

## Proposed maximum levels for the addition of vitamin A to foods including food supplements

The accompanying main opinion "**Updated recommended maximum levels for the addition of vitamins and minerals to food supplements and conventional foods**" can be found here: <https://www.bfr.bund.de/cm/349/updated-recommended-maximum-levels-for-the-addition-of-vitamins-and-minerals-to-food-supplements-and-conventional-foods.pdf>

### 1 Results

In the case of preformed vitamin A (retinol and retinyl esters), the safety margin between the Tolerable Upper Intake Level<sup>1</sup> (UL) and the 95th percentile of intake as well as the dietary reference intake is very small. Therefore, from the point of view of the German Federal Institute for Risk Assessment (BfR), the following options are proposed for the addition of this vitamin to food supplements:

Option 1: no addition to food supplements.

Option 2: Addition of up to 0.4 milligrams (mg) retinol equivalents<sup>2</sup> (RE) per day.

Taking into account an uncertainty factor regarding possible uses of multiple vitamin A-containing food supplements besides other scientific uncertainties, this corresponds to a maximum amount of 0.2 mg RE per daily recommended intake of a food supplement.

It is also recommended to include a note or labelling on vitamin A-containing food supplements stating that during pregnancy vitamin A should only be taken after medical consultation.

Due to the low safety margin, preformed vitamin A should not be used to fortify conventional foods. This does not apply to margarine or mixed fat products, which have been fortified with vitamin A as a substitute for butter in Germany for many years. For these purposes, a maximum amount of 10 milligrams RE per kilogram (mg RE/kg) or 1 milligram RE per 100 gram (mg RE/100 g) of food is recommended in accordance with the Ordinance on Vitaminised Foods (Table 1).

**Table 1: Proposed maximum levels**

Food category	Maximum levels
Foods marketed as butter substitutes (per 100 g)	1.0 mg RE
Other conventional foods (per 100 g)	no addition

### 2 Rationale

#### 2.1 Tolerable Upper Intake Level (UL) and Dietary Reference Value

<sup>1</sup> Tolerable Upper Intake Level = Maximum level of total chronic daily intake of a nutrient (from all sources) judged to be unlikely to pose a risk of adverse health effects to humans.

<sup>2</sup> 1 mg retinol equivalent (RE) = 1 mg retinol = 1.15 mg all-trans-retinyl acetate = 1.83 mg all-trans-retinyl palmitate = 3333,33 International Units (IU)

In view of the risk for liver toxicity and teratogenic effects of preformed vitamin A (in the form of retinoic acid), the former Scientific Committee on Food (SCF) of the European Commission derived a UL in the early 2000s of 3 mg RE/day for women of childbearing age and for adult men (SCF, 2002). For post-menopausal women, due to evidence of an association between high vitamin A intakes of retinol levels and adverse effects on bone health<sup>3</sup>, it was recommended to limit intakes to 1.5 mg RE/day (SCF, 2002). A UL of 2.6 mg RE/day was extrapolated for adolescents of 15 to 17 years of age, and ULs between 1.1 and 2 mg/day were extrapolated for those under 15 years of age (SCF, 2002; Table 2).

The D-A-CH Societies<sup>4</sup> have derived intake recommendations for vitamin A intake (as retinol or retinol activity equivalents; RAE), according to which children between 4 and 13 years of age should ingest between 0.35 and 0.6 mg RAE and older children and adults between 0.7 mg and 0.95 mg RAE per day, depending on sex and age. For pregnant and lactating women, 1.1 and 1.5 mg RAE/day, respectively, are recommended (D-A-CH, 2020; Table 2).

The intakes recommended by EFSA (2015) for vitamin A (as retinol equivalents; RE) differ only slightly from those of the D-A-CH Societies (EFSA, 2015; Table 2).

**Table 2: Dietary reference values (intake recommendation) and UL**

Age groups	Dietary Reference Values				UL*** (SCF, 2002)
	Retinol/ Retinol activity equivalents* (RAE) (D-A-CH, 2020)		Retinol equivalents** (RE) (EFSA, 2015)		
	mg RAE/day		mg RE/day		
4 to < 7 years	0.35		0.3		1.1
7 to < 10 years	0.45		0.4		1.5
10 years	0.60		0.4		1.5
11 to < 13 years	0.60		0.6		2.0
	<b>m</b>	<b>f</b>	<b>m</b>	<b>f</b>	
13 to < 15 years	0.80	0.70	0.6		2.0
15 to < 18 years	0.95	0.80	0.75	0.65	2.6
Adults (< 65 years)	0.85	0.70	0.75	0.65	3.0
Adults (≥ 65 years)	0.80	0.70	0.75	0.65	3.0
Postmenopausal women					1.5
Pregnant women		0.80		0.70	3.0
Lactating women		1.30		1.30	3.0

\* 1 µg retinol activity equivalent (RAE) = 1 µg retinol = 12 µg β-carotene = 24 µg other provitamin A carotenoids

\*\* 1 µg retinol equivalent (RE) = 1 µg retinol = 6 µg β-carotene = 12 µg other provitamin A carotenoids

\*\*\* retinol und retinyl ester (without provitamin A carotenoids)

<sup>3</sup> Epidemiological studies published since then provide conflicting results on this issue (Ribaya-Mercado et al., 2007; Caire-Juvera et al., 2009; Ambrosini et al., 2014; Wu et al., 2014; Holvik et al., 2015; Händel et al., 2016). However, based on *in vitro* and animal studies, it can be concluded that both too low and too high amounts of vitamin A can negatively affect bone health (Lind et al., 2017; Yorgan et al., 2016; Green et al., 2016).

<sup>4</sup> German-Austrian-Swiss Nutrition Societies

## 2.2 Exposure

According to the second National Food Consumption Survey (NFCS II), the median intake of total vitamin A in men aged 14 to 18 years was 1.5 mg RE/day and in men over 18 years between 1.5 and 1.8 mg RE/day. The median intake of females aged 14 to 18 years was 1.4 mg RE/day and in females over 18 years ranged between 1.4 and 1.7 mg RE/day (MRI, 2008). The vitamin A intake of the population studied in the NFCS II was thus above the intake recommendations derived by the D-A-CH societies.

In children aged 6 to 11 years, median intakes of total vitamin A were between 0.7 and 0.9 mg RE in boys and at 0.7 mg RE in girls; the 95th intake percentile of intake ranged from 1.9 to 2.1 mg RE (boys) and from 1.5 to 2.2 mg RE (girls) per day. At the age of 12 to 14 years, the median and 95th intake percentiles of boys and girls were at 1.2-1.3 (P95: 2.6-3.4) mg RE/day and at 1.3-1.4 (P95: 2.7-3.3) mg RE/day, respectively (Mensink et al., 2007). Accordingly, all age groups of children were at or above the intake recommendations.

Considering only the intake of preformed vitamin A, according to NFCS II, those aged 14 to 18 years had median intakes of 0.4 (f) and 0.6 (m) mg RE/day and 95th percentile intakes of 1.9 (f) and 2.6 (m) mg RE/day. For individuals over 18 years of age, median intakes were at 0.4-0.5 (f) and 0.6-0.7 (m) mg RE/day, respectively, and at the 95th intake percentile, intakes ranged from 1.3 to 2.0 mg (f) and from 2.5 to 2.9 (m) RE/day (MRI, 2008).

Postmenopausal women (51 to 80 years) had a median intake of 0.5 mg RE/day and a 95th intake percentile of 1.7 to 2.0 mg RE/day (MRI, 2008). The 95th percentile was thus above the highest tolerable daily intake of 1.5 mg RE/day recommended by the SCF (2002) for this population group.

## 2.3 Aspects considered in deriving maximum levels for vitamin A

The application of the derivation procedure proposed by the BfR results in a residual amount of "zero" ( $UL_{15- to 17-year-olds} - P95_{14-to 18-year-olds} = 2.6 \text{ mg/day} - 2.6 \text{ mg/day} = 0$ ).

The safety margin between UL and recommended intake or actual dietary intake of high consumers (P95) is very small and there is de facto no scope for the use of preformed vitamin A in food supplements or for fortification of conventional foods.

The 95th intake percentile of post-menopausal women via the usual dietary intake already exceeds the daily tolerable limit of 1.5 mg RE proposed for this group by the European Food Safety Authority (EFSA).

A re-evaluation of the NFCS II data by the Max Rubner-Institute (MRI) with regard to the intake of (multiple) food supplements showed that about 16 % of the food supplement users identified in the NFCS II took a vitamin A preparation, whereby no differentiation between products with preformed vitamin A and  $\beta$ -carotene was possible on the basis of these data. Just under 3% of vitamin A users took more than one supplement, of which 2.4% (3.3% of men and 1.9% of women) took two products and 0.2% took three products (Römer and Heuer, 2017).

It must be taken into account that the data on the supplements used by the participants of this survey as well as the nutrient data of the MRI supplement database originate from the years 2005 to 2007. A change in the intake behaviour of the population and the nutrient composition of supplements over the past ten years cannot be ruled out (Römer and Heuer, 2017).

Study results from the 2016 Food Monitoring show that animal liver can contain an average of between 17 and 29 mg vitamin A per 100 g. Depending on the amounts consumed and the actual vitamin A content of the liver, people who consume liver (approx. 40 % of the NFCS II population) may therefore experience significant exceedances of the UL (BVL, 2017). Already since the 1990s, due to high vitamin A contents in animal livers, it has been recommended that during pregnancy the consumption of livers of all animal species should be avoided and pregnant women and young children should be very cautious when consuming products containing liver (bga-press service 47/90 and BgVV press release 20/1995 of 23.10.1995<sup>5</sup>). In view of the current monitoring results, this recommendation is maintained.

### 2.3.1 *Maximum levels for vitamin A in food supplements*

In view of the small safety margin between the UL and the dietary intake (recommendation) for vitamin A, the BfR considers the following options for the use of preformed vitamin A in food supplements:

Option 1: no addition of vitamin A to food supplements

Option 2: Use of vitamin A up to a maximum daily amount of 0.4 mg.

Taking into account an uncertainty factor of 2 for use of multiple food supplements containing vitamin A, which cannot be excluded, besides other scientific uncertainties, this would result in a maximum level of 0.2 mg RE per daily recommended dose of a food supplement.

This maximum level can make a significant contribution to vitamin A supply in less well-supplied adults.

However, a part of the group of the 14- to 18-year-olds and adult males 25 years and older would exceed the UL for vitamin A, especially with use of multiple vitamin A-containing supplements. In postmenopausal women, the UL exceedance already present in the 95th percentile would be further increased (Figure 1).

### 2.3.2 *Maximum levels for vitamin A in fortified conventional foods*

Conventional foods should not be fortified with preformed vitamin A in view of the low safety margin of this vitamin. This does not apply to margarines or mixed fat products which are marketed as a substitute for traditional butter and which have already been mandatorily fortified with vitamin A in Germany for many years. For these purposes, a maximum level of 10 mg RE/kg or 1 mg RE/100 g product is recommended in accordance with the Ordinance on Vitaminised Foods.

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<sup>5</sup> [http://www.bfr.bund.de/de/presseinformation/1995/20/schwangere\\_sollten\\_weiterhin\\_auf\\_den\\_verzehr\\_von\\_leber\\_verzichten-775.htm](http://www.bfr.bund.de/de/presseinformation/1995/20/schwangere_sollten_weiterhin_auf_den_verzehr_von_leber_verzichten-775.htm)

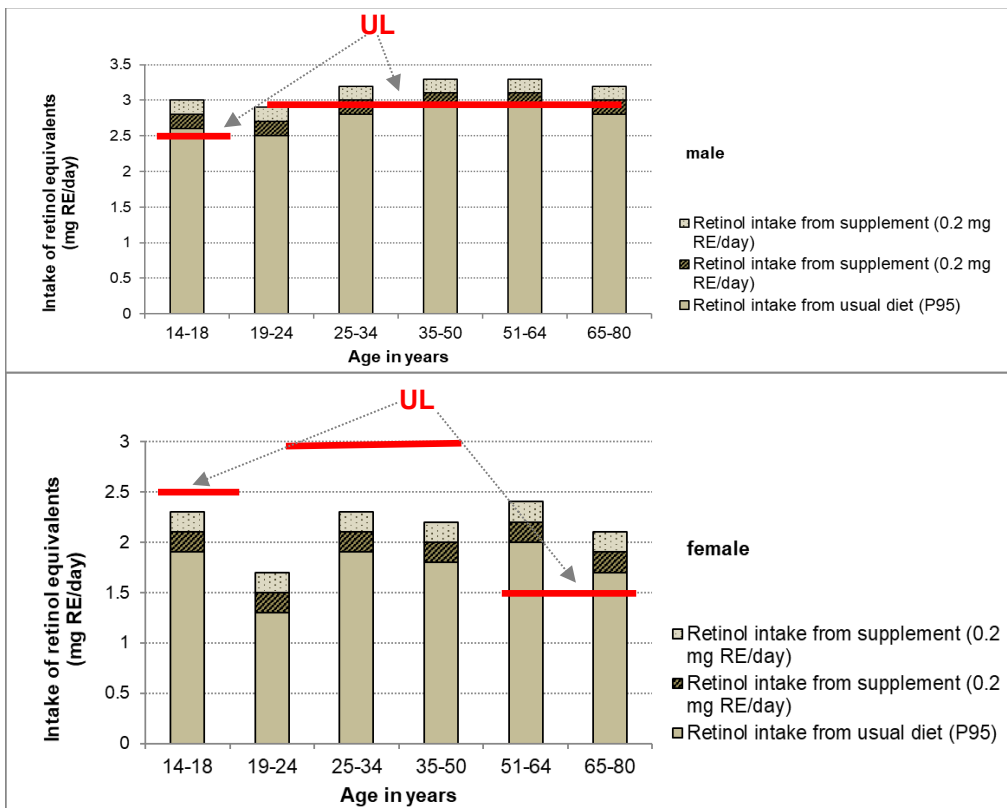


Figure 1: Effects of supplemental intake of one or two food supplements á 0.2 mg RE per day on the 95th percentiles of preformed vitamin A intake in 14- to 80-year-olds based on NFCS II data

**Further information on the BfR website on the subject of vitamin A**

A-Z Index to Vitamin A: [https://www.bfr.bund.de/en/a-z\\_index/vitamin\\_a-130213.html](https://www.bfr.bund.de/en/a-z_index/vitamin_a-130213.html)

Topic page on the assessment of vitamins and minerals in foods:  
[https://www.bfr.bund.de/en/vitamins\\_and\\_minerals-54417.html](https://www.bfr.bund.de/en/vitamins_and_minerals-54417.html)  
[https://www.bfr.bund.de/de/bewertung\\_von\\_vitaminen\\_und\\_mineralstoffen\\_in\\_lebensmitteln-54416.html](https://www.bfr.bund.de/de/bewertung_von_vitaminen_und_mineralstoffen_in_lebensmitteln-54416.html)



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Regulation (EC) No 1925/2006 of the European Parliament and of the Council of 20 December 2006 on the addition of vitamins and minerals and of certain other substances to foods. <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32006R1925&from=DE>; last accessed 04 March 2021.

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## About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent institution within the portfolio of the Federal Ministry of Food and Agriculture (BMEL) in Germany. It advises the German federal government and German federal states ("Laender") on questions of food, chemical and product safety. The BfR conducts its own research on topics that are closely linked to its assessment tasks.

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