

Vanadium citrate, bismaltolato oxo vanadium and bisglycinato oxo vanadium added for nutritional purposes to foods for particular nutritional uses and foods (including food supplements) intended for the general population and vanadyl sulphate, vanadium pentoxide and ammonium monovanadate added for nutritional purposes to food supplements¹

Scientific Opinion of the Panel on Food Additives, Flavourings, Processing Aids and Materials in Contact with Food

(Question No EFSA-Q-2005-162, EFSA-Q-2006-281, EFSA-Q-2006-225, EFSA-Q-2006-256, EFSA-Q-2006-275, EFSA-Q-2006-258, EFSA-Q-2006-257)

Adopted on 29 January 2008

PANEL MEMBERS*

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SUMMARY

Following a request from the Commission, the Panel on Food Additives, Flavourings, Processing Aids and Materials in Contact with Food was asked to deliver a scientific opinion on vanadium citrate, bismaltolato oxo vanadium and bisglycinato oxo vanadium added for nutritional purposes to foods for particular nutritional uses and foods (including food supplements) intended for the general population and on vanadyl sulphate, vanadium pentoxide and ammonium monovanadate added for nutritional purposes to food supplements.

¹ For citation purposes: Scientific Opinion of the Panel on Food Additives, Flavourings, Processing Aids and Materials in Contact with Food on a Request from the Commission on Vanadium Compounds as Sources for Vanadium. *The EFSA Journal* (2008) 634, 1-15.

* Sue Barlow declared an interest in this item as she had advised a vanadium producing company on classification and labelling in the non-food area and therefore the Vice Chair, John C. Larsen, chaired this part of the meeting. She did not participate in the discussion.

Riccardo Crebelli declared an interest in this item as he has advised the Italian Authorities on vanadium in drinking water. This was not considered as a conflict of interest and he was invited to participate in the discussion.

Details on the declarations of interest can be found in the minutes of the Panel meeting at:

<http://www.efsa.europa.eu/EFSA/ScientificPanels/AFC>

The present opinion deals with the safety of a number of vanadium compounds as sources of vanadium and with the bioavailability of vanadium from these sources added for nutritional purposes to foods for particular nutritional uses and foods (including food supplements) intended for the general population. The safety evaluation of vanadium itself is outside the remit of this Panel.

The absorption of vanadium from vanadium pentoxide is low and comparable to absorption of vanadium from the normal diet. The data on intestinal absorption of vanadium from vanadyl sulphate and sodium monovanadate in rats and from vanadyl sulphate in humans show that after oral administration vanadium from these sources is more bioavailable. The same is also reported from an unpublished study of bisglycinato oxo vanadium in humans. The available data indicate that the bioavailability of vanadium from most of these vanadium sources is higher than has been estimated for the absorption of vanadium from the normal diet in humans.

The anions sulphate and citrate as well as the ammonium cation have been considered by the Scientific Committee on Food (SCF) and the Joint FAO/WHO Expert Committee on Food Additives (JECFA) as safe constituents of a large number of authorised food additives. On the basis of these evaluations, the Panel concluded that they are of no safety concern as constituents of vanadyl salts or vanadates. Considering the existing safety evaluation of maltol and the safe use of maltol and glycine in food, the Panel concluded that the ligands maltol and glycine in the vanadate complexes bismaltolato and bisglycinato oxo vanadium are also of no safety concern at the levels considered in this opinion, if they are released from the complex compounds both in the gastrointestinal tract and in the metabolism after absorption.

However the Panel also noted the conclusions and risk characterisation in the opinion of the Scientific Panel on Dietetic Products, Nutrition and Allergies (NDA Panel) on vanadium, based on the toxicity of the vanadium sources vanadyl sulphate, vanadium pentoxide, ammonium monovanadate and some other vanadium compounds. The NDA Panel concluded that a no-observed-adverse-effect level (NOAEL) cannot be derived from the available studies, neither from subacute/subchronic studies, in which adverse effects were observed on kidneys, spleen, lungs and blood pressure, nor from studies, in which developmental toxicity was seen in the offspring of rats. Therefore, a tolerable upper intake level for vanadium could not be derived. The AFC Panel considers that these conclusions are relevant, not only for vanadium itself, but also for the vanadium sources under consideration in the present opinion.

Although data on use levels and categories of the foods intended for particular nutritional uses have not been provided by the applicant, based on the available information on bioavailability and the conclusions of the NDA Panel, the AFC Panel concludes that safe use of these sources for vanadium added to foods intended for the general population (including food supplements) and foods for particular nutritional uses, cannot be established.

The Panel noted the inconsistency and the lack of information on specific elements in the specifications of heavy metals in the different dossiers as well as the high levels of arsenic and lead in the specifications of some vanadium sources in comparison to other sources.

Key words:

Vanadyl sulphate, vanadium pentoxide, vanadium citrate, ammonium monovanadate, bismaltolato oxo vanadium, bisglycinato oxo vanadium, CAS Registry Numbers 27774-13-6, 1314-62-1, 16522-07-09, 7803-55-6, 38213-69-3, 15283-90-6.

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BACKGROUND AS PROVIDED BY THE COMMISSION

The European Community legislation lists nutritional substances that may be used for nutritional purposes in certain categories of foods as sources of certain nutrients.

The Commission has received a request for the evaluation of vanadyl sulphate, vanadium pentoxide, vanadium citrate, ammonium vanadate, bismaltolato oxo vanadium and bisglycinato oxo vanadium added for nutritional purposes to foodstuffs. The relevant Community legislative measures are:

Commission Directive 2001/15/EC of 15 February 2001 on substances that may be added for specific nutritional purposes in foods for particular nutritional uses².

Directive 2002/46/EC of the European Parliament and of the Council on the approximation of the laws of the Member States relating to food supplements³.

Regulation EC 1925/2006 on the addition of vitamins and minerals and of certain other substances to foods⁴.

TERMS OF REFERENCE AS PROVIDED BY THE COMMISSION

In accordance with Article 29 (1) (a) of Regulation (EC) No 178/2002, the European Commission asks the European Food Safety Authority to provide a scientific opinion, based on its consideration of the safety and bioavailability of vanadium citrate, bismaltolato oxo vanadium and bisglycinato oxo vanadium added for nutritional purposes to foods for particular nutritional uses and foods (including food supplements) intended for the general population and of vanadyl sulphate, vanadium pentoxide and ammonium vanadate added for nutritional purposes to food supplements.

ACKNOWLEDGEMENTS

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² OJ No L 52, 22.2.2001, p.19.

³ OJ No L 183, 12.7.2002, p. 51.

⁴ OJ No L 404, 30.12.2006, p. 26.

ASSESSMENT

1. Introduction

The present opinion deals with the safety and bioavailability of vanadium citrate, bismaltolato oxo vanadium and bisglycinato oxo vanadium added for nutritional purposes to foods for particular nutritional uses and foods (including food supplements) intended for the general population and of vanadyl sulphate, vanadium pentoxide and ammonium vanadate added for nutritional purposes to food supplements. The safety evaluation of vanadium itself is outside the remit of this Panel.

2. Technical data

2.1. Chemistry

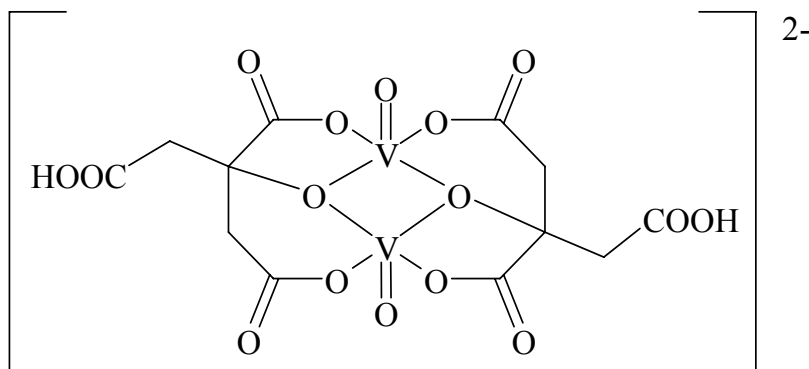
The sources of vanadium under evaluation contain vanadium in the oxidation state +4 (vanadyl (IV) sulphate, vanadium (IV) citrate, bismaltolato and bisglycinato oxo vanadium (IV)) and +5 (vanadium (V) pentoxide and ammonium monovanadate (V)).

Vanadyl sulphate (synonymous with vanadium (IV) oxide sulphate) with the chemical formula VOSO_4 and the molecular weight of 163.02 Dalton has the CAS Registry Number 27774-13-6. According to the applicant, the water soluble vanadyl salt is a hydrate.

Vanadium pentoxide with the chemical formula V_2O_5 and the molecular weight of 181.9 Dalton has a CAS Registry Number of 1314-62-1. It is only slightly soluble in water, but soluble in acids and alkalis.

According to the chemical data given by the applicant, the so-called vanadium citrate is in fact sodium vanadyl citrate. According to the applicant, this substance has the nominal chemical formula $\text{NaVOC}_6\text{H}_5\text{O}_7$ and the molecular weight of 279.942 Dalton. It is a water soluble salt of vanadium and has the CAS Registry Number 16522-07-09.

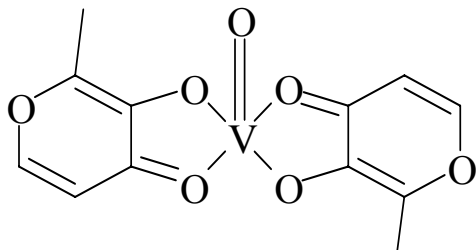
Figure 1. **The solid state chemical structure of the vanadyl citrate anion displays a dimeric structure (Tsaramyrsi *et al.*, 2001).**



Ammonium monovanadate (synonymous with ammonium metavanadate) with the chemical formula NH_4VO_3 and the molecular weight 116.98 Dalton is a water soluble salt of vanadium. Its CAS Registry Number is 7803-55-6.

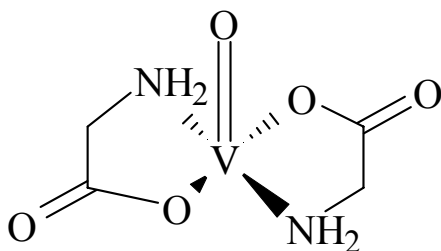
Bismaltolato oxo vanadium with the chemical formula $C_{12}H_{10}VO_7$ and the molecular weight 316.94 Dalton is a vanadyl complex salt. It is described as insoluble in water but to some extent soluble in acids and has the CAS Registry Number 38213-69-3.

The structural formula is as follows:



Bisglycinato oxo vanadium with the chemical formula $C_4H_8N_2O_5V$ and the molecular weight 228.10 Dalton is a vanadyl complex salt. It is soluble in water and sparingly soluble in dilute acids. Its CAS Registry Number is 15283-90-6.

The structural formula is as follows:



2.2. Specifications

According to the applicants, three of the vanadium compounds are not less than 97% (vanadyl sulphate), more than 99.56% (vanadium pentoxide) and not less than 99% (ammonium monovanadate) pure. In the case of vanadium citrate, the purity is described as not less than 16% vanadium on anhydrous basis and not more than 5 % loss on drying. Bismaltolato oxo vanadium is described as not less than 75.0% maltol and 15.0% vanadium, both on anhydrous basis, and not more than 1.0% moisture, and bisglycinato oxo vanadium as not less than 20.0% vanadium on anhydrous basis and not more than 10.0% moisture.

The following impurities have been indicated:

vanadyl sulphate:	not more than 3 mg arsenic (As)/kg, 5 mg lead (Pb)/kg, 1 mg mercury (Hg)/kg,
vanadium pentoxide:	not more than 10 mg As/kg, 3 mg Pb/kg, 5 mg cadmium (Cd)/kg,
vanadium citrate:	not more than 1 mg As/kg, 10 mg Pb/kg,
ammonium monovanadate:	not more than 30 mg heavy metals/kg, 20 mg Pb/kg, 30 mg iron (Fe)/kg,
bismaltolato oxo vanadium:	not more than 20 mg heavy metals/kg, 1 mg As/kg, 10 mg Pb/kg,

bisglycinato oxo vanadium: not more than 20 mg heavy metals/kg, 1 mg As/kg,
10 mg Pb/kg.

2.3. Manufacturing process

For vanadyl sulphate, vanadium pentoxide and ammonium monovanadate limited details of the manufacturing process were provided. In the case of the other vanadium compounds, the manufacturing process was more extensively described.

2.4. Methods of analysis in food

Apart from ammonium monovanadate, methods of analysis in food are not given or in case of vanadyl sulphate insufficiently described.

2.5. Reaction and fate in foods to which the source is added

For vanadium pentoxide no information on reaction and fate in foods is given. The other vanadium compounds are indicated as stable in foods.

2.6. Case of need and intended use

Vanadyl sulphate, vanadium pentoxide, ammonium monovanadate, vanadium citrate, bisglycinato oxo vanadium and bismaltolato oxo vanadium are intended to be used in food supplements. In addition vanadium citrate, bisglycinato oxo vanadium and bismaltolato oxo vanadium are proposed to be added for nutritional purposes in foods intended for particular nutritional uses. For the latter use, data on use levels and categories of the foods intended for particular nutritional uses have not been provided by the applicant.

2.7. Exposure

According to the applicant for vanadyl sulphate, typical diets supply less than 30 µg vanadium daily. The average intake is approximately 15 µg/day. Total diet studies resulted in an average intake of 13 µg/day from food in the UK (Evans *et al.*, 1985). In the USA, an estimated dietary intake in the range of 6 to 18 µg/day for different age-sex-groups of adults and 6.5 to 11 µg/day for infants, children, and adolescents has been estimated (Pennington and Jones, 1987).

According to the applicant of vanadyl sulphate, quantities to be added to supplements provide 50 µg vanadium/day. In the case of ammonium monovanadate, the average content of tablets is indicated to be 23 µg, equivalent to 10 µg vanadium/tablet.

Data provided by the manufacturers of vitamin and mineral supplements, sold in the UK and representative of at least 70% of the UK market, indicated that the highest level of vanadium in multiple-nutrient products is 25 µg/tablet or capsule (EVM, 2003).

The Panel made a conservative estimate of the exposure to vanadium from the content of 25 µg vanadium/tablet reported as the highest level in food supplements in the UK. Data from the UK Food Standards Agency survey on the consumption of food supplements indicate that 24% of adults (Henderson *et al.*, 2002) and 14% of young people (Gregory, 2000) consumed food supplements (Gregory *et al.*, 1995). The use among high consumers (97.5th percentile) ranged from 2 units per day (data do not discriminate between tablets or capsules) in young people to 7 units per day in adults. Based on these findings, the exposure to vanadium for high consumers of supplements could vary between 50 µg vanadium per day for young people and 175 µg vanadium per day for adults (corresponding to 1.3 µg/kg bw/day for people aged 4-18

(assumed mean body weight of 40 kg) and about 3 µg/kg bw/day for adults (assumed mean body weight of 60 kg). The Panel noted that this is about 10 to 30 times the average daily intake from the diet in adults (6-18 µg/day, see above).

2.8. Existing authorisations and evaluations

In the EU, sulphates of sodium (E 514), potassium (E 515) and calcium (E 516) as well as citrates of sodium (E 331), potassium (E 332) and calcium (E 333) are authorised food additives. Therefore, the sulphate and citrate ion formed by the dissociation of vanadyl sulphate and vanadium citrate have been evaluated in connection with the evaluation of the authorised sulphates and citrates by SCF and JECFA.

An Acceptable Daily Intake (ADI) not specified was established for the sulphate ion in combination with some cations (JECFA, 1986) and a group ADI not specified for sulphuric acid and its sodium, potassium, calcium, magnesium and ammonium salts (SCF, 1991). JECFA also established a group ADI „not limited,, for citric acid and its sodium, potassium, calcium and ammonium salts (JECFA, 1974) and the SCF established a group ADI not specified for citric acid and its sodium, potassium, calcium and ammonium salts (SCF, 1991).

The ammonium ion formed by the dissociation of ammonium monovanadate is also a constituent of many other ammonium salts permitted as food additives and has been included in the group ADIs of a number of acids and their salts (JECFA, 1974; SCF, 1991).

The use of maltol which can be formed from bismaltolato oxo vanadium is also permitted in food. JECFA established an ADI of 0 - 1 mg/kg bw (JECFA, 1981). Glycine, a constituent of bisglycinato oxo vanadium, is a permitted food additive (E 646) in the EU. The use limit for glycine is 300 mg/kg food.

Vanadium has been evaluated by a number of national and international committees. The US Food and Nutrition Board (FNB) derived a tolerable upper intake level for dietary intake of 1.8 mg vanadium/day for adults. However, given the severity of the critical effects of vanadium in adults and the lack of data in other more sensitive life stage groups, the Board did not establish such a tolerable upper intake level for pregnant and lactating women, children, infants and adolescents (up to 18 years) and indicated that these individuals should be particularly cautious about consuming vanadium supplements (FNB, 2001).

The UK Expert Group on Vitamins and Minerals (EVM) concluded that there are insufficient data from human or animal studies to establish a safe upper intake level and that data from animal studies suggest that vanadium has adverse effects on both male and female reproduction and on the development of the subsequent offspring. The available studies are characterized as inadequate to support the safe use of vanadium in supplements (EVM, 2003).

Similarly, EFSA NDA Panel came to the conclusion that a NOAEL could not be derived from the available studies, neither from subacute/subchronic studies, in which adverse effects were observed on kidneys, spleen, lungs and blood pressure, nor from studies, in which developmental toxicity was seen in the offspring of rats. Therefore, a tolerable upper intake level could not be derived (EFSA, 2004).

3. Biological data

3.1. Bioavailability

Some applicants refer only to the poor intestinal absorption of vanadium from the diet. Absorption in humans has been estimated to be less than 5 % vanadium ingested from the diet based on the low concentration of vanadium normally present in urine compared with the daily intake and the faecal levels (EVM, 2003; EFSA, 2004).

In addition to this estimation, some other information is available. Wiegmann *et al.* (1982) reported a cumulative 4 days excretion of 69 % vanadium in faeces and 17.5 % vanadium in urine of female Sprague-Dawley rats after gavage administration of 5 μmol ^{48}V -labelled sodium orthovanadate. From vanadium ingested by rats as sodium metavanadate at 5 or 25 mg/kg in the diet, 59 % was excreted in the faeces and the rats retained 40 % (Bogden *et al.*, 1982). Both studies indicate a higher bioavailability of vanadium from these vanadium sources than has been estimated for the absorption of vanadium from the normal diet in humans (EVM, 2003; EFSA, 2004).

According to a study on the pharmacokinetics of vanadium, the bioavailability of vanadium from vanadium sulphate after oral gavage administration of 7.5 and 15 mg vanadium/kg bw to male Wistar rats was estimated to be 16.8 and 12.5 %, as determined from area under the curve (AUC) data compared with intravenous administration (Azay *et al.*, 2001).

However, there is also a study reporting that the uptake of vanadium from radiolabelled vanadium pentoxide given orally to rats was only 2.6 % of the administered dose of about 0.3 mg vanadium/kg bw indicating that the chemical form of vanadium influences the intestinal absorption (Conklin *et al.*, 1982).

In the case of bisglycinato oxo vanadium, the applicant refers to an unpublished phase I clinical trial in humans, in which the relative bioavailability of vanadium from this source after oral administration was three times that from vanadyl sulphate. Details of the trial were not given.

3.1.1. Metabolism and kinetics

Data on the dissociation of the vanadium sources in the gastrointestinal tract has not been provided by the applicants. Vanadyl sulphate and vanadium citrate can be expected, however, to dissociate forming vanadyl cations and sulphate or citrate anions. In the case of ammonium monovanadate, ammonium cations and vanadate anions will be formed. No information is available on the formation of vanadyl cations from the bismaltolato and bisglycinato oxo vanadium complexes.

Data on the metabolism of dissociation products of the vanadium sources also has not been provided by the applicants. However, the metabolism of the potential dissociation products sulphate, citrate, ammonium and glycine along normal physiological pathways is well known.

Details of the metabolism and kinetics of vanadium in different forms have been reviewed by EFSA (2004), the UK Expert Group on Vitamins and Minerals (EVM, 2003) and Gorzsas (2005).

3.1.2. Toxicity data

Toxicity data on sulphate, citrate, maltol and glycine as anions or complex ligands of vanadium sources have not been provided by the applicants. Information is, however, available from other sources. The sulphate ion was evaluated by JECFA and SCF on the basis that it is a

natural constituent of food and a product of sulphur metabolism (JECFA, 1986, 2000, 2002, SCF 1991). The toxicity of citric acid/citrate was reviewed by JECFA (1974), the US Food and Drug Administration (FASEB, 1977) and more recently by the Organisation for Economic Cooperation and Development (OECD, 2001). The toxicological data on maltol has been reviewed by JECFA (1981) and BIBRA (1990).

Toxicological studies with the sources of vanadium under evaluation, i.e. vanadyl sulphate, vanadium pentoxide and ammonium monovanadate, but also with sodium mono- and orthovanadate, have been performed. They have been reviewed and evaluated in the context of vanadium toxicity by World Health Organisation (WHO, 2001), Food and Nutrition Board of the Institute of Medicine (FNB, 2001), Expert Group on Vitamins and Minerals (EVM, 2003) and EFSA (2004). More recent data on the oral toxicity of vanadium sources has not been provided by the applicants.

According to the EFSA opinion of the NDA Panel on vanadium (EFSA, 2004) and according to other reviews (WHO (2001), FNB (2001), EVM (2003)), vanadium compounds such as vanadyl sulphate, vanadium pentoxide and ammonium monovanadate affect kidneys and other organs of rats at relatively low doses and have adverse effects at higher doses on the reproduction and the development of the offspring of rats and mice. NOAELs for these effects could not be derived and there is no evidence that they cannot occur in humans. In addition, vanadium pentoxide has been evaluated by the International Agency for Research on Cancer (IARC, 2006) as possibly carcinogenic to humans on the basis of evidence from inhalation studies in rats and mice. The relevance of these results of inhalation studies for oral ingestion is unclear, however. Furthermore, vanadium compounds have been reported to be genotoxic in several *in vitro* systems and in some *in vivo* studies (EFSA, 2004). Recent studies with the Comet assay and the analysis of micronuclei in blood reticulocytes and bone marrow polychromatic erythrocytes indicate that in mice repeated oral exposure to vanadyl sulphate may be devoid of significant genotoxic effects both at somatic and germ cell levels, while administration of high doses of orthovanadate resulted in significant genotoxicity in bone marrow and splenocytes (Leopardi *et al.*, 2005; Villani *et al.*, 2007).

4. Discussion

The absorption of vanadium from vanadium pentoxide is low and comparable to absorption of vanadium from the normal diet. The data on intestinal absorption of vanadium from vanadyl sulphate and ortho- and metavanadate in rats and from vanadyl sulphate in humans show that after oral administration vanadium from these sources is more bioavailable. The same is also reported from an unpublished study of bisglycinato oxo vanadium in humans. The available data indicate that the bioavailability of vanadium from most of these vanadium sources is higher than has been estimated for the absorption of vanadium from the normal diet in humans (EVM, 2003; EFSA, 2004). The bioavailability varies between the sources being up to an order of magnitude greater than that estimated for the diet.

Because no data was submitted, the Panel was not able to evaluate the exposure to vanadium compounds added for nutritional purposes to foods others than supplements, intended for the general population.

For the population consuming food supplements, a conservative estimate of the exposure to vanadium was made by the Panel, using the 97.5th percentile of current food supplement use in the UK and assuming 25 µg vanadium/tablet or capsule which corresponds to the highest levels of vanadium forms reported by manufacturers of vitamins and minerals supplements in the UK market. The exposure in high consumers of supplements would vary between 50 µg vanadium

per day for young people and 175 µg vanadium per day for adults, which is about 10 to 30 times higher than the average daily intake from the diet in adults.

The anions sulphate and citrate as well as the ammonium cation have been considered by SCF (1991) and JECFA (1986) as safe constituents of a large number of authorised food additives. On the basis of these evaluations, the Panel concluded that they are of no safety concern as constituents of vanadyl salts or vanadates. Considering the existing safety evaluation of maltol (JECFA, 1981) and the presence and safe use of maltol and glycine in food, the Panel concluded that the ligands maltol and glycine in the vanadate complexes bismaltolato and bisglycinato oxo vanadium are also of no safety concern at the levels considered in this opinion, if they are released from the complex compounds both in the gastrointestinal tract and in the metabolism after absorption.

The opinion of the NDA Panel on vanadium (EFSA, 2004) concludes however that vanadium compounds such as vanadyl sulphate, vanadium pentoxide and ammonium monovanadate are toxic in rats at relatively low doses. Data from animal studies suggest that vanadium has adverse effects on both male and female reproduction and on the development of the subsequent offspring. NOAELs for these effects could not be derived and there is no evidence that these effects cannot occur in humans. The toxicological data provided by the applicants and the outcome of an updated literature search performed by the AFC Panel do not call into question the conclusions of the opinion of the NDA Panel on vanadium (EFSA, 2004).

CONCLUSIONS

The available data indicate that with the exception of vanadium pentoxide the bioavailability of vanadium from most of these vanadium sources is higher than has been estimated for the absorption of vanadium from the normal diet in humans (EVM, 2003; EFSA, 2004).

The Panel considered that the anions sulphate and citrate as well as the ammonium cation and the ligands maltol and glycine in the vanadate complexes bismaltolato and bisglycinato oxo vanadium are of no safety concern at the levels considered in this opinion.

However the Panel also noted the conclusions and risk characterisation in the opinion of the NDA Panel on vanadium (EFSA, 2004), based on the toxicity of the vanadium sources vanadyl sulphate, vanadium pentoxide, ammonium monovanadate and some other vanadium compounds. The NDA Panel concluded that a NOAEL could not be derived from the available studies, neither from subacute/subchronic studies, in which adverse effects were observed on kidneys, spleen, lungs and blood pressure, nor from studies, in which developmental toxicity was seen in the offspring of rats. Therefore, a tolerable upper intake level for vanadium could not be derived. The AFC Panel considers that these conclusions are relevant, not only for vanadium itself, but also for the vanadium sources under consideration in the present opinion

Although data on use levels and categories of the foods intended for particular nutritional uses have not been provided by the applicant, based on the available information on bioavailability of vanadium and the conclusions of the NDA Panel, the AFC Panel concludes that safe use of these sources for vanadium added to foods intended for the general population (including food supplements) and foods for particular nutritional uses, cannot be established.

The Panel noted the inconsistency and the lack of information on specific elements in the specifications for heavy metals in the different dossiers as well as the high levels of arsenic and lead in the specifications of some vanadium sources in comparison to other sources.

DOCUMENTATION PROVIDED TO EFSA

1. Dossier on Vanadyl sulphate added for nutritional purposes to food supplements. June, 2005. Submitted by Health Food Manufacturers Association, UK.
2. Dossier on Vanadium citrate added for nutritional purposes to food supplements. July, 2005. Submitted by Sami Labs Limited, India.
3. Dossier on Vanadium pentoxide added for nutritional purposes to food supplements. Submitted by Kabco Pharmaceutical, INC., USA.
4. Dossier on Ammonium monovanadate added for nutritional purposes to food supplements. April, 2005. Submitted by Béres Pharmaceuticals Co. Ltd., Hungary
5. Dossier on Bismaltolato oxo vanadium added for nutritional purposes to food supplements. July, 2005. Submitted by Sami Labs Limited, India.
6. Dossier on Bisglycinato oxo vanadium added for nutritional purposes to food supplements. July, 2005. Submitted by Sami Labs Limited, India.

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GLOSSARY / ABBREVIATIONS

ADI	Acceptable Daily Intake
AUC	Area under Curve
bw	Body weight
CAS	Chemical Abstract Service
EVM	Expert Group on Vitamins and Minerals
FAO	Food and Agriculture Organisation
FDA	Food and Drug Administration
FNB	Food and Nutrition Board of the Institute of Medicine
IARC	International Agency for Research on Cancer
JEFCA	Joint FAO/WHO Expert Committee on Food Additives
NDA	Scientific Panel on dietetic products, nutrition and allergies
NOAEL	No Observed Adverse Effect Level
OECD	Organisation for Economic Co-operation and Development
SCF	Scientific Committee on Food
WHO	World Health Organisation