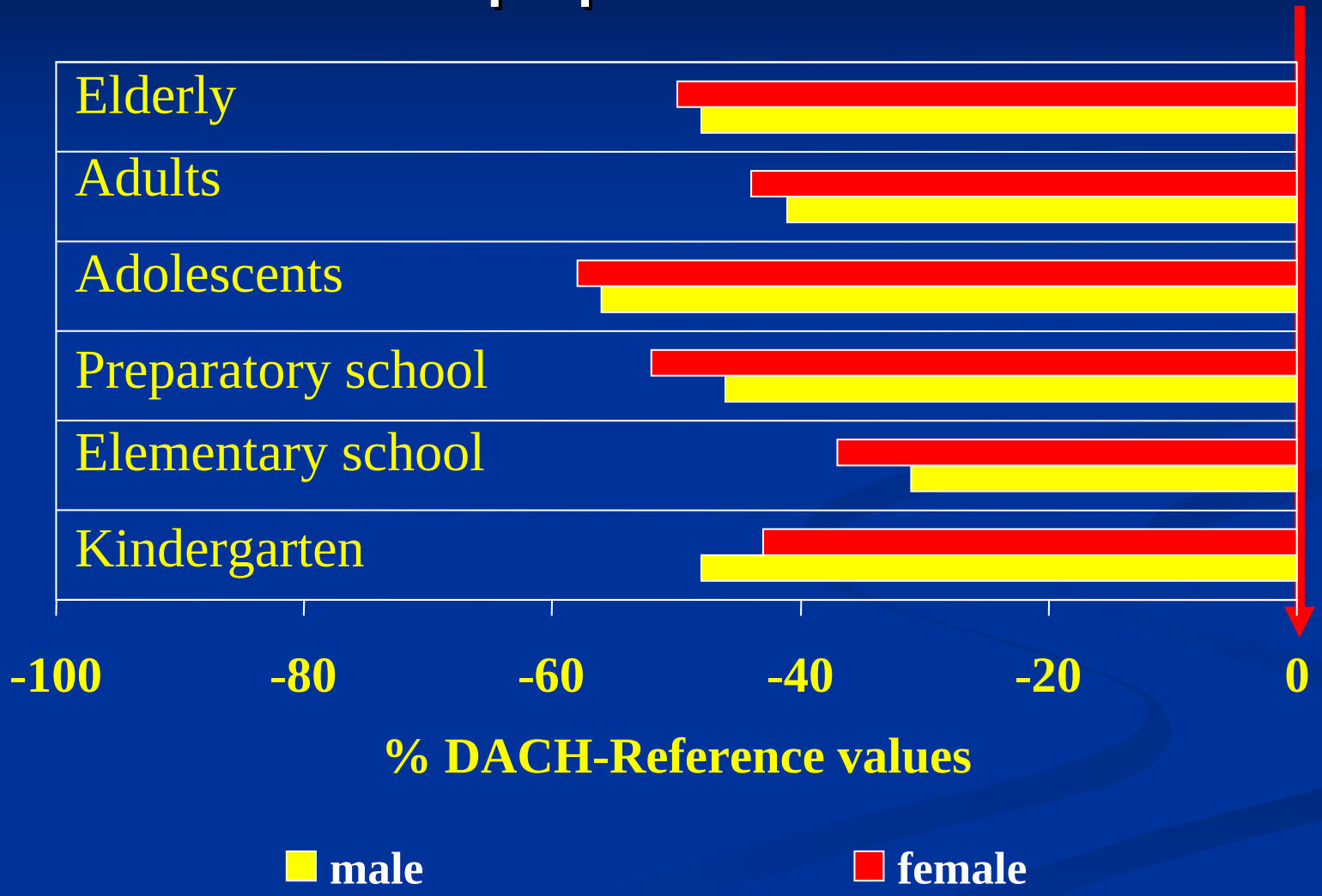
Mean folate intake of the Austrian population



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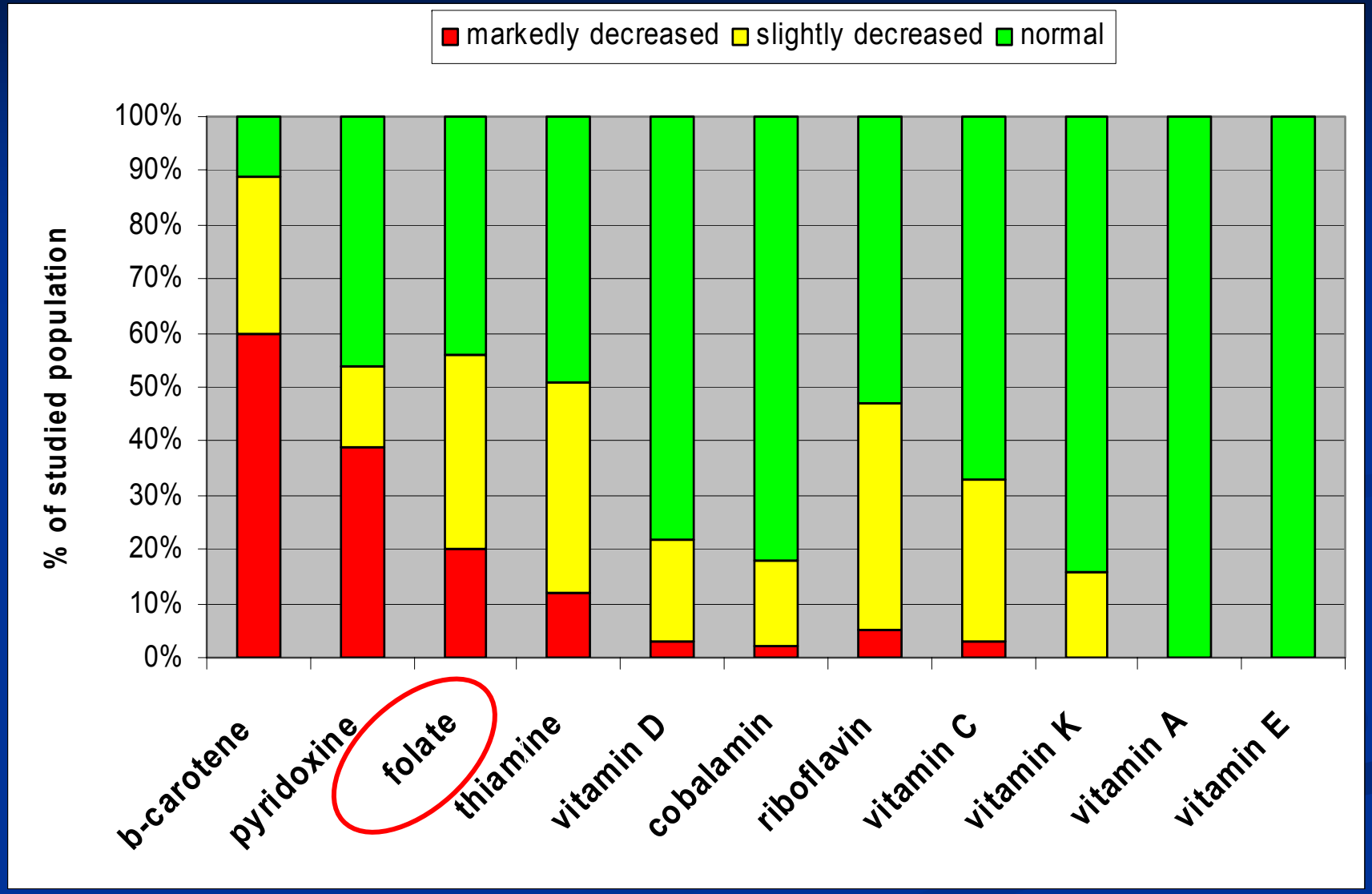
Vitamin status of Viennese senior citizens (n=224)



Source: 2nd Viennese Nutrition Report 2004

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FOOD FORTIFICATION

"Adding one or more nutrient(s) with the aim to prevent or correct nutrient deficiency in the whole population or in subpopulation groups at risk."

WHO/FAO 1994

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How to optimize nutrition?

Food based

- Chang. eating habits
- Diversification
- Fortification

Supplements

Health and Nutrition Education

- Info/Educ./Comm (IEC)

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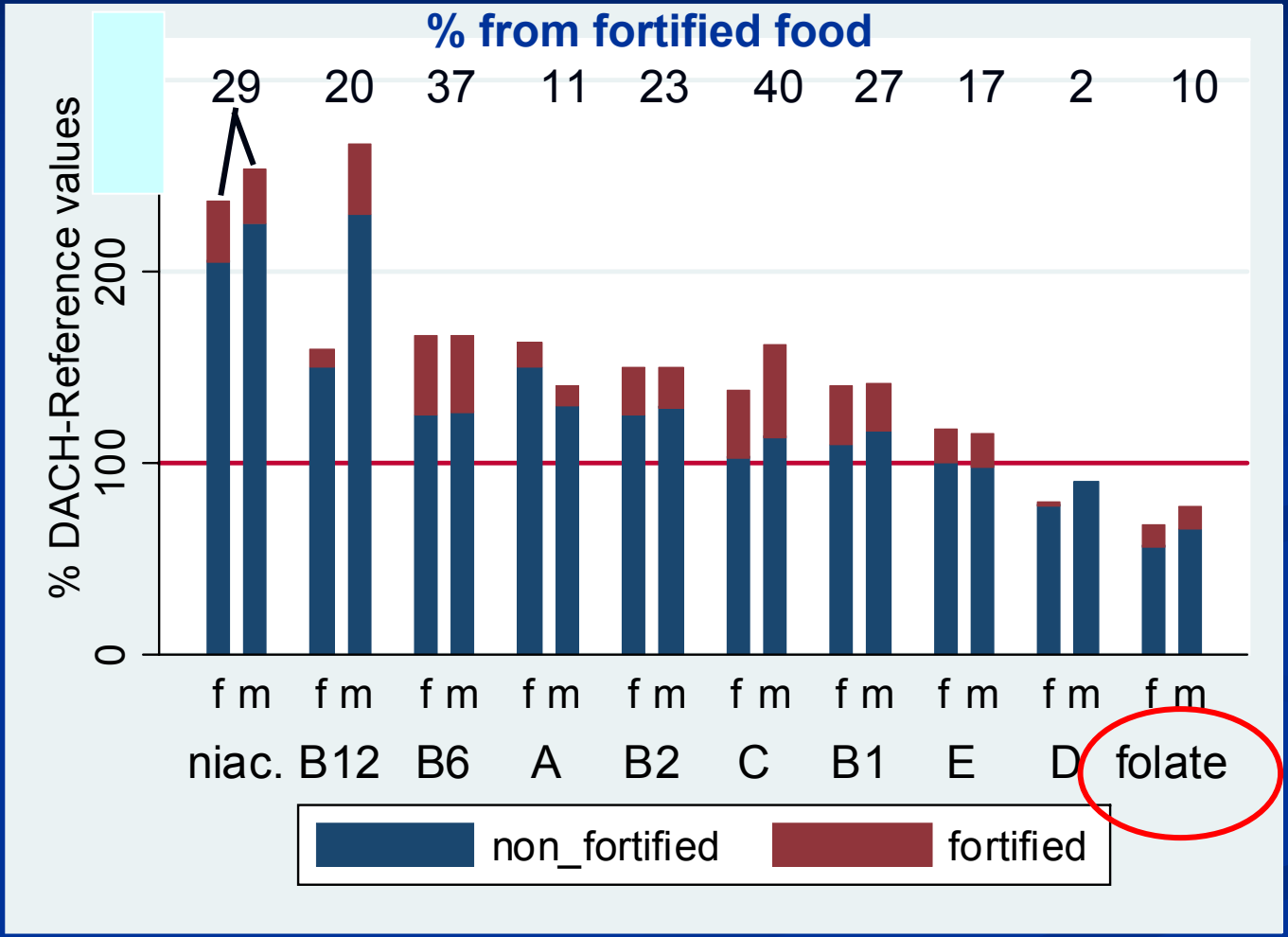
Proportion of the RDA supplied by fortified foods

in % of the D-A-CH reference values

	Total sample in % (n=1700)	USER only in % (n=914)
Folic acid	**10**	**19**
Vitamin B12	20	37

Contribution of fortified foods to vitamin supply (% of total intake)



Adults 18-65 y. (n=1700)

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Countries with mandatory folate fortification

Country	Legal status	Level and food
USA	Mandatory since 1998	140 µg/100g grain
Canada	Mandatory since 1998	150 µg/100g white flour 200 µg/ 100g pasta Voluntary: 150-220 µg/ 100g corn flour
Chile	Mandatory since 2000	220 µg/ 100g flour

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Food fortification with folate in Europe - Current situation

- Food fortification with folate is not mandatory in any European country.
- Many countries practise voluntary fortification (UK, Ireland, Austria, Portugal, Spain and Switzerland).
- However, Finland, Denmark and Sweden restrict this measure or do not allow it.

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Food fortification with folate in Europe – Future directions

- Currently, Ireland is envisaging compulsory addition of folate to commonly consumed bread types (120 µg/ 100g bread)
- In the UK, the Scientific Advisory Committee on Nutrition (SACN) – an independent committee that advises the Food Standards Agency and Government – recommended 'mandatory fortification' of flour with folate. A final consultation has been launched in december 2006. Measures are to be taken in 2007.

Thank you for your attention!!

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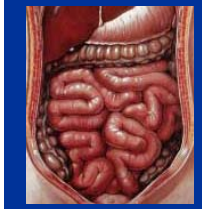
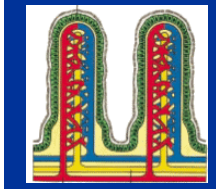
Absorption and transport of folate

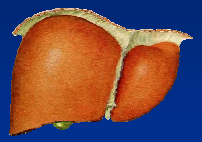
Food: different forms of folate (pteroylmono- und polyglutamate, different conjugates and oxidation states



Digestive tract:
Polyglutamates are hydrolyzed by the enzyme polyglutamate hydrolase
Absorption:
actively for monoglutamates



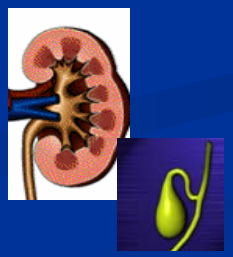
Intestinal mucosa:
Reduction of oxidized forms and synthesis of 5-methyl-THF



Liver: Reduction and synthesis of THF

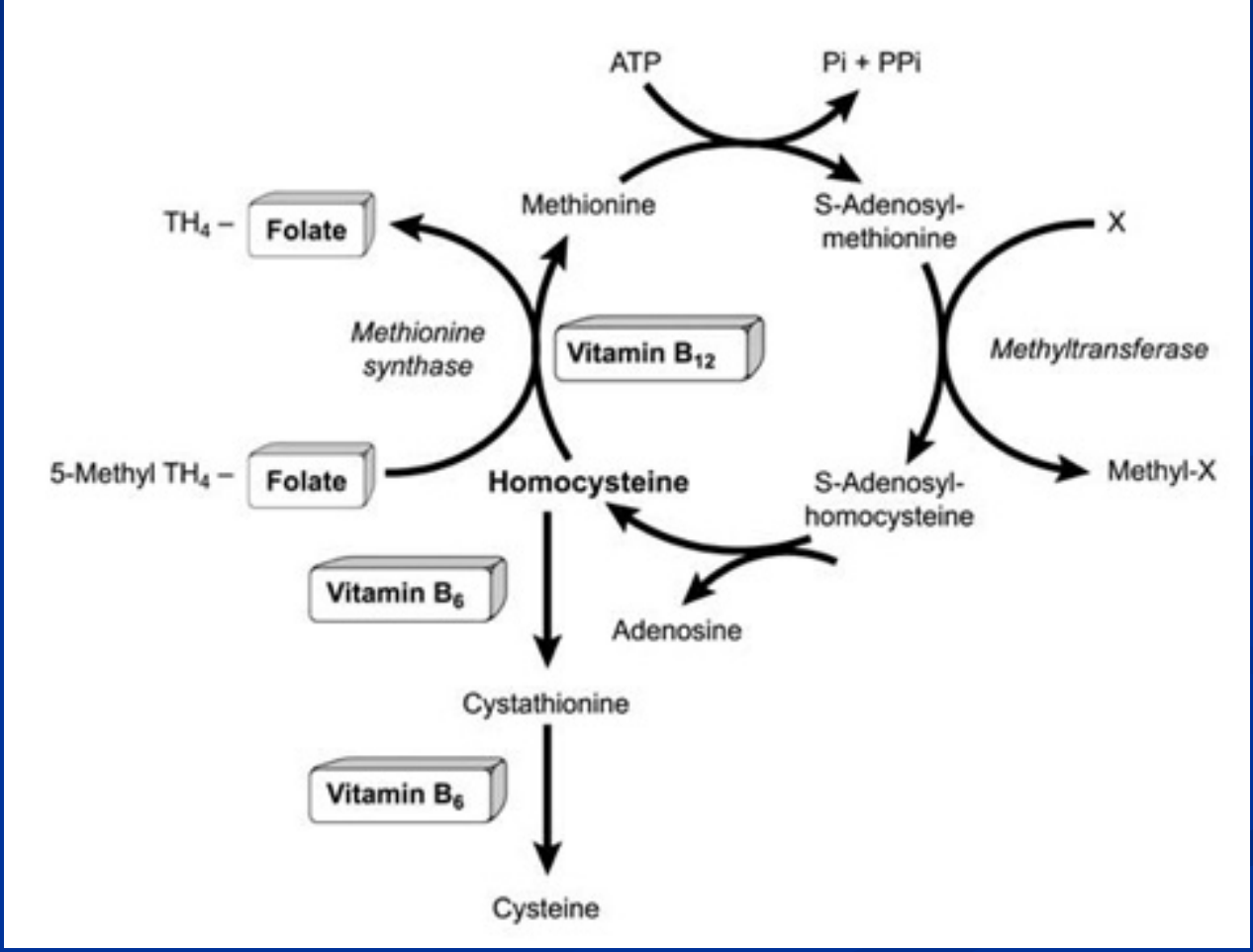
Blood: free folate; protein-bound 5-methyl-THF

Target cells: Absorption of reduced mono-glutamate; intra-cellular storage as polyglutamate



Excretion: in urine and bile; subject to enterohepatic cycle

Folate and homocysteine-metabolism



Why differ Nutrient Based Guidelines for one or more nutrients between countries?

- Avoiding nutrient deficiency vs. preventing nutritional risk of public health relevance (optimal health)
- Adjusting for dietary factors (e.g. calcium and intake of animal protein, sodium, vit. D)
- Adjusting for environmental factors (e.g. iodine and soil content)
- Bioavailability (e.g. iron bioa. vary from 5 - 18 %)