REASONED OPINION

APPROVED: 26 September 2017

doi: 10.2903/j.efsa.2017.5019

Review of the existing maximum residue levels for carboxin according to Article 12 of Regulation (EC) No 396/2005

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Abstract

According to Article 12 of Regulation (EC) No 396/2005, EFSA has reviewed the maximum residue levels (MRLs) currently established at European level for the pesticide active substance carboxin. To assess the occurrence of carboxin residues in plants, processed commodities, rotational crops and livestock, EFSA considered the conclusions derived in the framework of Directive 91/414/EEC as well as the European authorisations reported by Member States (including the supporting residues data). Based on the assessment of the available data, MRL proposals were derived and a consumer risk assessment was carried out. Some information required by the regulatory framework was missing and a risk to consumers cannot be excluded for the existing EU MRLs. Hence, the consumer risk assessment is considered indicative only and all MRL proposals derived by EFSA still require further consideration by risk managers and measures for reduction of the consumer exposure should also be considered.

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Keywords: carboxin, MRL review, Regulation (EC) No 396/2005, consumer risk assessment, anilide, fungicide, aniline

Requestor: European Commission

Question number: EFSA-Q-2009-00036

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Acknowledgement: EFSA wishes to thank the rapporteur Member State the United Kingdom for the preparatory work on this scientific output.

Suggested citation: EFSA (European Food Safety Authority), Brancato A, Brocca D, De Lentdecker C, Erdos Z, Ferreira L, Greco L, Jarrah S, Kardassi D, Leuschner R, Lythgo C, Medina P, Miron I, Molnar T, Nougadere A, Pedersen R, Reich H, Sacchi A, Santos M, Stanek A, Sturma J, Tarazona J, Theobald A, Vagenende B, Verani A and Villamar-Bouza L, 2017. Reasoned opinion on the review of the existing maximum residue levels for carboxin according to Article 12 of Regulation (EC) No 396/2005. EFSA Journal 2017;15(10):5019, 35 pp. https://doi.org/10.2903/j.efsa.2017.5019

ISSN: 1831-4732

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Summary

Carboxin was included in Annex I to Directive 91/414/EEC on 1 June 2011 by Commission Directive 2011/52/EC, and has been deemed to be approved under Regulation (EC) No 1107/2009, in accordance with Commission Implementing Regulation (EU) No 540/2011, as amended by Commission Implementing Regulation (EU) No 541/2011. As the active substance was approved after the entry into force of Regulation (EC) No 396/2005 on 2 September 2008, EFSA is required to provide a reasoned opinion on the review of the existing maximum residue levels (MRLs) for that active substance in compliance with Article 12(1) of the aforementioned regulation. To collect the relevant pesticide residues data, the European Food Safety Authority (EFSA) asked the United Kingdom, the designated rapporteur Member State (RMS), to complete the Pesticide Residues Overview File (PROFile) and to prepare a supporting evaluation report. The PROFile and evaluation report provided by the RMS were made available to the Member States. A request for additional information was addressed to the Member States in the framework of a completeness check period, which was initiated by EFSA on 31 October 2016 and finalised on 3 January 2017. After having considered all the information provided, EFSA prepared a completeness check report which was made available to Member States on 9 February 2017.

Based on the conclusions derived by EFSA in the framework of Directive 91/414/EEC and the additional information provided by the RMS and Member States, EFSA prepared in May 2017 a draft reasoned opinion, which was circulated to Member States for consultation via a written procedure. Comments received by 9 June 2017 were considered during the finalisation of this reasoned opinion. The following conclusions are derived.

The primary crop metabolism of carboxin was investigated in only one crop category (cereals). For cereals, the following residue definition for monitoring and risk assessment is proposed: carboxin plus its metabolites carboxin sulfoxide and oxycarboxin (carboxin sulfone), expressed as carboxin. In the absence of primary crop metabolism studies performed on other crop groups, it is proposed, on a tentative basis, to also apply this residue definition to pulses and oilseeds and root vegetables (the other crops under review). Based on the results of the metabolism studies in rotational crops, the same residue definition is applicable for rotational crops (leafy vegetables and root crops) and for cereals on a tentative basis. It was not possible to derive a residue definition for processed commodities.

An analytical method for the enforcement of the proposed residue definition at the combined limit of quantification (LOQ) of 0.03 mg/kg is available for high water, high acid and dry commodities. For high oil content commodities, a fully validated analytical method is missing and it is still required for the analysis of carboxin sulfoxide.

No hydrolysis studies are available. Moreover, according to the chemical structure of carboxin, the release of aniline may occur following processing. Given the toxicological concerns related to aniline, the formation and bioavailability of aniline in processed commodities must be investigated.

With the exception of rye, the available residue data is not considered sufficient to derive MRLs proposal as well as risk assessment values for all other commodities considered in this review.

According to the results of the confined rotational crops studies, carboxin sulfone and carboxin sulfoxide are expected to occur in significant levels in feed items such as wheat hay and straw, and therefore, field rotational studies are necessary to elucidate this issue.

Studies investigating the magnitude of residues in processed commodities are not available. Therefore, it was not possible to assess the levels of aniline and/or metabolites in processed commodities.

Carboxin is authorised for use on cereals, pulses and oilseeds that might be fed to livestock. Therefore, further consideration of the residues in livestock is required. The maximum dietary burden was calculated accounting for the notified use on rye. For other feed items, it was not possible to derive proper input values for exposure assessment which could underestimate the residue levels in livestock.

Due to the high level of uncertainties linked to the identified data gaps, it was not possible to conduct a risk assessment neither for the good agricultural practices (GAPs) reported in this MRL review nor for the existing EU MRLs. Therefore, EFSA assessed a scenario where all authorised uses would be withdrawn. Chronic consumer exposure, using the combined LOQ of 0.03 mg/kg for an indicative calculation, in the framework of this review was calculated using revision 2 of the EFSA Pesticide Residues Intake Model (PRIMo). The highest chronic exposure represented 76% of the acceptable daily intake (ADI) (Dutch child). Acute exposure calculations for the parent compound were not carried out because an acute reference dose (ARfD) was not deemed necessary for this active substance. Due to the lack of data, the potential exposure to aniline was not assessed; however the risk of exposure to aniline cannot be excluded.

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Background

Regulation (EC) No 396/2005[1] (hereinafter referred to as 'the Regulation') establishes the rules governing the setting and the review of pesticide maximum residue levels (MRLs) at European level. Article 12(1) of that Regulation stipulates that the European Food Safety Authority (EFSA) shall provide within 12 months from the date of the inclusion or non-inclusion of an active substance in Annex I to Directive 91/414/EEC[2] a reasoned opinion on the review of the existing MRLs for that active substance. In 2008, a decision on the non-inclusion of the active substance was taken by Commission Decision 2008/934/EC.[3] The applicant submitted a new application requesting the accelerated procedure regarding the inclusion of the active substance in Annex I of Directive 91/414/EEC. Based on the EFSA conclusion which was issued on 11 October 2010 (EFSA, 2010a,b), the decision to approve the active substance carboxin in accordance with the provision of Regulation (EC) 1107/2009, repealing the provisions of Directive 91/414/EEC, was taken. As carboxin was included in Annex I to Council Directive 91/414/EEC on 1 June 2011 by means of Commission Implementing Directive 2011/52/EC[4], and has been deemed to be approved under Regulation (EC) No 1107/2009[5], in accordance with Commission Implementing Regulation (EU) No 540/2011[6], as amended by Commission Implementing Regulation (EU) No 541/2011[7], EFSA initiated the review of all existing MRLs for that active substance.

According to the legal provisions, EFSA shall base its reasoned opinion in particular on the relevant assessment report prepared under Directive 91/414/EEC. It should be noted, however, that, in the framework of Directive 91/414/EEC, only a few representative uses are evaluated, whereas MRLs set out in Regulation (EC) No 396/2005 should accommodate all uses authorised within the European Union (EU), and uses authorised in third countries that have a significant impact on international trade. The information included in the assessment report prepared under Directive 91/414/EEC is therefore insufficient for the assessment of all existing MRLs for a given active substance.

To gain an overview of the pesticide residues data that have been considered for the setting of the existing MRLs, EFSA developed the Pesticide Residues Overview File (PROFile). The PROFile is an inventory of all pesticide residues data relevant to the risk assessment and MRL setting for a given active substance. This includes data on:

- the nature and magnitude of residues in primary crops;
- the nature and magnitude of residues in processed commodities;
- the nature and magnitude of residues in rotational crops;
- the nature and magnitude of residues in livestock commodities;
- the analytical methods for enforcement of the proposed MRLs.

United Kingdom, the designated rapporteur Member State (RMS) in the framework of Directive 91/414/EEC, was asked to complete the PROFile for carboxin and to prepare a supporting evaluation report (United Kingdom, 2011). The PROFile and the supporting evaluation report were submitted to EFSA on 29 June 2011 and made available to the Member States. A request for additional information was addressed to the Member States in the framework of a completeness check period which was initiated by EFSA on 31 October 2016 and finalised on 3 January 2017. Additional evaluation reports were submitted by the Czech Republic, France, Hungary, Italy, Spain and the European Union Reference Laboratories for Pesticide Residues (EURLs) (EURLs, 2016; Spain, 2016; Czech Republic, 2017; France, 2017; Hungary, 2017; Italy, 2017) and, after having considered all the information

[1] Regulation (EC) No 396/2005 of the European Parliament and of the Council of 23 February 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin and amending Council Directive 91/414/EEC. OJ L 70, 16.3.2005, p. 1–16.

[2] Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market. OJ L 230, 19.8.1991, p. 1–32. Repealed by Regulation (EC) No 1107/2009.

[3] Commission Decision 2008/934/EC of 5 December 2008 concerning the non-inclusion of certain active substances in Annex I to Council Directive 91/414/EEC and the withdrawal of authorisations for plant protection products containing these substances. OJ L 333, 11.12.2008, p. 11–14.

[4] Commission Implementing Directive 2011/52/EC of 20 April 2011 amending Council Directive 91/414/EEC to include carboxin as active substance and amending Commission Decision 2008/934/EC. OJ No L 105, 21.4.2011, p. 19-23.

[5] Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC. OJ L 309, 24.11.2009, p. 1–50.

[6] Commission Implementing Regulation (EU) No 540/2011 of 25 May 2011 implementing Regulation (EC) No 1107/2009 of the European Parliament and of the Council as regards the list of approved active substances. OJ L 153, 11.6.2011, p. 1–186.

[7] Commission Implementing Regulation (EU) No 541/2011 of 1 June 2011 amending Implementing Regulation (EU) No 540/2011 implementing Regulation (EC) No 1107/2009 of the European Parliament and of the Council as regards the list of approved active substances. OJ L 153, 11.6.2011, p. 187–188.

provided by RMS and Member States, EFSA prepared a completeness check report which was made available to all Member States on 9 February 2017. Further clarifications were sought from Member States via a written procedure in February-March 2017.

Based on the conclusions derived by EFSA in the framework of Directive 91/414/EEC and the additional information provided by the Member States, EFSA prepared in May 2017 a draft reasoned opinion, which was submitted to Member States for commenting via a written procedure. All comments received by 9 June 2017 were considered by EFSA during the finalisation of the reasoned opinion.

The evaluation report submitted by the RMS (United Kingdom, 2011) and the evaluation reports submitted by Member States the Czech Republic, France, Hungary, Italy, Spain and the EURLs (EURLs, 2016; Spain, 2016; Czech Republic, 2017; France, 2017; Hungary, 2017; Italy, 2017) are considered as supporting documents to this reasoned opinion and, thus, are made publicly available.

In addition, key supporting documents to this reasoned opinion are the completeness check report (EFSA, 2017a) and the Member States consultation report (EFSA, 2017b). These reports are developed to address all issues raised in the course of the review, from the initial completeness check to the reasoned opinion. Also, the chronic exposure calculations for all crops reported in the framework of this review performed using the EFSA Pesticide Residues Intake Model (PRIMo) and the PROFile are key supporting documents and made publicly available as background documents to this reasoned opinion. Furthermore, a screenshot of the Report sheet of the PRIMo is presented in Appendix C.

Terms of Reference

According to Article 12 of Regulation (EC) No 396/2005, EFSA shall provide a reasoned opinion on:

- the inclusion of the active substance in Annex IV to the Regulation, when appropriate;
- the necessity of setting new MRLs for the active substance or deleting/modifying existing MRLs set out in Annex II or III of the Regulation;
- the inclusion of the recommended MRLs in Annex II or III to the Regulation;
- the setting of specific processing factors as referred to in Article 20(2) of the Regulation.

The active substance and its use pattern

Carboxin is the ISO common name for 5,6-dihydro-2-methyl-1,4-oxathiine-3-carboxanilide (IUPAC).

Carboxin belongs to the group of anilide compounds which are used as fungicides. An anilide obtained by formal condensation of the amino group of aniline with the carboxy group of 2-methyl-5,6-dihydro-1,4-oxathiine-3-carboxylic acid.

The chemical structure of the active substance and its main metabolites are reported in Appendix F.

Carboxin was evaluated in the framework of Directive 91/414/EEC with the United Kingdom designated as RMS. The representative uses supported for the peer review process comprised seed treatment to control soil and seed borne diseases in cereals (wheat, barley, oats, rye and triticale). Following the peer review, which was carried out by EFSA, a decision on inclusion of the active substance in Annex I to Directive 91/414/EEC was published by means of Commission Implementing Directive 2011/52/EC, which entered into force on 1 June 2011. According to Regulation (EU) No 540/2011, carboxin is deemed to have been approved under Regulation (EC) No 1107/2009. This approval is restricted to uses as fungicide only.

The EU MRLs for carboxin are established in Annex IIIA of Regulation (EC) No 396/2005 and CXLs for active substance are not available. There are no MRL changes occurred since the entry into force of the Regulation mentioned above.

For the purpose of this MRL review, the critical uses of carboxin currently authorised within the EU, have been collected by the RMS and reported in the PROFile. The additional Good Agricultural Practices (GAPs) reported by Member States during the completeness check were also considered. The details of the authorised GAP(s) for carboxin are given in Appendix A. The RMS did not report any use authorised in third countries that might have a significant impact on international trade.

Assessment

EFSA has based its assessment on the PROFile submitted by the RMS, the evaluation report accompanying the PROFile (United Kingdom, 2011), the draft assessment report (DAR) and its addenda prepared under Council Directive 91/414/EEC (United Kingdom, 2006, 2009, 2010, 2015), the conclusion on the peer review of the pesticide risk assessment of the active substance carboxin (EFSA,

2010a,b), the technical report on carboxin confirmatory data (EFSA, 2016) as well as the evaluation reports submitted during the completeness check (EURLs, 2016; Spain, 2016; Czech Republic, 2017; France, 2017; Hungary, 2017; Italy, 2017). The assessment is performed in accordance with the legal provisions of the uniform principles for evaluation and authorisation of plant protection products as set out in Commission Regulation (EU) No 546/2011[8] and the currently applicable guidance documents relevant for the consumer risk assessment of pesticide residues (European Commission, 1997a–g, 2000, 2010a,b, 2016 and OECD, 2011, 2013).

More detailed information on the available data and on the conclusions derived by EFSA can be retrieved from the list of end points reported in Appendix B.

1. Residues in plants

1.1. Nature of residues and methods of analysis in plants

1.1.1. Nature of residues in primary crops

The metabolism of carboxin, labelled on the aniline ring, was investigated in a seed treatment conducted with wheat at an application rate of 60 g a.s./100 kg seed (United Kingdom, 2006). The total residues at harvest in grain and straw were 0.04 mg eq/kg and 1.9 mg eq/kg, respectively. Carboxin was extensively degraded and two major components were identified as carboxin sulfoxide and carboxin sulfone (oxycarboxin) (see Appendix F), accounting for 9% of total radioactivity in the grain and 53% of the total radioactivity in straw (no parent carboxin was detected in the grain or straw). The amounts of carboxin sulfoxide and carboxin sulfone were 0.7 mg eq/kg and 0.3 mg eq/kg in straw, respectively, and below 0.01 mg eq/kg in grain. The metabolism study was under dosed when compared to the GAPs on cereals reported for this MRL review, with the exception of GAPs on rye and rice. However, the study was considered sufficient to depict the metabolic pathway in cereals. Metabolism studies on pulses/oilseeds and tubers/roots are not available. Therefore, GAPs belonging to those crop categories are not supported by a primary crop metabolism study. As a consequence, a data gap is identified regarding the nature of residues in primary crops.

1.1.2. Nature of residues in rotational crops

According to the soil degradation studies evaluated in the framework of the peer review the field DT_{90} was greater than 100 days, indicating that carboxin is persistent in the soil (EFSA, 2010a,b). However, no rotational crop studies were available for the peer review and therefore a data gap was identified (EFSA, 2010a,b).

To address this issue, a rotational crop study with carboxin labelled on the oxathiine and phenyl ring conducted at an application rate of 0.125–0.133 kg a.s./ha (equivalent to 60 g carboxin/100 kg seed) or 1.25–1.31 kg a.s./ha and after plant-back intervals of 30, 120 and 365 days after treatment (DAT) was reported as confirmatory data (United Kingdom, 2015). The total radioactive residues (TRR) were above 0.01 mg/kg in all sampling intervals at the application rate of 0.125–0.130 kg a.s./ha with the exception of wheat grain (> 120 DAT), immature lettuce foliage (> 120 DAT, for oxathiine label only) and mature lettuce foliage (> 120 DAT), immature carrot root (> 30 DAT) and mature carrot root (> 120 DAT). The levels of carboxin were below the LOQ in all crops at all sampling intervals. Residues of carboxin sulfone and carboxin sulfoxide were below the LOQ in wheat grain 30 DAT and below 0.01 mg/kg at 120 and 365 DAT. However, in wheat hay and wheat straw, carboxin sulfone and carboxin sulfoxide were observed at levels higher than 0.01 mg/kg in all sampling periods. Metabolites P/V-55 and P/V-54 were also observed at levels above 0.01 mg/kg in wheat hay and wheat straw. As a consequence, in the technical report on carboxin confirmatory data (EFSA, 2016) it was recommended that these compounds (P/V-55 and P/V-54) would be looked for in field rotational studies. In lettuce, carrot foliage (for the phenyl label) and carrot root, carboxin sulfone and carboxin sulfoxide were observed at levels below 0.01 mg/kg in all sampling intervals.

The total radioactive residues (TRR) were above 0.01 mg/kg in all sampling intervals at the highest application rate with the exception of carrot roots (> 120 DAT). The metabolism in rotational crops followed a similar pathway to the metabolism observed in primary crops for cereals.

[8] Commission Regulation (EU) No 546/2011 of 10 June 2011 implementing Regulation (EC) No 1107/2009 of the European Parliament and of the Council as regards uniform principles for evaluation and authorisation of plant protection products. OJ L 155, 11.06.2011, p. 127–175.

1.1.3. Nature of residues in processed commodities

Studies investigating the effect of processing on the nature of residues of carboxin are not available. However, according to the chemical structure of carboxin, the release of aniline during hydrolysis may occur. Therefore, studies investigating the nature of residues in processed commodities are needed. Given the toxicological concerns related to aniline, the formation and bioavailability of aniline in processed commodities must be investigated.

1.1.4. Methods of analysis in plants

In the framework of the peer review, a multiresidue analytical method using high performance liquid chromatography with tandem mass spectrometry (HPLC–MS/MS) was validated for the determination of carboxin in dry commodities, with a LOQ of 0.01 mg/kg for each individual component: carboxin, carboxin sulfone and carboxin sulfoxide (EFSA, 2010a,b). A combined LOQ of 0.03 mg/kg can be achieved for the sum of these individual components. Furthermore, the EURL reported data for Quick, Easy, Cheap, Effective, Rugged, and Safe (QuEChERS) methods also using HPLC–MS/MS for the determination of carboxin in dry commodities, high water commodities, high oil and acidic commodities with an LOQ of 0.01 mg/kg and for carboxin sulfone in dry commodities, high oil and acidic commodities with an LOQ of 0.01 mg/kg and for high water commodities with an LOQ of 0.005 mg/kg (EURL, 2016). In addition, the EURL reported data for QuEChERS methods also using HPLC–MS/MS for the determination of carboxin sulfoxide with an LOQ of 0.01 mg/kg in high water, high acidic and dry commodities (EFSA, 2017b). Therefore, the EURLs confirmed that the QuEChERS/HPLC–MS/MS is validated for carboxin and carboxin sulfone in all matrices and for carboxin-sulfoxide in high water, high acid and dry commodities (2017b). For high oil content commodities, a fully validated analytical method is missing and it is still required for the analysis of carboxin sulfoxide.

1.1.5. Stability of residues in plants

The storage stability of carboxin, carboxin sulfone and carboxin sulfoxide was demonstrated for a period of 18 months at −18°C in high water and dry commodities and for 24 months at −18°C in wheat straw (United Kingdom, 2006). There are no studies on the storage stability in high oil content commodities, and therefore, a data gap is identified.

1.1.6. Proposed residue definitions

The metabolism study performed with wheat supports the residue definition for enforcement and risk assessment for cereals proposed in the framework of the peer review: carboxin plus its metabolites carboxin sulfoxide and oxycarboxin (carboxin sulfone), expressed as carboxin (EFSA, 2010a,b). The rotational crop study showed that the metabolic pathway in leafy vegetables and root crops was similar to the metabolism depicted for cereals (primary crops); however for cereals grown in rotation, additional field studies looking for metabolites P/V-54 and P/V-55 are still needed to conclude on the residue definition for cereals grown in rotation (EFSA, 2016).

In the absence of primary crop metabolism studies performed on other crop groups, it is proposed, on a tentative basis, to also apply this residue definition to pulses and oilseeds and root vegetables (the other crops also under review).

For processed commodities, a residue definition could not be derived.

An analytical method for the enforcement of the proposed residue definition at the combined LOQ of 0.03 mg/kg is available for high water content, high acid content and dry commodities. For high oil content commodities, a fully validated analytical method is missing and it is still required for the analysis of carboxin sulfoxide.

1.2. Magnitude of residues in plants

1.2.1. Magnitude of residues in primary crops

To assess the magnitude of carboxin residues resulting from the reported GAPs, EFSA considered all residue trials reported by the RMS in its evaluation report (United Kingdom, 2011), including residue trials evaluated in the framework of the peer review (EFSA, 2010a,b) and additional data submitted during the completeness check (Spain, 2016; Czech Republic, 2017; France, 2017; Hungary, 2017; Italy, 2017). Storage conditions for the residue trials considered in this framework were not reported.

For cereals, considering that storage stability in high water content and dry content commodities was demonstrated for 18 months decline of residues during storage of the trial samples is not expected. For high oil content crops, considering that storage stability has not been demonstrated, degradation of the residues cannot be excluded. Therefore, storage stability studies on high oil content commodities and information on storage conditions of the samples are still required to confirm the validity of the residue trials reported for linseeds and oilseed rape.

The number of residue trials and extrapolations were evaluated in accordance with the European guidelines on comparability, extrapolation, group tolerances and data requirements for setting MRLs (European Commission, 2016).

The samples from cereals, with the exception of rye grain and straw, were analysed for parent compound only. It was not clear if samples from oilseeds residue trials were analysed for all relevant components (carboxin, carboxin sulfone and carboxin sulfoxide); therefore, EFSA assumed that the residue levels referred to the parent compound only. As a consequence, and apart from rye, data from residue trials could not be used to propose MRLs; therefore, additional residue trials analysing all the components in the residue definition are required for all commodities other than rye.

1.2.2. Magnitude of residues in rotational crops

In its assessment of the confirmatory data, the RMS (United Kingdom) concluded that issue of residues in rotational crops was not fully addressed and therefore rotational crop field trials were required (United Kingdom, 2015). In the technical report on the outcome of the consultation with Member States following evaluation of the confirmatory data, EFSA also considered that the issue of residues in rotational crops was not fully addressed by the available data and that it was necessary to conduct rotational crop field studies since in certain feed items residues of carboxin sulfone and carboxin sulfoxide, metabolites included in the residue definition, were above 0.01 mg/kg (EFSA, 2016). Field studies investigating the magnitude of residues on rotational crops were not available for this review, and therefore, a data gap remains regarding the issue of residues in rotational crops.

1.2.3. Magnitude of residues in processed commodities

Studies investigating the magnitude of residues in processed commodities are not available.

1.2.4. Proposed MRLs

Consequently, the available data is considered sufficient to derive MRLs proposal as well as risk assessment values for rye. However, due to the major data gap identified in the previous sections (residue trials were not analysed for all relevant component in the residue definition), the available data is not considered sufficient to derive MRLs proposal as well as risk assessment values for all other commodities considered in this review.

2. Residues in livestock

Carboxin is authorised for use on cereals, pulses and oilseeds that might be fed to livestock. Therefore, further consideration of the residues in livestock is required. Livestock dietary burdens were therefore calculated for different groups of livestock according to OECD guidance (OECD, 2013), which has now also been agreed upon at European level. The input values for the notified use on rye are summarised in Appendix D. Since calculated dietary burdens for all groups of livestock were found to be below the trigger value of 0.1 mg/kg dry matter (DM), further investigation of residues as well as the setting of MRLs in commodities of animal origin is unnecessary for the notified use on rye. For the other feed items, there were no proper input values for exposure assessment, the animal intake of carboxin residues via these commodities has therefore not been assessed and may have been underestimated.

3. Consumer risk assessment

The available residues dataset is incomplete for all crops apart from the GAP on rye, which is supported by residue data analysed for all components included in the residue definition. In addition, it was not clear if the residues from trials available on oilseeds were analysed for all components included in the residue definition. Moreover, due to the lack of standard hydrolysis studies it was not possible to assess the potential release of aniline following processing. Therefore, due to the high level

of uncertainties linked to the identified data gaps, a risk for consumers due to the potential exposure to aniline cannot be excluded. It was not possible to conduct a risk assessment neither for the GAPs reported in this MRL review nor for the existing EU MRLs.

Therefore, EFSA assessed a scenario where all authorised uses would be withdrawn. It should be noted that in this scenario the potential exposure to aniline was not assessed. Chronic exposure calculations were done using the specific combined LOQ of 0.03 mg/kg for all commodities (assuming that this LOQ would be achievable for enforcement in all matrices but noting that this LOQ is not fully validated for high oil content commodities for the analysis of carboxin sulfoxide and animal commodities). Chronic exposure calculations for all crops reported in the framework of this review were performed using revision 2 of the EFSA PRIMo (EFSA, 2007). All input values included in the exposure calculations are summarised in Appendix D. Acute exposure calculations were not carried out because an acute reference dose (ArfD) was not deemed necessary for this active substance.

The exposures calculated were compared with the toxicological reference value for carboxin, derived by EFSA (2010a,b) under Directive 91/414/EEC. The highest chronic exposure was calculated for Dutch children, representing 76% of the acceptable daily intake (ADI).

Conclusions

The primary crop metabolism of carboxin was investigated in only one crop category (cereals). For cereals the following residue definition for monitoring and risk assessment is proposed: carboxin plus its metabolites carboxin sulfoxide and oxycarboxin (carboxin sulfone), expressed as carboxin. In the absence of primary crop metabolism studies performed on other crop groups, it is proposed, on a tentative basis, to also apply this residue definition to pulses and oilseeds and root vegetables (the other crops under review). Based on the results of the metabolism studies in rotational crops, the same residue definition is applicable for rotational crops (leafy vegetables and root crops) and for cereals on a tentative basis. It was not possible to derive a residue definition for processed commodities.

An analytical method for the enforcement of the proposed residue definition at the combined LOQ of 0.03 mg/kg is available for high water, high acid and dry commodities. For high oil content commodities, a fully validated analytical method is missing and it is still required for the analysis of carboxin sulfoxide.

No hydrolysis studies are available. Moreover, according to the chemical structure of carboxin, the release of aniline may occur following processing. Given the toxicological concerns related to aniline, the formation and bioavailability of aniline in processed commodities must be investigated.

With the exception of rye, the available residue data is not considered sufficient to derive MRLs proposal as well as risk assessment values for all other commodities considered in this review.

According to the results of the confined rotational crops studies, carboxin sulfone and carboxin sulfoxide are expected to occur in significant levels in feed items such as wheat hay and straw and therefore field rotational studies are necessary to elucidate this issue.

Studies investigating the magnitude of residues in processed commodities are not available. Therefore, it was not possible to assess the levels of aniline and/or metabolites in processed commodities.

Carboxin is authorised for use on cereals, pulses and oilseeds that might be fed to livestock. Therefore further consideration of the residues in livestock is required. The maximum dietary burden was calculated accounting for the notified use on rye. For other feed items, it was not possible to derive proper input values for exposure assessment which could underestimate the residue levels in livestock.

Due to the high level of uncertainties linked to the identified data gaps, it was not possible to conduct a risk assessment neither for the GAPs reported in this MRL review nor for the existing EU MRLs. Therefore, EFSA assessed a scenario where all authorised uses would be withdrawn. Chronic consumer exposure, using the combined LOQ of 0.03 mg/kg for an indicative calculation, in the framework of this review was calculated using revision 2 of the EFSA PRIMo. The highest chronic exposure represented 76% of the ADI (Dutch child). Acute exposure calculations for the parent compound were not carried out because an ARfD was not deemed necessary for this active substance. Due to the lack of data, the potential exposure to aniline was not assessed; however the risk of exposure to aniline cannot be excluded.

Recommendations

MRL recommendations were derived in compliance with the decision tree reported in Appendix E of the reasoned opinion (see Table 1). No MRL values could be recommended for inclusion in Annex II and further consideration by risk managers are still required (see Table 1 footnotes for details). In particular, the following data is needed to support the existing uses:

- additional supervised residue trials with samples analysed according to the proposed residue definition for the uses on potatoes, garlic, sweet corn, beans (with pods), peas (with pods), peas (without pods), peas (dry), lupins/lupini beans (dry), linseeds, sunflower seeds, rapeseeds/canola seeds, soyabeans, cotton seeds, barley grains, maize/corn grains, common millet/proso millet grains, oat grains, rice grains, sorghum grains, wheat grains and sugar beet roots;
- a representative study investigating primary crop metabolism in pulses and oilseeds;
- a representative study investigating primary crop metabolism in root and tuber vegetables;
- a representative hydrolysis study investigating the potential release of aniline;
- storage stability study covering the high oil content commodities and information on the storage conditions of the samples of the residue trials on oilseed crops;
- a fully validated analytical method for enforcement in high oil content commodities for the analysis of carboxin sulfoxide;
- a representative rotational crop field study.

Depending on the outcome of the above reported studies, the following additional studies may still be required:

- a representative study investigating the nature of residues in livestock;
- a representative study investigating the magnitude of residues in livestock.

Considering the relevant data gaps identified during the assessment and that a risk to consumers cannot be excluded for the existing uses, Member States are in any case recommended to withdraw the relevant authorisations at national level. This recommendation to withdraw the authorisations at national level is valid even for rye where residues analysed according to the residue definition for risk assessment are below the proposed default combined LOQ of 0.03 mg/kg. However, an MRL at the combined LOQ of 0.03 mg/kg may not be sufficient to control if the restriction is respected, i.e. confirm if the GAP was withdrawn.

Table 1: Summary table

Code number[a]	Commodity	Existing EU MRL (mg/kg)	Outcome of the review	
			MRL (mg/kg)	Comment
Enforcement residue definition (existing): carboxin **Enforcement residue definition (proposed):** carboxin plus its metabolites carboxin sulfoxide and oxycarboxin (carboxin sulfone), expressed as carboxin				
211000	Potatoes	0.05*	–	Further consideration needed[b]
220010	Garlic	0.1	–	Further consideration needed[b]
234000	Sweet corn	0.1	–	Further consideration needed[b]
260010	Beans (with pods)	0.2	–	Further consideration needed[b]
260030	Peas (with pods)	0.2	–	Further consideration needed[b]
260040	Peas (without pods)	0.2	–	Further consideration needed[b]
300030	Peas (dry)	0.2	–	Further consideration needed[b]
300040	Lupins/lupini beans (dry)	0.05*	–	Further consideration needed[b]
401010	Linseeds	0.2	–	Further consideration needed[b]
401050	Sunflower seeds	0.2	–	Further consideration needed[b]
401060	Rapeseeds/canola seeds	0.1	–	Further consideration needed[b]
401070	Soyabeans	0.2	–	Further consideration needed[b]
401090	Cotton seeds	0.2	–	Further consideration needed[b]
500010	Barley grains	0.01*	–	Further consideration needed[b]

Code number[a]	Commodity	Existing EU MRL (mg/kg)	Outcome of the review	
			MRL (mg/kg)	Comment
500030	Maize/corn grains	0.01*	–	Further consideration needed[b]
500040	Common millet/proso millet grains	0.01*	–	Further consideration needed[b]
500050	Oat grains	0.01*	–	Further consideration needed[b]
500060	Rice grains	0.01*	–	Further consideration needed[b]
500070	Rye grains	0.01*	–	Further consideration needed[c]
500080	Sorghum grains	0.01*	–	Further consideration needed[b]
500090	Wheat grains	0.01*	–	Further consideration needed[b]
900010	Sugar beet roots	0.2	–	Further consideration needed[b]
–	Other commodities of plant and/or animal origin	See Reg. (EC) No 839/2008	–	Further consideration needed[d]

MRL: maximum residue level; CXL: codex maximum residue limit.
*: Indicates that the MRL is set/proposed at the limit of quantification.
(a): Commodity code number, as listed in Annex I of Regulation (EC) No 396/2005.
(b): GAP evaluated at EU level is not supported by data and a risk to consumers cannot be excluded for the existing EU MRL; no CXL is available. Either a specific LOQ or the default MRL of 0.01 mg/kg may be considered (combination B-I in Appendix E).
(c): GAP evaluated at EU level is not fully supported by data and a risk to consumers cannot be excluded; no CXL is available. Either a specific LOQ or the default MRL of 0.01 mg/kg may be considered (combination D-I in Appendix E).
(d): There are no relevant authorisations or import tolerances reported at EU level; no CXL is available. Either a specific LOQ or the default MRL of 0.01 mg/kg may be considered (combination A-I in Appendix E).

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Abbreviations

a.i.	active ingredient
a.s.	active substance
ADI	acceptable daily intake
AR	applied radioactivity
ARfD	acute reference dose
BBCH	growth stages of mono- and dicotyledonous plants
Bw	body weight
CXL	codex maximum residue limit
DAR	draft assessment report
DAT	days after treatment
DB	dietary burden
DT_{90}	period required for 90% dissipation (define method of estimation)
DM	dry matter
dw	dry weight
eq	residue expressed as a.s. equivalent

EURLs	European Union Reference Laboratories for Pesticide Residues (former CRLs)
HPLC-MS/MS	high performance liquid chromatography with tandem mass spectrometry
HR	highest residue
IEDI	international estimated daily intake
IESTI	international estimated short-term intake
ILV	independent laboratory validation
ISO	International Organisation for Standardization
IUPAC	International Union of Pure and Applied Chemistry
LC	liquid chromatography
LOQ	limit of quantification
MRL	maximum residue level
MS/MS	tandem mass spectrometry detector
MW	molecular weight
NEU	northern European Union
OECD	Organisation for Economic Co-operation and Development
PBI	plant-back interval
PHI	preharvest interval
PRIMo	(EFSA) Pesticide Residues Intake Model
PROFile	(EFSA) Pesticide Residues Overview File
QuEChERS	Quick, Easy, Cheap, Effective, Rugged, and Safe (analytical method)
RA	risk assessment
RD	residue definition
RMS	rapporteur Member State
SANCO	Directorate-General for Health and Consumers
SEU	southern European Union
STMR	supervised trials median residue
TRR	total radioactive residue
WHO	World Health Organization

Appendix A – Summary of authorised uses considered for the review of MRLs

Critical outdoor GAPs for Northern Europe																				
Crop		Region	Outdoor/ Indoor	Member state or country	Pest controlled	Formulation			Application										PHI or waiting period (days)	Comments
Common name	Scientific name					Type	Content		Method	Growth stage		Number		Interval (days)		Rate				
							Conc.	Unit		From BBCH	Until BBCH	Min.	Max.	Min.	Max.	Min.	Max.	Unit		
Potatoes	*Solanum tuberosum* subsp. *tuberosum*	NEU	Outdoor	HU	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				60	g a.i./ 100 kg		
Sweet corn	*Zea mays* convar. *Saccharata*	NEU	Outdoor	HU	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				50	g a.i./ 100 kg		
Peas (with pods)	*Pisum sativum*	NEU	Outdoor	HU	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				50	g a.i./ 100 kg		
Peas (without pods)	*Pisum sativum*	NEU	Outdoor	HU	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				50	g a.i./ 100 kg		
Peas (dry)	*Pisum sativum*	NEU	Outdoor	FR	Fungi	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				50	g a.i./ 100 kg		

Critical outdoor GAPs for Northern Europe																				
Crop		Region	Outdoor/ Indoor	Member state or country	Pest controlled	Formulation			Application										PHI or waiting period (days)	Comments
Common name	Scientific name					Type	Content		Method	Growth stage		Number		Interval (days)		Rate				
							Conc.	Unit		From BBCH	Until BBCH	Min.	Max.	Min.	Max.	Min.	Max.	Unit		
Lupins (dry)	*Lupinus albus* subsp. *albus; Lupinus angustifolius; Lupinus luteus; Lupinus mutabilis*	NEU	Outdoor	FR	Fungal diseases	FS			Seed treatment – general (see also comment field)	0	0		1				50	g a.i./ 100 kg		
Linseeds	*Linum usitatissimum*	NEU	Outdoor	CZ	Fungal diseases	FS	37.5	% (w/ w)	Seed treatment – general (see also comment field)	0	0		1				56	g a.i./ 100 kg		
Sunflower seeds	*Helianthus annuus*	NEU	Outdoor	HU	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				40	g a.i./ 100 kg		
Rapeseeds	*Brassica napus* subsp. *napus*	NEU	Outdoor	CZ	Fungal diseases	LS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				80	g a.i./ 100 kg		

Critical outdoor GAPs for Northern Europe																				
Crop		Region	Outdoor/ Indoor	Member state or country	Pest controlled	Formulation			Application										PHI or waiting period (days)	Comments
Common name	Scientific name					Type	Content		Method	Growth stage		Number		Interval (days)		Rate				
							Conc.	Unit		From BBCH	Until BBCH	Min.	Max.	Min.	Max.	Min.	Max.	Unit		
Soyabeans	*Glycine max*	NEU	Outdoor	SI, HU	*Phytium* sp. *Ustilago* sp., *Fusarium* sp., *Penicillium* sp., *Aspergillus* sp. *Helmintho-sporium* sp.	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				50	g a.i./ 100 kg		
Barley	*Hordeum vulgare*	NEU	Outdoor	DE	*Drechslera graminea*, *Ustilago nuda*	FS	225.0	g/L	Seed treatment – general (see also comment field)	0	0		1				90	g a.i./ 100 kg		
Maize	*Zea mays*	NEU	Outdoor	FR	Fungal diseases	FS			Seed treatment – general (see also comment field)	0	0		1				100	g a.i./ 100 kg		
Oat	*Avena sativa*	NEU	Outdoor	EE	Leaf stripe, loose and stinking smut and foot rot diseases	FS	750.0	g/kg	Seed treatment – general (see also comment field)	0	0		1				150	g a.i./ 100 kg		
Rice	*Oryza sativa*	NEU	Outdoor	HU	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				40	g a.i./ 100 kg		

Critical outdoor GAPs for Northern Europe																				
Crop		Region	Outdoor/ Indoor	Member state or country	Pest controlled	Formulation			Application										PHI or waiting period (days)	Comments
Common name	Scientific name					Type	Content		Method	Growth stage		Number		Interval (days)		Rate				
							Conc.	Unit		From BBCH	Until BBCH	Min.	Max.	Min.	Max.	Min.	Max.	Unit		
Rye	*Secale cereale*	NEU	Outdoor	CZ	Fungal diseases	LS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				60	g a.i./ 100 kg		
Sorghum	*Sorghum bicolor*	NEU	Outdoor	HU	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				60	g a.i./ 100 kg		
Wheat	*Triticum aestivum*	NEU	Outdoor	EE	Leaf stripe, loose and stinking smut and foot rot diseases	FS	750.0	g/kg	Seed treatment – general (see also comment field)	0	0		1				150	g a.i./ 100 kg		
Sugar beets	*Beta vulgaris* subsp. *vulgaris* var. *altissima*	NEU	Outdoor	SI	*Phytium* sp. *Fusarium* sp., *Phoma* sp.	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				100	g a.i./ 100 kg		
Garlic	*Allium sativum*	SEU	Outdoor	ES	*Fusarium* spp.	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				140	g a.i./ 100 kg		

Critical outdoor GAPs for Northern Europe																				
Crop		Region	Outdoor/ Indoor	Member state or country	Pest controlled	Formulation			Application										PHI or waiting period (days)	Comments
Common name	Scientific name					Type	Content		Method	Growth stage		Number		Interval (days)		Rate				
							Conc.	Unit		From BBCH	Until BBCH	Min.	Max.	Min.	Max.	Min.	Max.	Unit		
Sweet corn	*Zea mays* convar. *Saccharata*	SEU	Outdoor	ES	*Ustilago maydis*	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				90	g a.i./ 100 kg		
Beans (with pods)	*Phaseolus vulgaris*	SEU	Outdoor	IT	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				60	g a.i./ 100 kg		
Soyabeans	*Glycine max*	SEU	Outdoor	IT	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				60	g a.i./ 100 kg		
Cotton seeds	*Gossypium barbadense; Gossypium herbaceum*	SEU	Outdoor	ES	*Sclerotinia* spp.	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				90	g a.i./ 100 kg		
Barley	*Hordeum vulgare*	SEU	Outdoor	IT	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				100	g a.i./ 100 kg		

Critical outdoor GAPs for Northern Europe																				
Crop		Region	Outdoor/ Indoor	Member state or country	Pest controlled	Formulation			Application										PHI or waiting period (days)	Comments
Common name	Scientific name					Type	Content		Method	Growth stage		Number		Interval (days)		Rate				
							Conc.	Unit		From BBCH	Until BBCH	Min.	Max.	Min.	Max.	Min.	Max.	Unit		
Maize	*Zea mays*	SEU	Outdoor	FR	Fungal diseases	FS			Seed treatment – general (see also comment field)	0	0		1				100	g a.i./ 100 kg		
Common millet	*Panicum miliaceum*	SEU	Outdoor	ES	Fungal diseases	FS			Seed treatment – general (see also comment field)	0	0		1				90	g a.i./ 100 kg		
Oat	*Avena sativa*	SEU	Outdoor	ES		FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				90	g a.i./ 100 kg		
Rice	*Oryza sativa*	SEU	Outdoor	IT	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				100	g a.i./ 100 kg		
Rye	*Secale cereale*	SEU	Outdoor	ES	Covered smut	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				90	g a.i./ 100 kg		

Critical outdoor GAPs for Northern Europe																				
Crop		Region	Outdoor/ Indoor	Member state or country	Pest controlled	Formulation			Application										PHI or waiting period (days)	Comments
Common name	Scientific name					Type	Content		Method	Growth stage		Number		Interval (days)		Rate				
							Conc.	Unit		From BBCH	Until BBCH	Min.	Max.	Min.	Max.	Min.	Max.	Unit		
Sorghum	*Sorghum bicolor*	SEU	Outdoor	ES		FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				90	g a.i./ 100 kg		
Wheat	*Triticum aestivum*	SEU	Outdoor	IT	Fungal diseases	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				100	g a.i./ 100 kg		
Sugar beets	*Beta vulgaris* subsp. *vulgaris* var. *altissima*	SEU	Outdoor	IT	Seed/soil borne fungi	FS	200.0	g/L	Seed treatment – general (see also comment field)	0	0		1				120	g a.i./ 100 kg		

MRL: maximum residue level; GAP: Good Agricultural Practice; NEU: northern European Union; SEU: southern European Union; BBCH: growth stages of mono- and dicotyledonous plants; a.i.: active ingredient; PHI: preharvest interval.

Appendix B – List of end points

B.1. Residues in plants

B.1.1. Nature of residues and methods of analysis in plants

B.1.1.1. Metabolism studies, methods of analysis and residue definitions in plants

Primary crops (available studies)	**Crop groups**	**Crop(s)**	**Application(s)**	**Sampling**
	Cereals/grass crops	Wheat	60 g a.s./100 kg seed	47, 167
	Pulses and oilseeds	–	–	–
	Root/tuber crops	–	–	–
	Source: United Kingdom, 2006 Sampling was done 47 days (foliage) and 167 days (chaff, straw and grain) after planting of the treated seed.			
Rotational crops (available studies)	**Crop groups**	**Crop(s)**	**Application(s)**	**PBI (DAT)**
	Root/tuber crops	Carrot	Bare soil, 0.13 kg a.s./ha (equivalent to 60 g carboxin/ 100 kg seed) or 1.3 kg a.s./ha (equivalent to 600 g carboxin/ 100 kg seed)	30, 120, 365
	Leafy crops	Lettuce	Bare soil, 0.13 kg a.s./ha (equivalent to 60 g carboxin/ 100 kg seed) or 1.3 kg a.s./ha (equivalent to 600 g carboxin/ 100 kg seed)	30, 120, 365
	Cereal (small grain)	Wheat	Bare soil, 0.13 kg a.s./ha (equivalent to 60 g carboxin/ 100 kg seed) or 1.3 kg a.s./ha (equivalent to 600 g carboxin/ 100 kg seed)	30, 120, 365
	Source: United Kingdom, 2015			
Processed commodities (hydrolysis study)	**Conditions**			**Investigated?**
	Pasteurisation (20 min, 90°C, pH 4)			No
	Baking, brewing and boiling (60 min, 100°C, pH 5)			No
	Sterilisation (20 min, 120°C, pH 6)			No
	According to the chemical structure of carboxin, the release of aniline during hydrolysis may occur. Given the toxicological concerns related to aniline, the formation and bioavailability of aniline in processed commodities must be investigated.			

Can a general residue definition be proposed for primary crops?	No
Rotational crop and primary crop metabolism similar?	Yes (tentative for cereals)
Residue pattern in processed commodities similar to residue pattern in raw commodities?	Inconclusive
Plant residue definition for monitoring (RD-Mo)	Carboxin plus its metabolites carboxin sulfoxide and oxycarboxin (carboxin sulfone), expressed as carboxin (valid for cereals but tentative for pulses and oilseeds and root/ tubers)
Plant residue definition for risk assessment (RD-RA)	carboxin plus its metabolites carboxin sulfoxide and oxycarboxin (carboxin sulfone), expressed as carboxin (valid for cereals but tentative for pulses and oilseeds and root/ tubers)
Conversion factor (monitoring to risk assessment)	Not relevant
Methods of analysis for monitoring of residues (analytical technique, crop groups, LOQs)	HPLC–MS/MS (United Kingdom, 2006; EURL, 2016; EFSA, 2017b): • Individual LOQ: carboxin (0.01 mg/kg); carboxin sulfoxide (0.01 mg/kg); carboxin sulfone (oxycarboxin) (0.01 mg/kg); Combined LOQ: 0.03 mg/kg validated in high water, high acid content and dry commodities • ILV available for dry commodities

a.i.: active ingredient; DAT: days after treatment; PBI: plant-back interval; HPLC–MS/MS: high-performance liquid chromatography with tandem mass spectrometry; LC–MS/MS: liquid chromatography with tandem mass spectrometry; LOQ: limit of quantification; ILV: independent laboratory validation.

B.1.1.2. Stability of residues in plants

Plant products (available studies)	**Category**	**Commodity**	**T (°C)**	**Stability (Months/years)**
	High water content	Wheat forage	−18	18 months
	Dry	Wheat grain	−18	18 months
	Other	Wheat straw	−18	24 months
	Source: United Kingdom, 2010 Stability demonstrated for carboxin, carboxin sulfone and carboxin sulfoxide.			

B.1.2. Magnitude of residues in plants

B.1.2.1. Summary of residues data from the supervised residue trials

Crop	Region/ indoor[a]	Residue levels observed in the supervised residue trials relevant to the supported GAPs (mg/kg)	Recommendations/comments (OECD calculations)	MRL proposals (mg/kg)	HR (mg/kg)[b]	STMR (mg/kg)[c]
Sweet corn	NEU	–	No data available	–	–	–
	SEU	–	No data available	–	–	–
Barley grains	NEU	2 × < 0.025; 7 × < 0.005	Trials on barley performed with 100–125 g a.s./100 kg seed (1.1–1.4N) analysed for parent compound only (United Kingdom, 2011). Storage period and analytical method unknown. Extrapolation to rye is proposed MRL_{OECD} = 0.05	–	–	–
	SEU		No data available	–	–	–
Rye grains	NEU	11 × < 0.03	Extrapolated from trials on wheat grain performed at 60 g a.s./100 kg seed (EFSA, 2010a,b) compliant with the residue definition for risk assessment using a validated method of analysis MRL_{OECD} = 0.03	0.03*	< 0.03	< 0.03
	SEU		No data available			
Maize/corn grains Sorghum grains	NEU	2 × < 0.025	Trials performed with 450 g a.s./100 kg seed (4.5N) and 2,600 g a.s./100 kg seed (26N) conducted outside the EU (United Kingdom, 2011) analysed for parent compound only. Storage period and analytical method unknown. Extrapolation to sorghum is proposed	–	–	–
	SEU	–	No data available	–	–	–
Common millet/proso millet grains	SEU	–	No data available	–	–	–
Oat grainsWheat grains	NEU	5 × < 0.05	Trials on barley performed with 120–125 g a.s./100 kg (0.8N) seed analysed for parent compound only (United Kingdom, 2011). Storage period and analytical method unknown. Extrapolation to oat grain and wheat grain is proposed MRL_{OECD} = 0.05	–	–	–
	SEU		No data available	–	–	–

Crop	Region/ indoor[a]	Residue levels observed in the supervised residue trials relevant to the supported GAPs (mg/kg)	Recommendations/comments (OECD calculations)	MRL proposals (mg/kg)	HR (mg/kg)[b]	STMR (mg/kg)[c]
Rice grains	NEU	–	No data available			
	SEU	2 × < 0.025	Trials performed with 2,600 g a.s./100 kg seed (26N) conducted outside the EU analysed for parent compound only (United Kingdom, 2011). Storage period, analytes and analytical method unknown	–	–	–
Barley straw	NEU	4 × < 0.10; 0.11; < 0.12; 0.13	Trials on barley performed with 120–125 g a.s./100 kg (1.1–1.4N) analysed for parent compound only (United Kingdom, 2011). Storage period and analytical method unknown. Extrapolation to rye straw is proposed MRL_{OECD} = 0.17	–	–	–
	SEU		No data available	–	–	–
Rye straw	NEU	11 × < 0.03	Extrapolated from trials on wheat straw performed at 60 g a.s./100 kg seed (EFSA, 2010a,b) compliant with the residue definition for risk assessment using a validated method of analysis MRL_{OECD} = 0.03	0.03*	< 0.03	< 0.03
	SEU		No data available			
Common millet straw	SEU	–	No data available	–	–	–
Maize/corn stover	NEU	–	No data available	–	–	–
	SEU	–	No data available	–	–	–
Oat straw Wheat straw	NEU	2 × < 0.10; 0.11; < 0.12; 0.13	Trials on barley performed with 120–125 g a.s./100 kg seed (0.8N) analysed for parent compound only are considered on a tentative basis. Storage period and analytical method unknown. Extrapolation to oat straw and wheat straw is proposed MRL_{OECD} = 0.20	–	–	–
	SEU	–	No data available	–	–	–
Rice straw	NEU		No data available	–	–	–
	SEU	–	No data available	–	–	–
Sorghum stover	NEU		No data available	–	–	–
	SEU	–	No data available	–	–	–
Potatoes	NEU	–	No data available	–	–	–
Garlic	SEU		No data available	–	–	–

Crop	Region/ indoor[a]	Residue levels observed in the supervised residue trials relevant to the supported GAPs (mg/kg)	Recommendations/comments (OECD calculations)	MRL proposals (mg/kg)	HR (mg/kg)[b]	STMR (mg/kg)[c]
Beans (with pods)	SEU		No data available	–	–	–
Peas (with pods)	NEU		No data available	–	–	–
Peas (without pods)	NEU		No data available	–	–	–
Peas (dry)	NEU	–	No data available	–	–	–
Lupins/lupini beans (dry)	NEU		No data available	–	–	–
LinseedsSunflower seedsRapeseeds/ canola seedsSoyabeans	NEU	9 × < 0.05	Combined data set of 2 trials performed on linseed at 80 g a.s./100 kg seed (1.4N) and 7 trials performed on oilseed rape at 99 g a.s./100 kg seed (1.8N) analysed for carboxin equivalents (United Kingdom, 2011). It was not clear if samples from oilseeds residue trials were analysed for all relevant components (carboxin, carboxin sulfone and carboxin sulfoxide); therefore, EFSA assumed that the residue levels referred to the parent compound only. Extrapolation to sunflower seeds, rapeseeds and soyabeans is proposed MRL_{OECD} = 0.05	–	–	–
Soyabeans	SEU		No data available	–	–	–
Cotton seeds	SEU		No data available	–	–	–
Sugar beet roots	NEU		No data available	–	–	–
	SEU		No data available	–	–	–
Sugar beet tops	NEU		No data available	–	–	–
	SEU		No data available	–	–	–

GAP: Good Agricultural Practice; OECD: Organisation for Economic Co-operation and Development; MRL: maximum residue level.
*: Indicates that the MRL is proposed at the limit of quantification.
(a): NEU: Outdoor trials conducted in northern Europe, SEU: Outdoor trials conducted in southern Europe, Indoor: indoor EU trials or Country code: if non-EU trials.
(b): Highest residue.
(c): Supervised trials median residue.

B.1.2.2. Residues in succeeding crops

Confined rotational crop study (quantitative aspect)	Residues of carboxin sulfone and carboxin sulfoxide observed at amounts higher than 0.1 mg/kg in wheat grain and straw
Field rotational crop study	No studies available but required

B.2. Residues in livestock

Relevant groups	Dietary burden expressed in				Most critical diet[(a)]	Most critical commodity[(a)]	Trigger exceeded (Y/N)
	mg/kg bw per day		mg/kg DM				
	Med.	Max.	Med.	Max.			
Cattle (all diets)	0.0008	0.0008	0.02	0.02	Cattle (dairy)	Rye, straw	No
Cattle (dairy only)	0.0008	0.0008	0.02	0.02	Cattle (dairy)	Rye, straw	No
Sheep (all diets)	0.0012	0.0012	0.03	0.03	Sheep (lamb)	Rye, straw	No
Sheep (ewe only)	–	–	–	–	Sheep (ram/ewe)	–	No
Swine (all diets)	0.0007	0.0007	0.02	0.02	Swine (finishing)	Rye, grain	No
Poultry (all diets)	0.0017	0.0017	0.02	0.02	Poultry (broiler)	Rye, grain	No
Poultry (layer only)	0.0008	0.0008	0.01	0.01	Poultry (layer)	Rye, grain	No

bw: body weight; DM: dry matter.
(a): Calculated for the maximum dietary burden from the notified use on rye.

B.2.1. Nature of residues and methods of analysis in livestock

B.2.1.1. Metabolism studies, methods of analysis and residue definitions in livestock

Livestock (available studies)	Animal	Dose (mg/kg bw per day)	Duration (days)	N rate/comment
	Laying hen	–	–	–
	Lactating goat/cow	–	–	–
	Pig	–	–	–
	No studies available.			

Time needed to reach a plateau concentration in milk and eggs (days)	Not available
Metabolism in rat and ruminant similar (Yes/No)	Not available
Animal residue definition for monitoring (RD-Mo)	Not available
Animal residue definition for risk assessment (RD-RA)	Not available
Conversion factor (monitoring to risk assessment)	Not available
Fat soluble residues (Yes/No)	No
Methods of analysis for monitoring of residues (analytical technique, crop groups, LOQs)	(EFSA, 2017b): • LOQ of 0.01 mg/kg is achievable for the metabolite carboxin sulfoxide in milk

B.2.1.2. Stability of residues in livestock

Animal products (available studies)	Animal	Commodity	T (°C)	Stability (Months/years)
	–	Muscle	–	–
	–	Liver	–	–
	–	Kidney	–	–
	–	Milk	–	–
	–	Egg	–	–
	No studies available			

B.2.2. Magnitude of residues in livestock

B.2.2.1. Summary of the residue data from livestock feeding studies

Animal commodity	Residues at the closest feeding level (mg/kg)		Estimated value at 1N		MRL proposal (mg/kg)
	Mean	Highest	STMR (mg/kg)	HR (mg/kg)	
Cattle (all diets) No MRL proposal is possible					
Cattle (dairy only) No MRL proposal is possible					
Sheep (all diets) No MRL proposal is possible					
Sheep (dairy only) No MRL proposal is possible					
Swine No MRL proposal is possible					
Poultry (all diets) No MRL proposal is possible					
Poultry (layer only) No MRL proposal is possible					

B.3. Consumer risk assessment

ADI	0.008 mg/kg bw per day (EFSA, 2010a,b)
Highest IEDI, according to EFSA PRIMo	76% ADI (Dutch, child)
Assumptions made for the calculations	For all commodities, EFSA considered the LOQ of 0.03 mg/kg for an indicative calculation. It is highlighted that the potential exposure to aniline was not assessed The contributions of commodities where no GAP was reported in the framework of this review were not included in the calculation

ARfD	Not necessary (EFSA, 2010a,b)
Highest IESTI, according to EFSA PRIMo	–
Assumptions made for the calculations	–

ADI: acceptable daily intake; bw: body weight; IEDI: international estimated daily intake; PRIMo: (EFSA) Pesticide Residues Intake Model; WHO: World Health Organization; ARfD: acute reference dose; IESTI: international estimated short-term intake.

B.4. Proposed MRLs

Code number[a]	Commodity	Existing EU MRL (mg/kg)	Outcome of the review	
			MRL (mg/kg)	Comment
Enforcement residue definition (existing): carboxin **Enforcement residue definition (proposed):** carboxin plus its metabolites carboxin sulfoxide and oxycarboxin (carboxin sulfone), expressed as carboxin				
211000	Potatoes	0.05*	–	Further consideration needed[b]
220010	Garlic	0.1	–	Further consideration needed[b]
234000	Sweet corn	0.1	–	Further consideration needed[b]
260010	Beans (with pods)	0.2	–	Further consideration needed[b]
260030	Peas (with pods)	0.2	–	Further consideration needed[b]
260040	Peas (without pods)	0.2	–	Further consideration needed[b]
300030	Peas (dry)	0.2	–	Further consideration needed[b]
300040	Lupins/lupini beans (dry)	0.05*	–	Further consideration needed[b]
401010	Linseeds	0.2	–	Further consideration needed[b]
401050	Sunflower seeds	0.2	–	Further consideration needed[b]
401060	Rapeseeds/canola seeds	0.1	–	Further consideration needed[b]
401070	Soyabeans	0.2	–	Further consideration needed[b]
401090	Cotton seeds	0.2	–	Further consideration needed[b]
500010	Barley grains	0.01*	–	Further consideration needed[b]
500030	Maize/corn grains	0.01*	–	Further consideration needed[b]
500040	Common millet/proso millet grains	0.01*	–	Further consideration needed[b]
500050	Oat grains	0.01*	–	Further consideration needed[b]
500060	Rice grains	0.01*	–	Further consideration needed[b]
500070	Rye grains	0.01*	–	Further consideration needed[c]
500080	Sorghum grains	0.01*	–	Further consideration needed[b]
500090	Wheat grains	0.01*	–	Further consideration needed[b]
900010	Sugar beet roots	0.2	–	Further consideration needed[b]
–	Other commodities of plant and/or animal origin	See Reg. (EC) No 839/2008	–	Further consideration needed[d]

MRL: maximum residue level; CXL: codex maximum residue limit.
*: Indicates that the MRL is set/proposed at the limit of quantification.
(a): Commodity code number, as listed in Annex I of Regulation (EC) No 396/2005.
(b): GAP evaluated at EU level is not supported by data and a risk to consumers cannot be excluded for the existing EU MRL; no CXL is available. Either a specific LOQ or the default MRL of 0.01 mg/kg may be considered (combination B-I in Appendix E).
(c): GAP evaluated at EU level is not fully supported by data and a risk to consumers cannot be excluded; no CXL is available. Either a specific LOQ or the default MRL of 0.01 mg/kg may be considered (combination D-I in Appendix E).
(d): There are no relevant authorisations or import tolerances reported at EU level; no CXL is available. Either a specific LOQ or the default MRL of 0.01 mg/kg may be considered (combination A-I in Appendix E).

Appendix C – Pesticide Residue Intake Model (PRIMo)

Carboxin			
Status of the active substance:		Code no.	
LOQ (mg/kg bw):		Proposed LOQ:	
Toxicological end points			
ADI (mg/kg bw per day):	**0.008**	ARfD (mg/kg bw):	**n.n.**
Source of ADI:	**EFSA**	Source of ARfD:	
Year of evaluation:	**2010**	Year of evaluation:	

Chronic risk assessment – refined calculations

TMDI (range) in % of ADI minimum – maximum: 12 – 76

No of diets exceeding ADI: ---

Highest calculated TMDI values in % of ADI	MS Diet	Highest contributor to MS diet (in % of ADI)	Commodity/ group of commodities	2nd contributor to MS diet (in % of ADI)	Commodity/ group of commodities	3rd contributor to MS diet (in % of ADI)	Commodity/ group of commodities	pTMRLs at LOQ (in % of ADI)
76.0	NL child	12.3	PRODUCTS OF ANIMAL ORIGIN	11.0	Milk and cream	11.0	Milk and milk products: Cattle	
67.0	FR toddler	16.2	PRODUCTS OF ANIMAL ORIGIN	14.9	Milk and cream	6.5	VEGETABLES	
63.7	DE child	8.8	PRODUCTS OF ANIMAL ORIGIN	8.6	FRUIT (FRESH OR FROZEN)	5.4	Milk and cream	
60.0	FR infant	10.3	PRODUCTS OF ANIMAL ORIGIN	9.7	Milk and cream	9.7	Milk and cream	
59.3	UK Infant	15.7	PRODUCTS OF ANIMAL ORIGIN	14.5	Milk and cream	3.8	SUGAR PLANTS	
56.5	UK Toddler	8.8	PRODUCTS OF ANIMAL ORIGIN	8.6	SUGAR PLANTS	8.6	SUGAR PLANTS	
52.8	WHO Cluster diet B	5.4	VEGETABLES	4.5	CEREALS	3.2	Wheat	
42.7	IE adult	4.0	FRUIT (FRESH OR FROZEN)	3.4	VEGETABLES	2.5	CEREALS	
42.0	SE general population 90th percentile	6.6	PRODUCTS OF ANIMAL ORIGIN	4.6	Milk and cream	4.6	Milk and cream	
40.4	DK child	8.2	PRODUCTS OF ANIMAL ORIGIN	4.7	Milk and cream	3.9	CEREALS	
40.4	ES child	6.6	PRODUCTS OF ANIMAL ORIGIN	4.7	Milk and cream	4.7	Milk and milk products: Cattle	
34.2	WHO cluster diet E	3.4	VEGETABLES	2.5	PRODUCTS OF ANIMAL ORIGIN	2.3	CEREALS	
32.3	WHO regional European diet	3.5	PRODUCTS OF ANIMAL ORIGIN	3.5	VEGETABLES	1.8	Milk and cream	
31.4	WHO cluster diet D	3.4	VEGETABLES	3.2	CEREALS	2.7	PRODUCTS OF ANIMAL ORIGIN	
29.4	WHO Cluster diet F	2.7	PRODUCTS OF ANIMAL ORIGIN	2.6	VEGETABLES	2.0	CEREALS	
26.0	NL general	3.1	PRODUCTS OF ANIMAL ORIGIN	2.5	Milk and cream	2.5	Milk and milk products: Cattle	
23.3	ES adult	3.0	PRODUCTS OF ANIMAL ORIGIN	1.9	Milk and cream	1.9	Milk and milk products: Cattle	
22.4	FR all population	2.3	FRUIT (FRESH OR FROZEN)	1.7	PRODUCTS OF ANIMAL ORIGIN	1.6	Berries & small fruit	
21.3	PT General population	2.4	FRUIT (FRESH OR FROZEN)	2.0	VEGETABLES	2.0	CEREALS	
18.6	LT adult	2.2	PRODUCTS OF ANIMAL ORIGIN	1.9	VEGETABLES	1.5	Milk and cream	
17.9	UK vegetarian	1.4	SUGAR PLANTS	1.4	SUGAR PLANTS	1.4	VEGETABLES	
17.8	DK adult	2.8	PRODUCTS OF ANIMAL ORIGIN	2.0	Milk and cream	1.3	VEGETABLES	
17.1	UK Adult	1.7	PRODUCTS OF ANIMAL ORIGIN	1.5	SUGAR PLANTS	1.5	SUGAR PLANTS	
16.6	IT kids/toddler	3.1	CEREALS	2.5	Wheat	1.6	VEGETABLES	
13.8	FI adult	2.6	PRODUCTS OF ANIMAL ORIGIN	2.1	Milk and cream	1.0	VEGETABLES	
12.9	IT adult	1.9	CEREALS	1.6	Wheat	1.5	VEGETABLES	
11.9	PL general population	2.3	VEGETABLES	1.5	Root and tuber vegetables	1.3	Potatoes	

Conclusion:

The estimated Theoretical Maximum Daily Intakes (TMDI), based on pTMRLs were below the ADI.

A long-term intake of residues of carboxin is unlikely to present a public health concern.

Acute risk assessment/children – refined calculations	Acute risk assessment/adults/general population – refined calculations

Acute risk assessment is not necessary.

For each commodity, the calculation is based on the highest reported MS consumption per kg bw and the corresponding unit weight from the MS with the critical consumption. If no data on the unit weight was available from that MS, an average European unit weight was used for the IESTI calculation.
In the **IESTI 1** calculation, the variability factors were 10, 7 or 5 (according to JMPR manual 2002); for lettuce, a variability factor of 5 was used.
In the **IESTI 2** calculations, the variability factors of 10 and 7 were replaced by 5. For lettuce, the calculation was performed with a variabilty factor of 3.
Threshold MRL is the calculated residue level which would leads to an exposure equivalent to 100% of the ARfD.

Unprocessed commodities

No of commodities for which ARfD/ADI is exceeded (IESTI 1): ---			**No of commodities for which ARfD/ADI is exceeded (IESTI 2):** ---			**No of commodities for which ARfD/ADI is exceeded (IESTI 1):** ---			**No of commodities for which ARfD/ADI is exceeded (IESTI 2):** ---		
IESTI 1 *)		**)	**IESTI 2** *)		**)	**IESTI 1** *)		**)	**IESTI 2** *)		**)
Highest % of ARfD/ADI	Commodities	pTMRL/ threshold MRL (mg/kg)	Highest % of ARfD/ADI	Commodities	pTMRL/ threshold MRL (mg/kg)	Highest % of ARfD/ADI	Commodities	pTMRL/ threshold MRL (mg/kg)	Highest % of ARfD/ADI	Commodities	pTMRL/ threshold MRL (mg/kg)
No of critical MRLs (IESTI 1) ---						**No of critical MRLs (IESTI 2)** ---					

Processed commodities

No of commodities for which ARfD/ADI is exceeded: ---				**No of commodities for which ARfD/ADI is exceeded:** ---			
***)				***)			
Highest % of ARfD/ADI	Processed commodities	pTMRL/ threshold MRL (mg/kg)		Highest % of ARfD/ADI	Processed commodities	pTMRL/ threshold MRL (mg/kg)	

*) The results of the IESTI calculations are reported for at least 5 commodities. If the ARfD is exceeded for more than 5 commodities, all IESTI values > 90% of ARfD are reported.
**) pTMRL: provisional temporary MRI.
***) pTMRL: provisional temporary MRL for unprocessed commodity.

Conclusion:
As no ARfD was considered necessary, it is concluded that the short-term intake of carboxin residues is unlikely to present a pulbic health concern.

Appendix D – Input values for the exposure calculations

D.1. Livestock dietary burden calculations

Feed commodity	Median dietary burden		Maximum dietary burden	
	Input value (mg/kg)	Comment	Input value (mg/kg)	Comment
Risk assessment residue definition – carboxin plus its metabolites carboxin sulfoxide and oxycarboxin (carboxin sulfone), expressed as carboxin				
Rye, grain	0.03	STMR[(a)]	0.03	STMR[(a)]
Rye, straw	0.03	STMR	0.03	HR

STMR: supervised trials median residue; HR: highest residue.
(a): For cereal bran no default processing factor was applied because carboxin is applied early in the growing season and residues are expected to be below the LOQ. Concentration of residues in these commodities is therefore not expected.

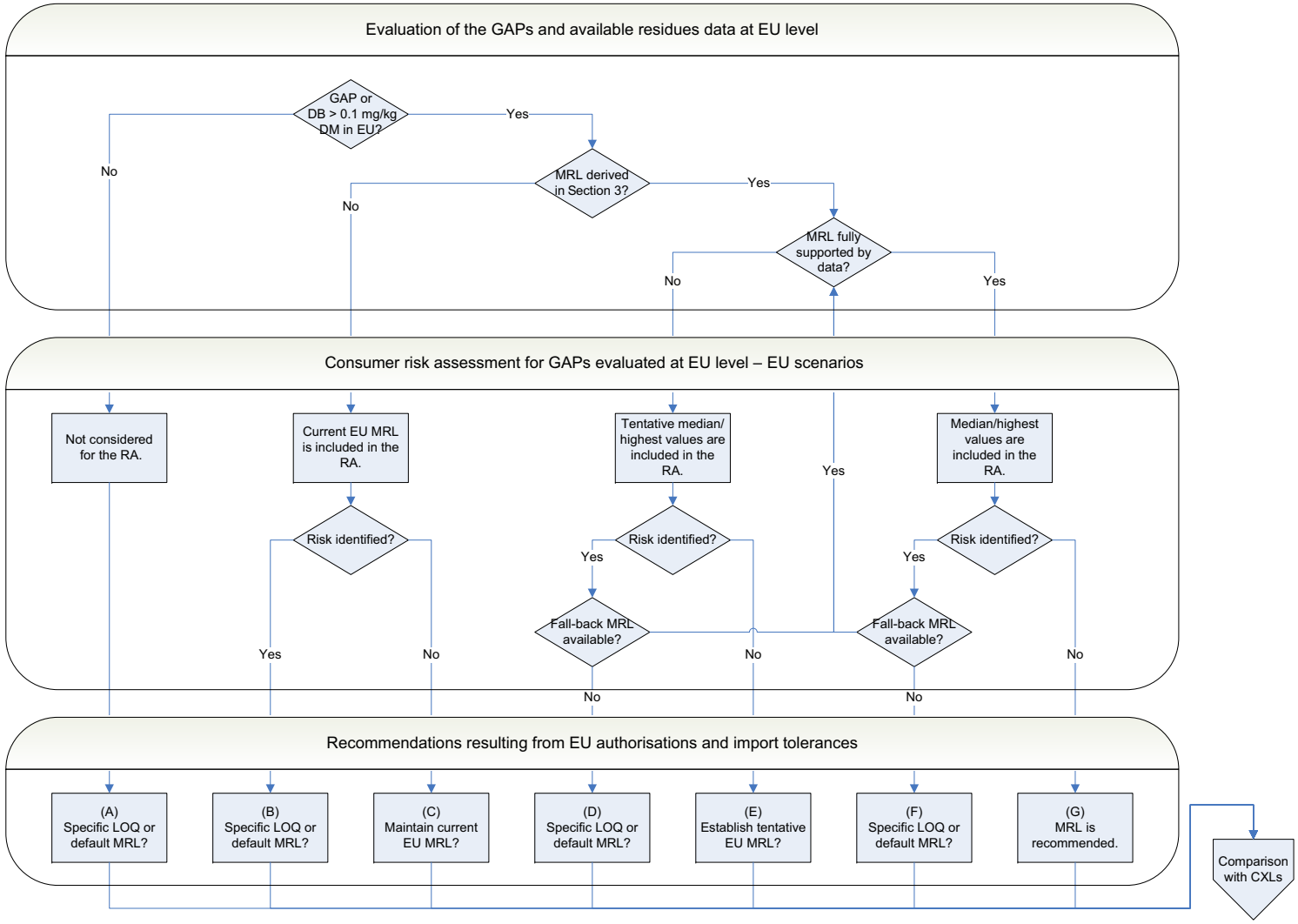
D.2. Consumer risk assessment

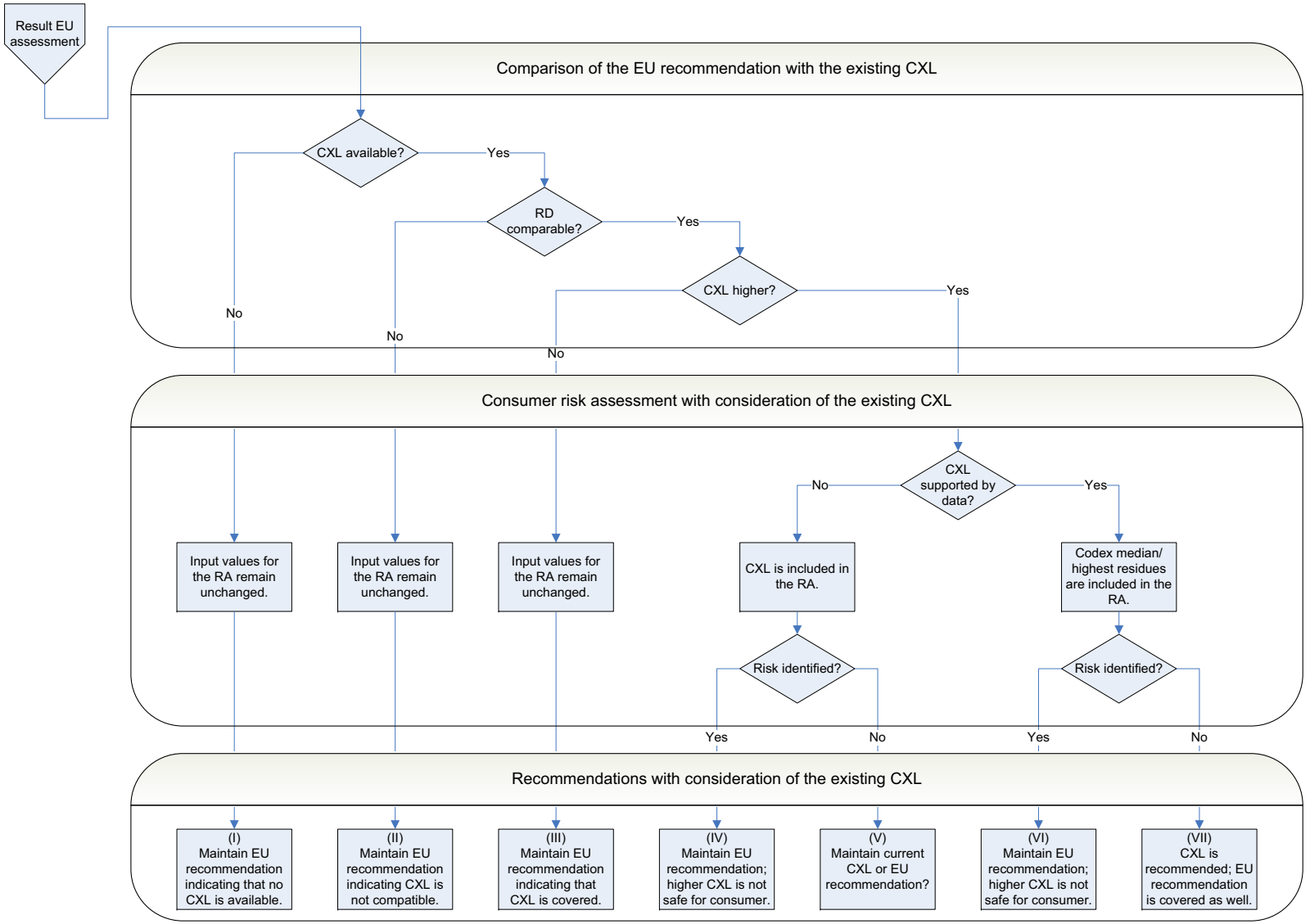
Commodity	Chronic risk assessment	
	Input value (mg/kg)	Comment
Risk assessment residue definition: carboxin plus its metabolites carboxin sulfoxide and oxycarboxin (carboxin sulfone), expressed as carboxin		
Potatoes	0.03*	LOQ[(a)]
Garlic	0.03*	LOQ[(a)]
Sweet corn	0.03*	LOQ[(a)]
Beans (with pods)	0.03*	LOQ[(a)]
Peas (with pods)	0.03*	LOQ[(a)]
Peas (without pods)	0.03*	LOQ[(a)]
Peas (dry)	0.03*	LOQ[(a)]
Lupins/lupini beans (dry)	0.03*	LOQ[(a)]
Linseeds	0.03*	LOQ[(a)]
Sunflower seeds	0.03*	LOQ[(a)]
Rapeseeds/canola seeds	0.03*	LOQ[(a)]
Soyabeans	0.03*	LOQ[(a)]
Cotton seeds	0.03*	LOQ[(a)]
Barley grains	0.03*	LOQ[(a)]
Maize/corn grains	0.03*	LOQ[(a)]
Common millet/proso millet grains	0.03*	LOQ[(a)]
Oat grains	0.03*	LOQ[(a)]
Rice grains	0.03*	LOQ[(a)]
Rye grains	0.03*	LOQ[(a)]
Sorghum grains	0.03*	LOQ[(a)]
Wheat grains	0.03*	LOQ[(a)]
Sugar beet roots	0.03*	LOQ[(a)]
Swine muscle	0.03*	LOQ[(a)]
Swine fat tissue	0.03*	LOQ[(a)]
Swine liver	0.03*	LOQ[(a)]
Swine kidney	0.03*	LOQ[(a)]
Bovine muscle	0.03*	LOQ[(a)]
Bovine fat tissue	0.03*	LOQ[(a)]
Bovine liver	0.03*	LOQ[(a)]
Bovine kidney	0.03*	LOQ[(a)]
Sheep muscle	0.03*	LOQ[(a)]

Commodity	Chronic risk assessment	
	Input value (mg/kg)	Comment
Sheep fat tissue	0.03*	LOQ[(a)]
Sheep liver	0.03*	LOQ[(a)]
Sheep kidney	0.03*	LOQ[(a)]
Goat muscle	0.03*	LOQ[(a)]
Goat fat tissue	0.03*	LOQ[(a)]
Goat liver	0.03*	LOQ[(a)]
Goat kidney	0.03*	LOQ[(a)]
Equine muscle	0.03*	LOQ[(a)]
Equine fat tissue	0.03*	LOQ[(a)]
Equine liver	0.03*	LOQ[(a)]
Equine kidney	0.03*	LOQ[(a)]
Poultry muscle	0.03*	LOQ[(a)]
Poultry fat tissue	0.03*	LOQ[(a)]
Poultry liver	0.03*	LOQ[(a)]
Cattle milk	0.03*	LOQ[(a)]
Sheep milk	0.03*	LOQ[(a)]
Goat milk	0.03*	LOQ[(a)]
Horse milk	0.03*	LOQ[(a)]
Birds eggs	0.03*	LOQ[(a)]

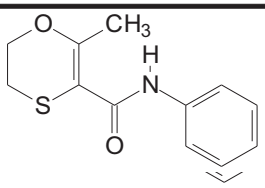
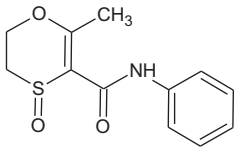
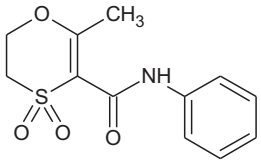
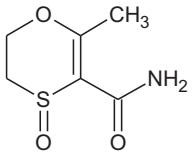
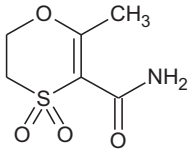
*: Indicates that the input value is proposed at the limit of quantification.
(a): Since the existing MRLs are not fully supported by data and there is a high level of uncertainties it was not possible to conduct a risk assessment with the current MRLs. Chronic consumer exposure, with the combined LOQ of 0.03 mg/kg as input value was used for an indicative calculation.

Appendix E – Decision tree for deriving MRL recommendations




Result EU assessment
Comparison of the EU recommendation with the existing CXL
CXL available?
Yes
No
RD comparable?
Yes
No
CXL higher?
Yes
No
Consumer risk assessment with consideration of the existing CXL
CXL supported by data?
No
Yes
Input values for the RA remain unchanged.
Input values for the RA remain unchanged.
Input values for the RA remain unchanged.
CXL is included in the RA.
Codex median/ highest residues are included in the RA.
Risk identified?
Risk identified?
Yes
No
Yes
No
Recommendations with consideration of the existing CXL
(I) Maintain EU recommendation indicating that no CXL is available.
(II) Maintain EU recommendation indicating CXL is not compatible.
(III) Maintain EU recommendation indicating that CXL is covered.
(IV) Maintain EU recommendation; higher CXL is not safe for consumer.
(V) Maintain current CXL or EU recommendation?
(VI) Maintain EU recommendation; higher CXL is not safe for consumer.
(VII) CXL is recommended; EU recommendation is covered as well.

Appendix F – Used compound codes

Code/trivial name	Chemical name/SMILES notation	Structural formula
Carboxin	5,6-dihydro-2-methyl-*N*-phenyl-1,4-oxathiin-3-carboxamide	
Carboxin sulfoxide	2-methyl-*N*-phenyl-5,6-dihydro-1,4-oxathiine-3-carboxamide 4-oxide	
Carboxin sulfone (oxycarboxin)	5,6-dihydro-2-methyl-1,4-oxathiine-3-carboxanilide 4,4-dioxide	
P/V-54	2-methyl-5,6-dihydro-1,4-oxathiine-3-carboxamide 4-oxide CC=1OCCS(=O)C=1C(N)=O	
P/V-55	2-methyl-5,6-dihydro-1,4-oxathiine-3-carboxamide 4,4-dioxide CC=1OCCS(=O)(=O)C=1C(N)=O	

SMILES: simplified molecular-input line-entry system.