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REASONED OPINION

Modification of the residue definition of glyphosate in genetically modified maize grain and soybeans, and in products of animal origin[1]

European Food Safety Authority[2]

European Food Safety Authority (EFSA), Parma, Italy

SUMMARY

Germany as the Rapporteur Member State (RMS) for the active substance glyphosate has received an application from DuPont de Nemours regarding the amendment of the risk assessment residue definition for new varieties of genetically modified soybeans and maize produced in the USA. The evaluation report prepared by the RMS on this subject and the application were submitted to the European Commission and forwarded to EFSA on 30 January 2009.

Based on this evaluation report, the Draft Assessment Report prepared by the RMS under Directive 91/414/EEC, and the JMPR assessments, EFSA derives the following conclusions regarding the application.

Metabolism studies in genetically modified soybeans and maize containing the glyphosate-N-acetyltransferase (GAT) gene demonstrated that new metabolites are formed which were not observed in conventional crops or in glyphosate tolerant crops containing the modified 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) gene. The major metabolite in the new maize and soybean varieties under consideration is N-acetyl-glyphosate. Parent glyphosate, N-acetyl-aminomethyl phosphonic acid (N-acetyl-AMPA) and aminomethyl phosphonicacid (AMPA) were found in low concentrations in the edible parts of the crops. The toxicological assessment of N-acetyl-glyphosate and N-acetyl-AMPA revealed that these metabolites are of no higher toxicological concern than the parent compound. The ADI established for glyphosate may therefore also be applied to assess the long-term consumer risk related to the exposure to these substances.

Sufficient supervised field trials on the genetically modified maize and soybeans were submitted in which the parent compound and the metabolites were analysed separately to estimate the expected residues in treated crops. From these trials and from the metabolism studies it becomes evident that glyphosate is not a good marker substance suitable to monitor compliance with the GAP in the new genetically modified crops. EFSA therefore elaborated three options regarding decision on residue definitions for enforcement, describing advantages and disadvantages in each case:

Option 1: *glyphosate*

Option 2: *sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate*

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Option 3: *N-acetyl-glyphosate* (establishing separate MRLs for N-acetyl-glyphosate in addition to the existing MRLs for glyphosate)

For risk assessment the residue definition should be changed to "*sum of glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, expressed as glyphosate*" to cover all metabolites that can be found on conventional and genetically modified crops.

Analytical methods for glyphosate are available. Additional methods have been provided to the EMS in support of the application. However, the EMS did not outline if these validated methods are applicable to enforce the proposed new residue definitions as proposed in option 2 and 3. It has to be ensured that a validated analytical method suitable for the enforcement residue definition is provided before the residue definition is changed in the MRL legislation.

It is concluded that sufficient residue data on soybean and maize were submitted to estimate the magnitude of residues in GAT maize and soybeans. In case risk managers decide to follow option 1 or 2 regarding the enforcement residue definition, the currently established MRLs for plant or animal commodities do not have to be changed because the GAPs in conventional and/or genetically modified soybean and maize based on the modification of the EPSPS gene lead to higher residues compared with the agricultural practices authorised in the US for GAT maize and soybeans.

Option 3, however (establishing separate MRLs for N-acetylglyphosate) would require to include a new substance in Annex III of Regulation (EC) No 396/2005 and to set specific MRLs at the level of 0.3 mg/kg for maize and at the level of 7 or 10 mg/kg for soybeans.

The nature and magnitude of N-acetyl-glyphosate in processed commodities was investigated. It was concluded that this compound is stable under processing conditions simulating pasteurisation, cooking, baking and sterilistation. The processing studies performed with incurred residues suggest that no measurable residues will occur in starch produced from treated maize, in soya oil and in maize oil. In soya hulls a concentration by a factor of ca. 5.5 was observed for glyphosate and its metabolites N-acetyl-glyphosate and N-acetyl-AMPA. However, due to the limited database no robust processing factors could be derived.

In case GAT maize and soybeans treated with glyphosate are used as feed, livestock will be exposed not only to glyphosate and AMPA but also to the new metabolites typical for these genetically modified varieties (mainly N-acetylglyphosate). The dietary burden calculations identified that a significant intake of glyphosate and its related metabolites above the trigger value of 0.1 mg/kg DM might be expected for all animal species if livestock is exposed to genetically modified maize and soybeans containing the GAT gene. In order to address the situation in livestock, the applicant provided metabolism studies in ruminants and poultry performed with N-acetyl-glyphosate. These studies demonstrated that N-acetyl-glyphosate either remains unchanged or loses its N-acetyl-group forming parent glyphosate which is further metabolised into AMPA. To a certain extent also N-acetyl-AMPA was found in certain animal matrices. The feeding studies with N-acetyl-glyphosate showed that the transfer into food of animal origin is very low and that in all commodities the N-acetyl-glyphosate residues are expected to be below the limit of quantification. Thus, based on the results of the metabolism and the feeding studies, it is concluded that neither the current enforcement residue definition for animal commodities nor the MRLs for animal products have to be changed. However, the residue definition for risk assessment should be amended taking into account the possible presence of N-acetyl-glyphosate and N-acetyl-AMPA.

EFSA performed a consumer risk assessment to assess whether the proposed change of the risk assessment residue definitions for plant and animal commodities would have an impact on the consumer safety. The calculation was based on the current MRLs and the available residue concentrations for AMPA as described in the DAR. N-acetyl-glyphosate and N-acetyl-AMPA were not included in the calculation, since the current MRLs for soybeans and maize based on the glyphosate use in conventional and/or genetically modified varieties with a different mode of action are significantly higher than the residues in GAT soybeans and maize. The use of the current MRLs and the expected residues of AMPA is therefore a more critical scenario regarding the consumer exposure. Although the intake calculation is expected to overestimate the real exposure estimation, the exposure was below the ADI (45% of the ADI). It is therefore concluded that for glyphosate and glyphosate related residues no long-term consumer health risk is expected.

The following recommendations are derived:

EFSA proposes to amend the residue definitions for risk assessment purposes as follows:

	Residue definition risk assessment
All plant commodities, including soybeans and maize	Sum of glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, calculated as glyphosate.
All food commodities of animal origin	

Concerning the residue definition for enforcement EFSA proposes 3 different options to be decided by risk managers.

		Residue definition enforcement	**Conversion factor residue definition enforcement to residue definition risk assessment**
Maize, soybeans	**Option 1**	Glyphosate	3 (maize) 17.7 (soybeans)
	Option 2	Sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate	1.2 (soybeans) 2.3 (maize)
	Option 3	N-acetyl-glyphosate	2.5 (maize) 1.3 (soybeans)
Other plant commodities		Glyphosate No change needed	No information available for AMPA in conventional crops and genetically modified crops containing EPSPS enzyme. For N-acetyl-glyphosate and N-acetyl-AMPA not relevant because no occurrence on crops except GAT maize and soybeans.
Animal commodities		Glyphosate No change needed	Could not be calculated because in feeding studies no measurable residues of N-acetyl-glyphosate, AMPA and N-acetyl-AMPA in animal commodities were observed.

In case **option 1 or 2** is selected, no amendment of the numeric MRL values is needed.

In the case of **option 3** the following MRLs have to be included in Annex III Regulation (EC) No. 396/2005

Commodity	**Enforcement residue definition:** **N-acetyl-glyphosate**
Maize	0.3 mg/kg
Soybeans	7 or 10 mg/kg
Other plant commodities	Not relevant
Food of animal origin	Not relevant

It is also concluded that in case of option 1 or 3 the availability of analytical methods suitable for routine MRL enforcement has to be ensured.

KEY WORDS

Glyphosate, maize, soybeans, MRL application, Regulation (EC) No 396/2005, consumer risk assessment, N-acetyl-glyphosate, N-acetyl-AMPA, glyphosate acetyl-transferase (GAT)

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BACKGROUND

Regulation (EC) No 396/2005 establishes the rules governing the setting of pesticide MRLs at Community level. Article 6 of that regulation lays down that a party having a legitimate commercial interest may submit to the Rapporteur Member State designated pursuant to Directive 91/414/EEC an application to set an import tolerance in accordance with the provisions of Article 7 of that regulation.

Germany, hereafter referred to as the Evaluating Member State (EMS), received an application from the company DuPont de Nemours GmbH3 regarding the request for an import tolerance for glyphosate in genetically modified maize and soybeans. This application was notified to the European Commission and EFSA and subsequently evaluated by the EMS in accordance with Article 8 of the Regulation.

After completion, the evaluation report of the EMS was submitted to the European Commission who forwarded the application, the evaluation report and the supporting dossier to EFSA on 30/01/2009. The application was included in the EFSA Register of Question with the reference number EFSA-Q-2009-00372 and the following subject:

Glyphosate - Application to modify the risk assessment residue definition of glyphosate from "glyphosate" to "glyphosate, N-acetyl glyphosate, AMPA, N-acetyl AMPA" in genetically modified maize grain and soya beans, and in several products of animal origin

EFSA then proceeded with the assessment of the application as required by Article 10 of the Regulation.

TERMS OF REFERENCE

According to Article 10 of Regulation (EC) No 396/2005, EFSA shall, based on the evaluation report provided by the Evaluating Member State, provide a reasoned opinion on the risks to the consumer associated with the application.

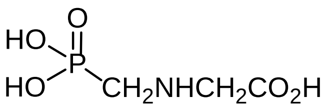
According to Article 11 of that Regulation, the reasoned opinion shall be provided as soon as possible and at the latest within 3 months from the date of receipt of the application. Where EFSA requests supplementary information, the time limit laid down shall be suspended until that information has been provided.

In this particular case the calculated deadline for providing the reasoned opinion is 30/07/2009.

[3] DuPont de Nemours (Deutschland) GmbH, Du Pont Straße 1, 61352 Bad Homburg, Germany

THE ACTIVE SUBSTANCE AND ITS USE PATTERN

Glyphosate is the ISO common name for N-(phosphonomethyl)glycine (IUPAC).



Glyphosate is a non-selective herbicide absorbed by the foliage, with a rapid translocation throughout the plant. It is used for the control of annual and perennial grasses and broad-leaved weeds in agriculture, horticulture, viticulture, forestry, orchards, plantation crops, amenities, home gardening and greenhouses. Furthermore it is used for weed control on aquatic areas, on industrial areas, on railroad tracks, along roads and on non-cultivated areas. In non-genetically modified plants glyphosate prevents the synthesis of essential aromatic amino acids needed for protein biosynthesis by inhibition of 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS), an enzyme of the aromatic acid biosynthetic pathway. This enzyme and pathway is unique to plants and microbes. In transgenic glyphosate tolerant crops the EPSPS enzyme is overproduced or the tolerance is mediated by the introduction of microbial EPSPS enzyme variants which are not inhibited by glyphosate. Other transgenic plant varieties have been developed which contain in addition a glyphosate oxidoreductase gene (GOX) which degradates glyphosate into aminomethyl-phosphonic acid (AMPA), a non-phytotoxic compound.

A novel strategy for the development of glyphosate tolerance in plants was the introduction of the enzyme glyphosate-N-acetyltransferase (GAT) which is capable of detoxifying the herbicide by forming N-acetyl-glyphosate (Castle, 2004). In the US market the commercial name assigned to the genetically modified soybean, following this novel mode of action and in which the protein expression of the GAT4601 and GM-HRA genes are modified is Optimum™GAT™ Soybean. An application for the authorisation of this genetically modified soybean and derived food and feed in accordance with Regulation (EC) 1829/2003 has been submitted to EFSA on 11 April 2007 and has been included in the Register of Questions under the reference number EFSA-Q-2007-087. The commercial name assigned to the GAT maize 98140 variety in the US market is Optimum™GAT™Corn. An application for this maize variety was submitted to EFSA on 15 April 2008 (EFSA-Q-2008-301). The scope for both applications is for food and feed uses, import and processing, excluding cultivation. In both cases the assessment by the GMO Panel of EFSA is not yet completed.

Glyphosate (including glyphosate trimesium) was assessed in the framework of Directive 91/414/EEC in stage 1. It was included in Annex I of this directive by Directive 2001/99/EC which entered into force on 1 July 2002. The Annex I inclusion is restricted to the use as herbicide. The representative uses assessed under the peer review covered a wide range of conventional and transgenic crops (e.g. conventional orchards, vegetables, pulses, oil seeds, cereals, sugar beets, forestry, home garden sites, and glyphosate tolerant crops (modification of the EPSPS gene), e.g. oil seed rape, maize, soybean, sugar beet, cotton). Since EFSA was not involved in the peer review of active substances belonging to stage 1, no EFSA conclusion is available for this active substance.

In the European Community MRLs for glyphosate were first established in 1993 (Directives 93/57/EC and 93/58/EC) which were amended several times (Directives 96/32/EC, 98/82/EC, 2000/57/EC, 2005/70/EC, 2006/60/EC and 2008/17/EC). In 2008, in the framework of MRL harmonisation, the MRLs established by the previous MRL legislation were transferred to Annex II of Regulation 396/2005 after amendment of several of the MRLs. For crops not covered by the previous MRL legislation, MRLs were established in Annex IIIB of this Regulation. The current EU MRLs are listed in Appendix C. Codex Alimentarius has set CXLs for a wide range of food and feed commodities. The residue definition for enforcement in Codex and at EU level is parent glyphosate only.

Germany received a request to consider the setting of import tolerances for glyphosate and its metabolites N-acetyl-glyphosate and N-acetyl-AMPA (N-acetyl-aminophosphonic acid) occurring in genetically modified soybean and maize (Optimum™GAT™corn and Optimum™GAT™soybeans). Germany performed an assessment and concluded that the residue definition for risk assessment on genetically modified maize grain and soybeans and for several products of animal origin should be amended. The details of the GAPs on which the import tolerance request is based can be found in Appendix A. Glyphosate is used up to 4 times on tolerant maize and soybeans grown in the US at application rates of up to 6.77 kg a.s./ha per season. The current EC MRL for soybeans is 20 mg/kg, which is identical with the MRL established in Codex. For maize a MRL of 1 mg/kg is established at EU level; Codex has adopted a value of 5 mg/kg. Germany also concluded in its evaluation that the MRLs don’t have to be amended.

The following assessment is based on the evaluation report prepared by Germany in response to the import tolerance request, the DAR prepared under Directive 91/414/EEC (Germany, 1998) and the JMPR evaluations (WHO/FAO 2004, WHO/FAO 2005).

ASSESSMENT

1. Methods of analysis

1.1. Methods for enforcement of residues in food of plant origin

The current enforcement residue definition for glyphosate comprises the parent compound only. Analytical methods have been provided in the framework of the peer review under Directive 91/414/EEC. Since no multi-methods can be used to enforce glyphosate MRLs, single methods have been developed. These methods involve aqueous extraction, clean-up by cation and anion exchange, followed by chromatographic separation by HPLC and a post-column derivatisation. Alternatively, a pre-column derivatisation method is available. The final measurement is performed with a fluorescent detector. Also other methods involving GC separation and detection with FPD, MS or MS/MS have been developed. Satisfactory recoveries at the LOQ of 0.05 mg/kg for glyphosate were reported for dry commodities and matrices with high fat content (Germany, 1998).

1.2. Methods for enforcement of residues in food of animal origin

Analytical methods are available to enforce glyphosate MRLs for products of animal origin. These methods have been assessed in the framework of the peer review and under the previous MRL legislation.

Since the import tolerance request will not result in a change of the enforcement residue definition for animal products (see 3.2.2), additional analytical methods are not required.

2. Mammalian toxicology

2.1. Glyphosate and AMPA

The toxicological properties of glyphosate and AMPA have been assessed in the framework of the peer review under Directive 91/414/EEC and an ADI was established as outlined in table 2-1. It was also concluded that it is not necessary to establish an ARfD for glyphosate in view of its low acute toxicity (Germany, 1998).

Table 2-1. Overview of the toxicological reference values

	Source	Year	Value (mg/kg bw/d)	Study relied upon	Safety factor
Parent compound glyphosate					
ADI	COM	2002	0.3	2 yr. rat	100
ARfD	COM	2002		Not necessary	

Toxicological studies on AMPA which were assessed in the peer review revealed that the metabolite is of no greater toxicological concern than the parent compound.

It should be noted that a different ADI has been established by the JMPR, 2004 (ADI: 1 mg/kg bw/day). This is mainly because new long-term studies were available for the JMPR which were not available in the peer review. According to the JMPR summary, a higher NOAEL was identified in the new long term studies. This is in line with EU peer review since the EC ADI of 0.3 mg/kg bw/day was based on a NOAEL of 30 mg/kg bw/day where this dose level was the highest dose level tested indicating that a higher NOAEL could be found.

In the evaluation report the EMS assessed the two new metabolites formed in soybean and maize varieties in which the glyphosate N-acetyltransferase (GAT) was introduced, i.e. N-acetyl-glyphosate and N-acetyl-aminomethyl phosponic acid (N-acetyl-AMPA).

2.2. N-acetyl-glyphosate

The available toxicological data package is almost complete except for reproduction toxicity and long-term toxicity. Comparison with toxicological studies performed with glyphosate showed that N-acetyl-glyphosate is of no higher toxicity than glyphosate. In particular, despite a similar NOAEL for the metabolite and glyphosate in short-term toxicity assays, the effects occurring with the metabolite are of much lower concern. With regard to the reproductive toxicity potential and the carcinogenicity, it is not expected that the metabolite can cause such effects, also taking into account chemical structure similarities.

2.3. N-acetyl-AMPA

The database is not so extensive as for N-acetyl-glyphosate (there are only an acute toxicity study and a complete genotoxicity data package) but a wide database is available for the structural similar metabolite AMPA. Comparison of toxicological studies between N-acetyl-AMPA, AMPA and glyphosate leads to the conclusion that N-acetyl-AMPA is of no higher toxicity than glyphosate.
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2.4. Overall conclusion on toxicological reference values

Based on the available information, it is concluded that the metabolites N-acetyl-glyphosate and N-acetyl-AMPA are of no greater toxicological concern that the parent compound. The ADI established for glyphosate may therefore also be applied to assess the long-term consumer risk related to the exposure to these substances.

It is also noted that, the US-EPA has recently (EPA, 2008) reached the same conclusion.

3. Residues

3.1. Nature and magnitude of residues in plant

3.1.1. Primary crops

3.1.1.1. Nature of residues

Metabolism of radiolabelled glyphosate in non-genetically modified soybeans and maize was investigated after glyphosate treatment of the soil and uptake via roots, and in maize grown hydroponically. The major component of the total radioactive residue (TRR) in aerial parts of the plants was glyphosate (21- 69%). Other components identified were AMPA (4.1 -28%), N-methyl-AMPA (0 -2.0%) as well as small amounts of natural products. In the roots, glyphosate was also the major compound detected (7.6-57%) together with smaller amounts of AMPA (2.8 – 7.4%), N-methyl-AMPA (0 – 0.4%) and natural products (1-11%) (JMPR, 2005).

Metabolism in glyphosate tolerant maize containing both the CP4 EPSPS and the GOX gene (glyphosate oxidoreductase) are reported in the DAR. Glyphosate and AMPA were the major compounds identified in the aqueous extracts which accounted for 61 to 90% of the TRR. Glyphosate was observed to be the major radioactive residue in forage, silage and fodder (67-83% of TRR), whereas only low levels of glyphosate were present in grain (3-7% of TRR). In contrast, AMPA was found at approximately 5 – 16% of TRR in forage, silage and fodder, and 54-60% in grain.

JMPR also reported metabolism studies in glyphosate tolerant soybeans that contain the CP4-EPSPS gene. Glyphosate is metabolised substantially to AMPA, the latter can be conjugated with natural plant constituents to give trace level metabolites, or degraded to one carbon fragments that are incorporated into natural products. None of the trace level metabolites account for greater than 2% of the TRR in any soybean raw agricultural commodity. Glyphosate plus AMPA account for at least 66% of the total radioactive residues in forage, hay, and grain. Glyphosate residues differ among the plant components accounting for about 90% of the TRR in forage but only about 25% of the TRR in grain. AMPA accounted for only 6.8% of the TRR in forage, but was the major ^{14}C-compound in grain accounting for up to 49% of the TRR. About 9% of the TRR in grain was shown to be due to incorporation of ^{14}C into natural products.

JMPR and the experts of the peer review meeting concluded that the metabolic fate of glyphosate in tolerant maize and soybean containing the CP EPSPS gene is basically the same as in non-tolerant plants. Glyphosate is the major compound present in all plant tissues. In grain of tolerant maize and soybeans AMPA was the predominant metabolite. No other metabolites than AMPA were detected that account for more than 5% of the TRR. In maize containing the glyphosate oxidoreductase gene (GOX) a rapid and complete metabolisation of glyphosate to AMPA was observed.

In the Evaluation Report provided by Germany, studies investigating the metabolism of glyphosate in genetically modified plants (maize, soybeans) containing the enzyme glyphosate-N-acetyltransferase (GAT) have been evaluated.

The genetically modified maize (GAT maize) was treated with a single application of ^{14}C-glyphosate at pre-emergence of 4.3 kg a.s./ha (acid equivalents) and three foliar applications (each 1.1 kg a.s./ha). Thus, the total dose of 7.6 kg a.s. corresponds to 1.12 N dose compared with the intended GAP. Samples of immature foliage (48 days after soil treatment, before first foliar application), forage (59 days after the second foliar application) and mature plants separated into stover, cob and grain (7 days after final application) were taken.

For all matrices more than 90% of the radioactivity was extracted and identified or characterised. In the samples analysed, TRR values ranging from 12.2 mg/kg for stover down to 0.275 mg/kg for grain were found. In contrast to the genetically modified crops in which the glyphosate tolerance is linked to the EPSPS activity, AMPA is not the preferred metabolite. Most of the radioactivity found in the samples was unchanged glyphosate at early PHIs and N-acetyl-glyphosate at later PHIs. Neither AMPA nor N-accetyl-AMPA, the latter might be formed from AMPA or N-acetyl-glyphosate, was found at levels above 10% of the TRR. A summary of the results is presented in Table 3-1.

Table 3-1 Radioactive glyphosate residues found in GAT-maize

Component	Corn matrices			
	Forage	Stover	Cobs	Grain
	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)
TRR	3.476 (100)	12.242 (100)	0.686 (100)	0.275 (100)
Extracted	3.350 (96.4)	12.304 (100.5)	0.583 (84.9)	0.234 (84.9)
Unextracted	0.031 (0.9)	0.110 (0.9)	0.029 (4.2)	0.022 (7.9)
AMPA	0.140 (4.0)	0.422 (4.4)	n.d.	0.016 (6.1)
Glyphosate	2.016 (58.0)	9.166 (74.9)	n.d.	< 0.001 (< 0.1)
N-acetyl-AMPA	0.060 (1.7)	0.152 (1.3)	0.034 (5.0)	0.026 (9.4)
N-acetyl-glyphosate	0.937 (27.0)	2.188 (17.8)	0.435 (63.8)	0.141 (51.2)
Unidentified	0.057 (1.6)	0.092 (0.8)	0.074 (12.8)	0.041 (10.9)

n.d. not detected

The edible part of the crop (maize grain) contained mainly N-acetyl-glyphosate (0.141 mg/kg), in lower concentrations N-acetyl-AMPA (0.026 mg/kg) and AMPA (0.016 mg/kg). Parent glyphosate was not detected neither in cobs nor in grain (<0.001 mg/kg).

The metabolism of genetically modified soybeans containing the GAT gene was investigated after treatment with glyphosate at a dose rate of 3.4 kg a.s./ha (acid equivalents) before emergence and after foliar applications of 1.5 kg a.s./ha (about 10 days before mid-full bloom), 2.4 kg a.s./ha (full bloom) and 0.9 kg a.s./ha(14 days before maturity). The total application rate corresponds to 1.2 N compared with the US GAP. Samples of the plants were taken at four sampling dates: soybean forage was collected 36 days after the soil treatment before the first foliar treatment was applied, soybean hay was sampled 4 days after the first foliar treatment, foliage (with pods and grain) was collected 82 days after the second foliar application and mature plants (foliage, pods and grain) 14 days after the final treatment.

In the samples taken after foliar application only minor amounts of radioactivity could not be extracted (<2% of TRR). The early forage samples receiving only a pre-emergence application showed higher unextractable residues of 43% of the TRR. The radioactive residues in the different matrices ranged from 1.874 mg/kg (grain) up to 21.844 mg/kg in mature foliage. In the early samples obtained before foliar application most of the residue consisted of AMPA.

Following foliar treatment, AMPA was still found at levels about 10% of the TRR, but the main structures identified were unchanged parent glyphosate (early PHIs) and N-acetyl-glyphosate (late PHIs). N-acetyl-AMPA was identified at minor amounts of up to 3.3% in foliage. The results are summarised in table 3-2.

Table 3-2 Radioactive glyphosate residues found in GAT-soybeans

Component	Forage (before 1st foliar treatment	Hay (after 1st foliar treatment)	Pre-harvest (82 days after 2nd foliar treatment)		Maturity (14 days after last treatment)		
	Forage	Hay	Grain	Foliage	Grain	Pods	Foliage
	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)
TRR	0.428 (100)	13.444 (100)	1.905 (100)	11.225 (100)	3.142 (100)	17.751 (100)	22.087 (100)
Extractable residue	0.245 (57.1)	13.323 (99.1)	1.874 (98.3)	11.079 (98.7)	3.101 (98.7)	17.611 (99.2)	21.844 (98.9)
Unextractable residue	0.184 (42.9)	0.121 (0.9)	0.032 (1.7)	0.146 (1.3)	0.047 (1.5)	0.124 (0.7)	0.243 (1.1)
Glyphosate	0.039 (9.1)	9.740 (72.5)	0.434 (22.7)	4.894 (43.6)	0.102 (3.2)	10.101 (56.9)	11.791 (53.4)
AMPA	0.166 (39.3)	0.704 (5.3)	0.103 (5.3)	0.819 (7.4)	0.351 (11.2)	1.794 (10.2)	2.250 (10.3)
N-acetyl-AMPA	n.d.	0.096 (0.7)	n.d.	0.255 (2.2)	0.738 (23.5)	0.574 (3.3)	0.308 (1.4)
N-acteyl-glyphosate	0.009 (1.9)	2.581 (19.2)	1.156 (60.6)	4.699 (42.0)	1.788 (56.9)	4.906 (27.7)	7.039 (31.9)
Unidentified	0.003 (0.6)	0.032 (1.7)	0.032 (1.7)	0.179 (1.6)	0.035 (1.1)	0.165 (0.7)	0.243 (1.1)

n.d. not detected

It is noted that the major metabolites in soybeans (grains) are N-acetyl-glyphosate and N-acetyl-AMPA (56.7% of TRR or 1.788 mg/kg and 23.5 % TRR or 0.738 mg/kg, respectively). Parent glyphosate and AMPA account only for 0.102 mg/kg and 0.351 mg/kg, respectively.

Conclusion:

Metabolism studies are available which allow a comparison of the metabolic degradation of glyphosate in conventional and genetically modified maize and soybeans. Whereas the conventional and the GMO crops which contain the CP4-EPSPS gene and the glyphosate oxidoreductase gene (GOX) show a similar metabolic pattern which consists mainly of parent compound and AMPA, in crops containing the GAT gene the major metabolic pathway is different. The parent compound is extensively metabolised to N-acetyl-glyphosate; to a lower extent N-acetyl-AMPA and AMPA are formed. The identified metabolic pathway is depicted in Figure 3-1.

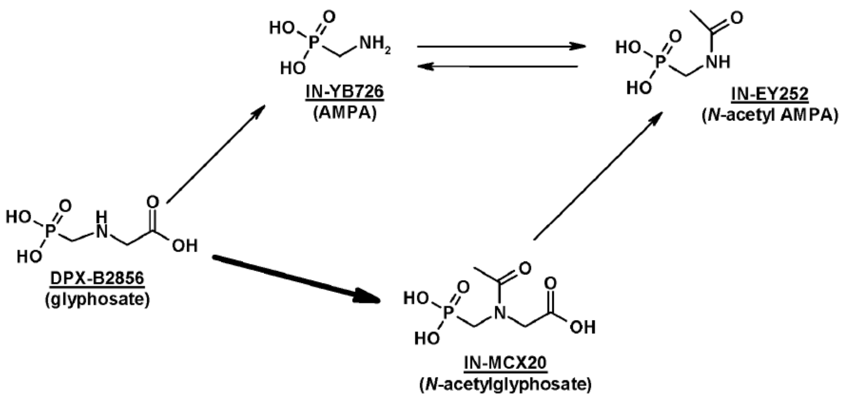

Figure 3-1 Metabolism of glyphosate in GAT-maize and soybeans

In the peer review under Directive 91/414/EEC the following residue definitions have been derived which apply for conventional and genetically modified crops containing the CP4-EPSPS and the GOX gene.

Residue definition for enforcement:	glyphosate
Residue definition for risk assessment:	Sum of glyphosate and AMPA, calculated as glyphosate.

Taking into account the results of the metabolism studies on GAT maize and soybean, the residue definitions should be reconsidered for the genetically modified crops under consideration.

Basically, residue definitions for risk assessment should include metabolites and degradates of toxicological concern which contribute significantly to the overall dietary burden. Considering that the toxicological assessment of the metabolites formed by GAT maize and soybean concluded that the toxicity of the metabolites N-acetyl-glyphosate and N-acetyl-AMPA is in the same order of magnitude as the parent compound, and that both compounds are found in significant concentrations in the edible parts of treated crops, the typical metabolites formed in the GAT maize and soybean should be considered in the risk assessment. Thus, the following residue definition is proposed to be used for assessing consumer exposure:

	Residue definition risk assessment (MRL setting scenario)
Soybeans, maize	Sum of glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, calculated as glyphosate.
Other plant commodities	

Concerning the residue definition for enforcement, EFSA is of the opinion that for these new varieties of maize and soybeans, parent glyphosate is not a good marker substance suitable for monitoring compliance with the GAP. The major residue in the edible part of GAT maize (grain) and soybeans (seeds) was identified as N-acetyl-glyphosate with 51% and 57% of TRR, respectively. Supervised field trials on GAT maize and soybeans (see 3.1.1.2) confirm that in many samples parent glyphosate or AMPA would not be detectable in the crop at harvest stage.

For establishing a residue definition for enforcement purposes, the following facts have to be taken into account:

- The residue definition for enforcement should be simple and suitable for practical routine monitoring and enforcement of the MRL at a reasonable cost.
- Parent glyphosate is not a reliable marker substance for checking whether GAT maize and soybeans have been treated with glyphosate.
- N-acetyl-glyphosate would be a suitable indicator molecule for GAT maize and soybeans, but is not expected to be present in conventional crops or in genetically modified crops containing the EPSPS enzyme.
- Including the major metabolite N-acetyl-glyphosate in the residue definition for enforcement requires very high analytical efforts for laboratories measuring glyphosate in maize and soybeans. The availability of analytical standards for N-acetyl-glyphosate will also create additional costs.

Taking into account all these arguments, EFSA proposes three possible opinions for enforcement residue definition for GAT maize and soybeans:

Residue definition enforcement for soybeans and maize		
Option 1		**Glyphosate (parent compound only)**
	Advantage:	-No additional burden for enforcement laboratories; -The same residue definition applicable for all commodities.
	Disadvantage:	-On GAT maize and soybeans the treatment with glyphosate would not be detectable because in most cases glyphosate residues are below LOQ; -N-acetyl-glyphosate which is the major metabolite with comparable toxicity as parent compound would not be detected. -The conversion factor residue definition enforcement to risk assessment (see table 3-3) is affected by high uncertainties because glyphosate was not detectable in most samples; -The conversion factor should only be applied for GAT maize and soybeans. Enforcement laboratories may not know the nature of the GM varieties. -The actual exposure assessment based on monitoring data after recalculation with the conversion factor would be inaccurate.
Option 2		**Sum of glyphosate and N-acetyl-glyphosate, calculated as glyphosate**
	Advantage:	-N-acetyl-glyphosate is a marker compound for genetically modified varieties which contain the GAT enzyme. -Reliable actual exposure assessment based on monitoring data (after recalculating the results with the conversion factor) would be possible.
	Disadvantage:	-More work and higher costs for enforcing MRLs on soybeans and maize. Establishing a different residue definition for maize and soybeans may create confusion in enforcement laboratories.
Option 3:		Establishing separate MRLs for **N-acetyl-glyphosate**
	Advantage:	-Enforcement laboratories could identify the genetically modified varieties which contain the GAT enzyme through the marker compound N-acetyl-glyphosate. -Enforcement laboratories do not have to analyse all soybean and maize samples for N-acetyl-glyphosate, but only those samples where it is considered necessary The GAP compliance can be checked by measuring the concentration of N-acetyl-glyphosate.
	Disadvantage:	Additional work to enforce separate MRLs for N-acetyl-glyphosate on soybeans and maize.

It is noted that the decision on the residue definition does not have an impact on the pre-regulatory risk assessment as reported in section 4. Hence, EFSA concludes that the decision on whether and how the residue definition for enforcement should be amended has to be taken by risk managers, considering the advantages and disadvantages as outlined in the table above. In the following section (3.1.1.2), EFSA provides a separate assessment of the residue data for the three different options.

For other plant commodities except maize and soybeans, the residue definition established in the peer review still is applicable and does not have to be changed since the pathway via N-acetyl-glyphosate is only relevant for genetically modified crops containing the GAT gene.

Before the residue definition is amended in the legislation as proposed in option 2 and 3, the availability of an analytical method capable to quantify the relevant analytes must be ensured. The

German evaluation report makes reference to new analytical methods based on LC-MS/MS and GC-MS/MS with LOQ of 0.05 mg/kg, including independent laboratory validation and confirmatory methods. However, no details have been reported which analytes can be measured by this method. The EMS is asked to provide further information on the available analytical methods. If these methods are not capable to enforce the new proposed residue definition, the applicant has to be requested to provide an appropriate analytical method as a precondition for placing the GAT maize and soybeans on the European market.

3.1.1.2. Magnitude of residues

The applicant submitted supervised field trials performed in the USA and Canada in 2005 and 2006 on soybeans (variety 356043) and on maize (variety GAT event 49712) in accordance with the GAPs as specified in Appendix A. For maize grain in total 47 trials were submitted in which residues of glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA were measured separately (the three metabolites mentioned were calculated to glyphosate taking into account the molecular weight ratios). For soybeans 36 supervised field trials were submitted. The results are summarised in table 3-3. EFSA performed three separate evaluations reflecting the three options proposed for the enforcement residue definition (see 3.1.1.1).

It is concluded that sufficient residue data on soybean and maize were submitted to estimate the magnitude of residues in GAT maize and soybeans. In case risk managers decide to follow option 1 or 2 proposed for the enforcement residue definition as outlined in section 3.1.1.1 (option 1: leaving the current residue definition unchanged as glyphosate; option 2: amend residue definition to *"sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate"*), the current application does not have an impact on the currently established MRLs for plant or animal commodities. Option 3, however (establishing separate MRLs for N-acetylglyphosate) would require to include a new substance in Annex III of Regulation (EC) No 396/2005 and to set specific MRLs at the level of 0.3 mg/kg for maize and at the level of 7 or 10 mg/kg for soybeans.

For all three options, median conversion factors were derived for maize and soybeans which have to be used to recalculate residues obtained in enforcement to the residue concentration to be used in risk assessment.

Storage stability studies were provided by the applicant and assessed by the EMS. The studies demonstrated that N-acetyl-glyphosate, glyphosate and AMPA are stable in maize (forage, grain and stover) and in soy beans (forage seed hay) for at least 9 months, for maize mostly 12 months (except N-acetyl-glyphosate in stover where the recovery after 12 months was only 64%). N-acetyl-AMPA was investigated only for one month. No significant degradation could be observed during this period. The evaluation report does not explicitly mention the storage period of samples derived in supervised field trials prior to analysis. However, since the EMS accepted the results it is assumed the samples were stored not longer than the demonstrated storage stability.

Table 3-3. Overview of the available residues trials data

Commodity	Region [(a)]	Outdoor /Indoor	Individual trial results (mg/kg)		STMR (mg/kg) [(b)]	HR (mg/kg) [(c)]	MRL proposal (mg/kg)	Median CF [(d)]	Comments
			Enforcement RD: glyphosate	**Risk assessment RD: glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, expressed as glyphosate**					
Option 1 : Maintaining current residue definition enforcement: glyphosate Proposed new residue definition risk assessment: glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, expressed as glyphosate									
Maize	Import (USA)	Outdoor	24*<0.02; 0.02; 3*0.03; 2*0.04; 11*<0.05; 4*0.05; 2*0.08	3*<0.08; 0.08; 8*0.09; 7*0.1; 5*0.11; 3*0.12; 2*0.13; 0.15; 0.17; 5*0.2; 0.21; 2*0.22; 2*0.23; 0.25; 0.3; 0.32; 0.36; 0.43; 0.6	0.11	0.6	0.1	3.0 (range 2.2 to 5.7)	Current MRL: 1 mg/kg, no modification needed. Rmax=0.069 Rber=0.1 CF factor calculated from a dataset of 12 values where glyphosate residues were >LOQ.
Soybeans	Import (USA)	Outdoor	6*<0.05; 0.05; 2*0.06;0.07; 0.08; 5*0.09; 0.1; 0.11; 3*0.12; 2*0.14; 0.17; 0.19; 0.2; 0.21; 0.29; 2*0.32; 0.45; 0.62; 0.86; 0.94; 1.7	<0.2; 0.33; 0.49; 0.64; 0.73; 0.82; 0.86; 1.04; 2*1.19; 1.26; 1.3; 1.42; 1.52; 2.02; 2*2.04; 2.18; 2.21; 2.36; 2.9; 3.01; 3.03; 3.08; 3.53; 3.59; 3.6; 5.52; 5.65; 5.66; 6.13; 6.61; 6.82; 6.87; 8.07; 8.64	2.2	8.64	1	17.7 (range 2.4 to 79)	Current MRL: 20 mg/kg, no modification necessary. Rmax=0.94 Rber=0.41 CF calculated from a dataset of 30 values where glyphosate residues were >LOQ.

Commodity	Region [a]	Outdoor /Indoor	Individual trial results (mg/kg)		STMR (mg/kg) [b]	HR (mg/kg) [c]	MRL proposal (mg/kg)	Median CF [d]	Comments
			Enforcement RD: sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate	**Risk assessment RD: glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, expressed as glyphosate**					
Option 2	**Proposed new residue definition enforcement: sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate** **Proposed new residue definition risk assessment: glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, expressed as glyphosate**								
Maize	Import (USA)	Outdoor	3*<0.04; 0.04; 8*0.05; 7*0.06; 5*0.07; 3*0.08; 2*0.09; 4*<0.1; 0.1; 2*0.11; 2*0.12; 2*0.13; 0.15; 0.19; 0.2; 0.28; 0.32; 0.38; 0.54;	3*<0.08; 0.08; 8*0.09; 7*0.1; 5*0.11; 3*0.12; 2*0.13; 0.15; 0.17; 5*0.2; 0.21; 2*0.22; 2*0.23; 0.25; 0.3; 0.32; 0.36; 0.43; 0.6	0.11	0.6	0.5	1.7 (range 1.1 to 2)	Rmax=0.307 Rber=0.220 CF factor calculated from a dataset of 41 values where residues for glyphosate and N-acetyl-glyphosate were both >LOQ.
Soybeans	Import (USA)	Outdoor	<0.1; 0.23; 0.36; 0.43; 0.54; 0.71; 0.72; 0.81; 0.91; 0.96; 1.01; 1.11; 1.14; 1.31; 1.65; 1.75; 1.76; 1.82; 1.92; 1.99; 2*2.49; 2.54; 2.87; 3.06; 3.26; 3.39; 4.37; 5.22; 5.45: 5.7; 5.89; 6.0; 6.14: 6.72; 8.02	<0.2; 0.33; 0.49; 0.64; 0.73; 0.82; 0.86; 1.04; 2*1.19; 1.26; 1.3; 1.42; 1.52; 2.02; 2*2.04; 2.18; 2.21; 2.36; 2.9; 3.01; 3.03; 3.08; 3.53; 3.59; 3.6; 5.52; 5.65; 5.66; 6.13; 6.61; 6.82; 6.87; 8.07; 8.64	2.2	8.64	10	1.2 (range 1 to 1.5)	Rmax=7.311 Rber=7.272 CF factor calculated from a dataset of 35 values where residues for glyphosate and N-acetyl-glyphosate were both >LOQ

Commodity	Region (a)	Outdoor /Indoor	Individual trial results (mg/kg)		STMR (mg/kg) (b)	HR (mg/kg) (c)	MRL proposal (mg/kg)	Median CF (d)	Comments
			Enforcement RD N-acetyl-glyphosate	Risk assessment RD glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, expressed as glyphosate					
Option 3:	**Proposed new residue definition enforcement: N-acetyl-glyphosate** **Proposed new residue definition risk assessment: glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, expressed as glyphosate**								
Maize	Import (USA)	Outdoor	4*<0.02; 2*0.02; 8*0.03; 11*0.04; 4*<0.05; 3*0.05; 4*0.06; 2*0.07; 0.08; 2*0.1; 0.15; 0.17; 0.2; 0.24; 0.36; 0.52	3*<0.08; 0.08; 8*0.09; 7*0.1; 5*0.11; 3*0.12; 2*0.13; 0.15; 0.17; 5*0.2; 0.21; 2*0.22; 2*0.23; 0.25; 0.3; 0.32; 0.36; 0.43; 0.6	0.11	0.6	0.3	2.5 (range 1.15 to 5.5)	Rmax= 0.265 Rber= 0.12 CF factor calculated from a dataset of 39 values where residues for N-acetyl-glyphosate were >LOQ
Soybeans	Import (USA)	Outdoor	<0.05; 0.18; 0.31; 0.38: 0.49; 0.61; 0.62; 0.63; 0.69; 0.86; 0.88: 0.9; 2*1.0; 1.1; 1.3; 2*1.6; 2*1.7; 1.9; 2*2.4; 2.7; 3.0; 2*3.2; 4.0; 2*4.3; 4.9; 5.0; 5.6; 5.9; 6.0; 6.6; 7.9	<0.2; 0.33; 0.49; 0.64; 0.73; 0.82; 0.86; 1.04; 2*1.19; 1.26; 1.3; 1.42; 1.52; 2.02; 2*2.04; 2.18; 2.21; 2.36; 2.9; 3.01; 3.03; 3.08; 3.53; 3.59; 3.6; 5.52; 5.65; 5.66; 6.13; 6.61; 6.82; 6.87; 8.07; 8.64	2.2	8.64	7 or 10	1.3 (range 1.1 to 2.3)	Rmax= 6.95 Rber= 6.8 CF factor calculated from a dataset of 35 values where residues for N-acetyl-glyphosate were >LOQ

(a): NEU, SEU, EU or Import (country code). In the case of indoor uses there is no necessity to differentiate between NEU and SEU.
(b): Median value of the individual trial results according to the enforcement residue definition.
(c): Highest value of the individual trial results according to the enforcement residue definition.
(d): The median conversion factor for enforcement to risk assessment is obtained by calculating the median of the individual conversion factors for each residues trial.
(*): Indicates that the MRL is set at the limit of analytical quantification.

3.1.1.3. Effect of industrial processing and/or household preparation

The effects of processing on the nature of the residues were investigated in a hydrolysis study with the ^{14}C-labelled plant metabolite N-acetyl-glyphosate. Under conditions simulating pasteurisation (20 min at 90°C, pH 4), cooking (60 min at 100°C, pH 5) and sterilisation (20 min at 120°C, pH 6) the majority of the residues were the unchanged metabolite (89.5 to 69.9%).

For the parent substance glyphosate and AMPA, no hydrolysis studies have been reported, neither in the DAR nor in the JMPR evaluation.

The residue behaviour of incurred residues of glyphosate and its metabolites N-acetyl-glyphosate, AMPA and N-acetyl-AMPA during processing of genetically modified maize and soya was investigated in several studies assessed by the EMS.

Maize (containing the GAT gene) treated with an exaggerated dose of 5 times the GAP was processed into starch, grits, flour, oil (wet and dry milled) and meal. Residues of glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA were measured separately in the unprocessed grain and in processed commodities. In unprocessed maize grain, glyphosate residues were between 0.013 and 0.16 mg/kg. N-acetyl glyphosate occurred in a range of 0.1 to 0.13 mg/kg. No AMPA residues were measurable whereas N-acetyl-AMPA was found in low concentrations up to 0.036 mg/kg.

In starch and oil (wet and dry milled) in no case residues of glyphosate and the related metabolites were measured above the LOQ. In grits, flour and meal, AMPA residues were occurred in low concentrations only, whereas glyphosate, N-acetyl-glyphosate and N-acetyl-AMPA (in meal only) were still measurable in comparable concentrations as in the unprocessed maize. However, reliable processing factors could not be derived because of the limited number of studies available and because in most cases the analytes were below the LOQ.

For soybeans (containing the GAT gene) the effect of processing was investigated in one trial (duplicate samples) where glyphosate was applied on the crop at an exaggerated dose rate (5 times the maximum GAP). The unprocessed soybeans contained average glyphosate residues of 0.3 mg/kg, N-acetyl-glyphosate in a concentration of 2.3 mg/kg. The average AMPA and N-acetyl-AMPA concentrations were 0.15 mg/kg and 0.65 mg/kg, respectively.

Soy meal, hulls and oil were analysed regarding the parent compound and the three metabolites N-acetyl-glyphosate, AMPA and N-acetyl-AMPA.

In oil, no residue of any of the analytes was found above the LOQ of 0.05 mg/kg. In hulls the parent compound and the metabolites occurred in higher concentrations compared with the unprocessed RAC. The residues of glyphosate, N-acetyl-glyphosate and N-acetyl-AMPA increased significantly, on average by a factor of 5.5. The AMPA concentration was in the same magnitude as in the unprocessed soybeans. For meal a slight residue reduction was observed for all compounds concerned.

Since only a limited number of trials is available, no sound processing factors could be derived to be recommended for Annex VI.

3.1.2. Rotational crops

3.1.2.1. Preliminary considerations

Since the application is related to a GAP authorised outside the EC, the possible occurrence of residues in rotational crops is not considered relevant for the European consumer exposure.

3.2. Nature and magnitude of residues in livestock

3.2.1. Dietary burden of livestock

Maize and soybeans are potential feed items; thus a dietary burden calculation had to be performed. The intake of glyphosate and its metabolite AMPA have been assessed previously when the MRLs have been established. The new maize and soybean varieties under consideration will not alter the dietary burden regarding glyphosate and AMPA because these compounds are not expected to occur in higher concentrations than in conventional or transgenic varieties containing the modified EPSPS gene. However, the metabolites N-acetyl-glyphosate and N-acetyl-AMPA which are unique for the new genetically modification in the GAT soybeans and maize, have to be assessed as relevant compounds present in animal feed.

The glyphosate related residues on GAT maize and soybeans as reported in table 3-3 were used to calculate dietary burden of livestock. EFSA did not include maize (forage and stover) and soybean (hay and forage) in the calculation because these feed commodities are currently not included in the list of feed items commonly fed to livestock in Europe. In table 3-4 and 3-5 the input values and the results of the dietary burden calculations are presented.

Table 3-4. Input values for the dietary burden calculation

Commodity	Median dietary burden		Maximum dietary burden	
	Input value (mg/kg)	Comment	Input value (mg/kg)	Comment
Glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA				
Maize grain	0.11	STMR	0.6	HR
Soy beans	2.2	STMR	8.64	HR

Table 3-5. Results of the dietary burden calculation

	Maximum dietary burden (mg/kg bw/d)	Median dietary burden (mg/kg bw/d)	Highest contributing commodity	Max dietary burden (mg/kg DM)	Trigger exceeded ?
Glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA					
Dairy ruminants	0.029302	0.029302	Soya bean	0.805814	Yes
Meat ruminants	0.034535	0.034535	Soya bean	0.804663	Yes
Poultry	0.021812	0.021812	Soya bean	0.344622	Yes
Pigs	0.022512	0.022512	Soya bean	0.562791	Yes

It is concluded that a significant intake of glyphosate and its related metabolites above the trigger value of 0.1 mg/kg DM might be expected for all animal species under the assumption that livestock is exposed to genetically modified maize and soybeans containing the GAT gene. The dietary exposure of livestock is triggered mainly by N-acetyl-glyphosate which was the major metabolite quantified in supervised field trials on maize and soybeans. Calculations for the individual compounds included in the risk assessment residue definition also demonstrated that the dietary burden for N-acetyl-glyphosate was *ca.* 0.022 mg/kg bw for ruminants and 0.015 mg/kg bw for poultry. Parent glyphosate, AMPA and N-acetyl-AMPA are minor contributors in dietary exposure of livestock regarding the new GMO varieties of soybeans and maize. Therefore, in the framework of this evaluation, the main focus in the assessment of nature and magnitude of residues in livestock was put on N-acetyl-glyphosate.

3.2.2. Nature of residues

Based on the animal metabolism studies with ^{14}C-labelled glyphosate and AMPA which were assessed in the peer review it was concluded that the residue definitions for risk assessment and monitoring for animal products should be established as glyphosate only.

The metabolism of the metabolite N-acetyl-glyphosate resulting from genetically modified GAT plants, was investigated in goats and poultry.

Lactating goats were dosed with 205.4 mg/kg of ^{14}C-labelled N-acetyl-glyphosate in the diet via capsule for 5 consecutive days. The total recovery of the administered dose in excreta, milk and tissues was 87.83%. Most of the radioactivity was found in faeces (74.17%), urine (11.45%) and cage wash (2.12%). The extraction rates were above 75% in all matrices except muscle, where only 42% of the TRR could be released after acid and enzyme treatment. Milk, liver and kidney each contained about 0.03% of the total dose administered. The TRR in muscle, fat, kidney and liver were 0.047, 0.089, 4.689 and 0.715 mg/kg, respectively.

Most of the radioactivity found was identified as unchanged N-acetyl-glyphosate. Further metabolites were glyphosate, AMPA and N-acetyl-AMPA. The results of the metabolism study as reported in the evaluation report are summarised in Table 3-6.

Table 3-6: Summary of the metabolism study in lactating goats after N-acetyl-glyphosate administration

Component	Radioactive residues				
	Milk	Liver	Kidney	Muscle	Fat[1]
	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)
TRR	0.027	0.804	4.852	0.086	0.144
Extracted	0.021 (77.8)	0.669 (83.2)	4.708 (97.0)	0.036 (41.9)	0.098 (68.1)
AMPA	0.001 (3.7)	0.068 (8.5)	n.d.	n.d.	0.003 (2.1)
Glyphosate	0.001 (3.7)	0.118 (14.7)	0.242 (5.0)	n.d.	0.007 (4.9)
N-Acetyl-AMPA	n.d.	n.d.	n.d.	n.d.	0.010 (6.9)
N-Acetyl-glyphosate	0.011 (40.7)	0.446 (55.5)	3.742 (77.1)	0.014 (16.3)	0.069 (47.9)

1 Mean of omental, renal and subcutaneous fat
n.d. not detected

Laying hens (5 animals) were dosed for 7 consecutive days with 63 mg/kg ^{14}C-N-acetyl-glyphosate in the feed via oral administration. Excreta and eggs were sampled during the whole period of time once or twice daily, respectively.

The total recovery of the radioactivity administered was 90.18%. Most of the radioactivity (90.08%) was found in the excreta of the hens. In animal tissues TRR values ranged from 0.01 mg/kg for egg white up to 0.505 mg/kg for liver. In all matrices about 90% of the radioactivity was extracted and identified. In general, most of the radioactivity found was identified as unchanged N-acetyl-glyphosate. Further compounds identified were glyphosate, AMPA and N-acetyl-AMPA. The total radioactive residues and the identified metabolites are summarised in Table 3-7.

Table 3-7: Summary of the metabolism study in laying hens after N-acetyl-glyphosate administration

Component	Radioactive residues					
	Egg white	Egg yolk	Whole egg	Liver	Muscle	Fat
	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)	mg/kg (% TRR)
TRR	0.01	0.229	0.239	0.505	0.033	0.057
Extracted	0.009 (90)	0.187 (81.7)	0.196 (82.0)	0.483 (95.6)	0.029 (87.9)	0.053 (93)
Unextracted	0.001 (10)	0.008 (3.5)	0.009 (3.8)	0.002 (0.4)	0.004 (12.1)	0.004 (7.0)
AMPA	n.d.	0.002 (0.9)	0.002 (1.0)	0.034 (6.7)	0.005 (15.2)	0.007 (12.3)
Glyphosate	0.001 (10)	0.013 (5.7)	0.014 (5.4)	0.084 (16.6)	0.002 (6.1)	0.023 (40.4)
N-acetyl-AMPA	< 0.001 (< 10)	0.003 (1.3)	0.004 (1.7)	0.020 (4.0)	0.001 (3.0)	0.006 (10.5)
N-acetyl-glyphosate	0.004 (40)	0.157 (68.6)	0.161 (67.4)	0.323 (63.9)	0.009 (27.3)	0.014 (24.7)

n.d. not detected

In conclusion the metabolism studies in ruminants and poultry revealed that the molecule N-acetyl-glyphosate either remains unchanged or loses its N-acetyl-group forming parent glyphosate, which is further metabolised into AMPA. To a certain extent also N-acetyl-AMPA was formed. It is also noticed that glyphosate and N-acetyl-glyphosate have a tendency to accumulate in fat.

Conclusions:

The current residue definition for enforcement comprises only the parent compound glyphosate. However, EFSA is of the opinion that parent glyphosate is not a good marker residue in case livestock is exposed to maize or soybeans containing residues of N-acetyl-glyphosate. N-acetyl-glyphosate, which is expected to be the predominant compound in the genetically modified maize and soybean containing the GAT gene, is also expected to be the major compound in products of animal origin which receive feed derived from these new GMO varieties of maize and soybeans. Taking into account the low transfer rates from feed to animal tissues (see also table 3-9 and 3-10), measurable N-acetyl-glyphosate residues are not expected in animal products. Therefore EFSA proposes not to amend the residue definition for enforcement in order not to increase the burden of enforcement laboratories.

Regarding the residue definition for risk assessment the EMS proposes to extend the current residue definition (sum of glyphosate and AMPA) by including also N-acetyl-glyphosate and N-acetyl-AMPA. EFSA is of the opinion that this proposal is justified by the available data and reflects the results of the metabolism studies. In the risk assessment in the framework of MRL setting, these relevant metabolites should be included in the intake assessment. However, it was not possible to calculate conversion factors from the enforcement residue definition to the risk assessment residue definition, because in the available trials the residue concentrations of glyphosate, AMPA, N-acetyl-glyphosate and N-acetyl-AMPA are mostly below the LOQ (see 3.2.3).

EFSA proposal for amending the residue definition for livestock:

Residue definition for enforcement:	Glyphosate
Residue definition for risk assessment (in the MRL setting scenario):	Sum of glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, calculated as glyphosate.

3.2.3. Magnitude of residues

The magnitude of residues in livestock resulting from an exposure to N-acetyl-glyphosate was investigated in dairy cows and laying hens.

Dairy cows: N-acetyl-glyphosate was administered orally as aqueous solution via drench gun to lactating cows twice daily for 28 consecutive days. Dosing was conducted at treatment levels of 1.25 (dosing group 1), 3.75 (dosing group 2), 12.5 (dosing group 4) and 37.5 mg/kg bw (dosing group 5). Additional two cows were dosed at 37.5 mg/kg bw followed by a 7-day depuration period. Thus, the lowest dose level corresponds 55 times the calculated dietary burden calculated for N-acetyl-glyphosate. Milks samples were collected over the whole period of dosing. After sacrifice, the tissues and milk were analysed for residues of N-acetyl-glyphosate, glyphosate, AMPA and N-acetyl-AMPA.

In milk no residues were detected at any dose level.

In liver N-acetyl-glyphosate residues were only detected in the dosing groups 4 and 5 (mean N-acetyl-glyphosate concentrations 0.07 mg/kg (dosing group 4) and 0.43 mg/kg (dosing group 5)). AMPA was found in low concentrations in the highest dosed group after the depuration period (0.028 mg/kg).

In the kidney mean N-acetyl-glyphosate residues were detected at all dose levels ranging from 0.082 mg/kg at the lowest dose group up to 2.8 mg/kg for the test animals of dosing group 5. At the higher dose rates also glyphosate, AMPA and N-acetyl-AMPA residues were detected in low concentrations (0.21 mg/kg, 0.063 mg/kg and 0.077 mg/kg, respectively).

In fat measurable N-acetyl-glyphosate residues above the LOQ of 0.05 mg/kg were measured only at the higher dose levels (maximum value 0.12 mg/kg at dose level 5). No other related compounds (glyphosate, AMPA or N-acetyl-AMPA) could be detected above the LOQ of 0.05 mg/kg.

Muscle was free of any detectable residues of the administered N-acetyl-glyphosate or related compounds (<0.025 mg/kg for each of the individual compounds).

Based on the results of the feeding studies transfer factors can be calculated which reflect the correlation of residues in edible animal matrices and the exposure levels of livestock. The transfer rate was calculated as the quotient of residue level in edible commodity and the dosing in the feeding study (expressed in mg/kg bw).

In Table 3-8 the transfer factors for N-acetyl-glyphosate derived from the lowest feeding dose level in the feeding study in ruminants are summarised. The low transfer factors give an indication that no residues are expected in the relevant animal commodities if feed containing N-acetyl-glyphosate residues at the expected dietary burden is fed to ruminants.

Table 3-8: Estimated transfer factors calculated from the feeding study with N-acetyl-glyphosate in lactating cows at a dose rate of 1.25 mg/kg bw/d

Food commodity	Transfer factor
Milk	0.007
Ruminant meat	0.007
Ruminant fat	0.045
Ruminant liver	0.013
Ruminant kidney	0.064

<u>Laying hens:</u>

The transfer of N-acetyl-glyphosate into animal products was investigated in three groups of laying hens which were dosed with 1.5, 5.0, 15 and 50 mg per kg bw for 35 consecutive days. The lowest dose level is 100 fold of the calculated dietary burden for N-acetyl-glyphosate. Eggs were collected over the whole period of time. From the highest dose group some animals were kept for depuration for additional 19 day during which eggs were collected. At sacrifice the tissues and eggs were analysed for residues of N-acetyl-glyphosate, glyphosate, AMPA and N-acetyl-AMPA.

In eggs measurable residues of N-acetyl-glyphosate were detected in all dose groups. A constant level was reached after 14 to 24 days. The maximum concentrations in the different dose groups were 0.037 mg/kg (after dosing of 1.5 mg/kg bw) to 0.66 mg/kg in the highest dose group. In the depuration period the residues declined and after 10 days no residues above the LOD were observed. Glyphosate was measured only on one sampling day at the highest dose rate in concentrations of 0.036 mg/kg, whereas no residues of AMPA and N-acetyl-AMPA were detected above the LOQ in any sample.

In liver, fat and muscle N-acetyl-glyphosate was detected in all dose groups. In the lowest dose level the mean residues accounted for 0.19 mg/kg in liver, 0.11 mg/kg for poultry fat, and 0.031 mg/kg for muscle. The other analytes (glyphosate, AMPA and N-acetyl-AMPA) were not detected in any of the matrices.

In Table 3-9 the transfer factors for N-acetyl-glyphosate derived from the lowest feeding dose level in the feeding study in poultry are summarised.

Table 3-9: Estimated transfer factors from the feeding study with N-acetyl-glyphosate in poultry at a dose rate of 1.5 mg/kg bw/d

Food commodity	Transfer factor
Poultry meat	0.024
Poultry fat	0.087
Poultry liver	0.14
Eggs	0.033

Conclusion:
From the abovementioned feeding studies in ruminants and poultry it is concluded that at the expected dietary burden of N-acetyl-glyphosate the resulting residues of N-acetyl-glyphosate, glyphosate, AMPA and N-acetyl-AMPA in food of animal origin are below the limit of quantification of 0.05 mg/kg.

The current MRLs for glyphosate have been established on the basis of the exposure of glyphosate. Feeding soybeans and maize containing N-acetyl-glyphosate to livestock residues will not require a change of the MRLs established in Regulation 396/2005.

4. Consumer risk assessment

Since the residue definition for risk assessment for soybeans, maize and animal products is proposed to be changed, EFSA calculated the expected long-term exposure regarding glyphosate and the compounds included in the proposed residue definitions by means of the EFSA PRIMo rev. 2. An acute intake calculation was not performed since no ARfD was established.

Comparing the expected residues of glyphosate and the relevant metabolites on transgenic GAT maize and GAT soybeans (including N-acetyl-glyphosate, AMPA and N-acetyl-AMPA) with residues on EPSPS maize and soybeans (glyphosate plus AMPA), it becomes evident, that the residues on the GAT varieties are significantly lower. Thus, EFSA decided to base the intake calculation on the current MRLs and the AMPA values as reported in the DAR for EPSPS varieties, not including the N-acetyl-metabolites resulting from the GAT maize and soybean varieties.

The expected AMPA residues on genetically modified soybeans, cotton, rape seed and maize (EPSPS gene modification) were reported in the DAR (Germany, 1998). To accommodate for the different molecular weight, a correction factor of 1.67 is applied to recalculate AMPA (MW 111) to glyphosate (MW 186).

For all other plant commodities the intake calculation were performed with the MRLs.

For animal products the MRLs established for glyphosate were used as input values for the long-term dietary exposure. The contribution of N-acetyl-glyphosate, AMPA and N-acetyl-AMPA is marginal compared with the contribution of glyphosate parent compound.

Table 4-1. Input values for the consumer risk assessment

Commodity	Chronic risk assessment		Acute risk assessment	
	Input value (mg/kg)	**Comment**	**Input value (mg/kg)**	**Comment**
Risk assessment residue definition: glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, expressed as glyphosate				
Rape seed	10.8	MRL for rape (10mg/kg) plus 1.6 * MRL for AMPA (0.5 mg/kg)	Not relevant, no ARfD established	
Soybeans	28.4	MRL for rape (20 mg/kg) plus 1.6 * proposed MRL for AMPA1 (5 mg/kg)		

Commodity	Chronic risk assessment		Acute risk assessment	
	Input value (mg/kg)	**Comment**	**Input value (mg/kg)**	**Comment**
Maize	2.6	MRL for maize (1mg/kg) plus 1.6 * proposed MRL for AMPA[1] (1 mg/kg)		
All other commodities of plant origin	MRL	See Appendix B		
Food of animal origin	MRL	See Appendix B		

[1] It should be noted that the MRL proposed for AMPA in the peer review (Germany, 2000) was not included in the MRL legislation.

The approach used to calculate the dietary exposure is a very conservative screening as it is based on MRL values instead of STMR values which are normally significantly lower. But since no detailed information was available and since the current application will not change the intake situation, the calculation should just confirm that currently no consumer health risk is expected.

The results of this calculation which are reported in more detail in Appendix B demonstrate that the existing MRLs do not lead to an ADI exceedance. The highest chronic exposure was calculated for the WHO cluster diet B representing 46.5% of the ADI.

EFSA concludes that the long-term intake of residues of glyphosate, AMPA, N-acetyl-glyphosate and N-acetyl-AMP from currently authorised uses in Europe, import tolerances and potential future uses on GAT soybeans and GAT maize in the US are unlikely to present a public health concern.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Metabolism studies in genetically modified soybeans and maize containing the glyphosate-N-acetyltransferase (GAT) gene demonstrated that new metabolites are formed which were not observed in conventional crops or in glyphosate tolerant crops containing the modified 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) gene. The major metabolite in the new maize and soybean varieties under consideration is N-acetyl-glyphosate. Parent glyphosate, N-acetyl-aminomethyl phosphonic acid (N-acetyl-AMPA) and aminomethyl phosphonicacid (AMPA) were found in low concentrations in the edible parts of the crops. The toxicological assessment of N-acetyl-glyphosate and N-acetyl-AMPA revealed that these metabolites are of no higher toxicological concern than the parent compound. The ADI established for glyphosate may therefore also be applied to assess the long-term consumer risk related to the exposure to these substances.

Sufficient supervised field trials on the genetically modified maize and soybeans were submitted in which the parent compound and the metabolites were analysed separately to estimate the expected residues in treated crops. From these trials and from the metabolism studies it becomes evident that glyphosate is not a good marker substance suitable to monitor compliance with the GAP in the new genetically modified crops. EFSA therefore elaborated three options regarding decision on residue definitions for enforcement, describing advantages and disadvantages in each case:

Option 1: *glyphosate*

Option 2: *sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate*

Option 3: *N-acetyl-glyphosate* (establishing separate MRLs for N-acetyl-glyphosate in addition to the existing MRLs for glyphosate)

For risk assessment the residue definition should be changed to "*sum of glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, expressed as glyphosate*" to cover all metabolites that can be found on conventional and genetically modified crops.

Analytical methods for glyphosate are available. Additional methods have been provided to the EMS in support of the application. However, the EMS did not outline if these validated methods are applicable to enforce the proposed new residue definitions as proposed in option 2 and 3. It has to be ensured that a validated analytical method suitable for the enforcement residue definition is provided before the residue definition is changed in the MRL legislation.

It is concluded that sufficient residue data on soybean and maize were submitted to estimate the magnitude of residues in GAT maize and soybeans. In case risk managers decide to follow option 1 or 2 regarding the enforcement residue definition, the currently established MRLs for plant or animal commodities do not have to be changed because the GAPs in conventional and/or genetically modified soybean and maize based on the modification of the EPSPS gene lead to higher residues compared with the agricultural practices authorised in the US for GAT maize and soybeans.

Option 3, however (establishing separate MRLs for N-acetylglyphosate) would require to include a new substance in Annex III of Regulation (EC) No 396/2005 and to set specific MRLs at the level of 0.3 mg/kg for maize and at the level of 7 or 10 mg/kg for soybeans.

The nature and magnitude of N-acetyl-glyphosate in processed commodities was investigated. It was concluded that this compound is stable under processing conditions simulating pasteurisation, cooking, baking and sterilistation. The processing studies performed with incurred residues suggest that no measurable residues will occur in starch produced from treated maize, in soya oil and in maize oil. In soya hulls a concentration by a factor of ca. 5.5 was observed for glyphosate and its metabolites

N-acetyl-glyphosate and N-acetyl-AMPA. However, due to the limited database no robust processing factors could be derived.

In case GAT maize and soybeans treated with glyphosate are used as feed, livestock will be exposed not only to glyphosate and AMPA but also to the new metabolites typical for these genetically modified varieties (mainly N-acetylglyphosate). The dietary burden calculations identified that a significant intake of glyphosate and its related metabolites above the trigger value of 0.1 mg/kg DM might be expected for all animal species if livestock is exposed to genetically modified maize and soybeans containing the GAT gene. In order to address the situation in livestock, the applicant provided metabolism studies in ruminants and poultry performed with N-acetyl-glyphosate. These studies demonstrated that N-acetyl-glyphosate either remains unchanged or loses its N-acetyl-group forming parent glyphosate which is further metabolised into AMPA. To a certain extent also N-acetyl-AMPA was found in certain animal matrices. The feeding studies with N-acetyl-glyphosate showed that the transfer into food of animal origin is very low and that in all commodities the N-acetyl-glyphosate residues are expected to be below the limit of quantification. Thus, based on the results of the metabolism and the feeding studies, it is concluded that neither the current enforcement residue definition for animal commodities nor the MRLs for animal products have to be changed. However, the residue definition for risk assessment should be amended taking into account the possible presence of N-acetyl-glyphosate and N-acetyl-AMPA.

EFSA performed a consumer risk assessment to assess whether the proposed change of the risk assessment residue definitions for plant and animal commodities would have an impact on the consumer safety. The calculation was based on the current MRLs and the available residue concentrations for AMPA as described in the DAR. N-acetyl-glyphosate and N-acetyl-AMPA were not included in the calculation, since the current MRLs for soybeans and maize based on the glyphosate use in conventional and/or genetically modified varieties with a different mode of action are significantly higher than the residues in GAT soybeans and maize. The use of the current MRLs and the expected residues of AMPA is therefore a more critical scenario regarding the consumer exposure. Although the intake calculation is expected to overestimate the real exposure estimation, the exposure was below the ADI (45% of the ADI). It is therefore concluded that for glyphosate and glyphosate related residues no long-term consumer health risk is expected.

RECOMMENDATIONS

EFSA proposes to amend the residue definitions for risk assessment purposes as follows:

	Residue definition risk assessment
All plant commodities, including soybeans and maize	Sum of glyphosate, N-acetyl-glyphosate, AMPA and N-acetyl-AMPA, calculated as glyphosate.
All food commodities of animal origin	

Concerning the residue definition for enforcement EFSA proposes 3 different options to be decided by risk managers.

		Residue definition enforcement	**Conversion factor residue definition enforcement to residue definition risk assessment**
Maize, soybeans	**Option 1**	Glyphosate	3 (maize) 17.7 (soybeans)

	Option 2	Sum of glyphosate and N-acetyl-glyphosate, expressed as glyphosate	1.2 (soybeans) 2.3 (maize)
	Option 3	N-acetyl-glyphosate	2.5 (maize) 1.3 (soybeans)
Other plant commodities		Glyphosate No change needed	No information available for AMPA in conventional crops and genetically modified crops containing EPSPS enzyme. For N-acetyl-glyphosate and N-acetyl-AMPA not relevant because no occurrence on crops except GAT maize and soybeans.
Animal commodities		Glyphosate No change needed	Could not be calculated because in feeding studies no measurable residues of N-acetyl-glyphosate, AMPA and N-acetyl-AMPA in animal commodities were observed.

In case **option 1 or 2** is selected, no amendment of the numeric MRL values is needed.

In the case of **option 3** the following MRLs have to be included in Annex III Regulation (EC) No. 396/2005

Commodity	**Enforcement residue definition:** **N-acetyl-glyphosate**
Maize	0.3 mg/kg
Soybeans	7 or 10 mg/kg
Other plant commodities	Not relevant
Food of animal origin	Not relevant

It is also concluded that in case of option 1 or 3 the availability of analytical methods suitable for routine MRL enforcement has to be ensured.

DOCUMENTATION PROVIDED TO EFSA

1. Evaluation Report: Vorlage eines Antrags auf Festlegung eines Rückstandshöchstgehalts an Glyphosat in gentechnisch veränderten Sojabohnen und Mais nach Artikel 9 Absatz 1 der Verordnung (EG) Nr. 396/2005. 23.01.2009. Berichterstattung durch Bundesrepublik Deutschland

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APPENDIX A – GOOD AGRICULTURAL PRACTICES (GAPS)

Federal Office for Consumer Protection and Food Safety
Division 2 – Plant Protection Product – Section 207
D-38104 Braunschweig, Messeweg 11 – 12

Date : 2008-07-21

Country : Federal Republic of Germany

Pesticide(s) (common name(s)) : **Glyphosate**
EEC, CIPAC and CCPR No(s). :
Trade name(s) : **Touchdown HITech & Touchdown Total**
Main uses e.g. insecticide, fungicide : Herbizide
Applicant : DuPont

Use Pattern

1	2	3	4	5	6			7			8	9
Crop and / or situation	F, G or I	Pest or group of pests Controlled	Formulation		Application			Application rate per treatment			PHI (days)	Remarks:
			Type	Conc. of a.i.	method, kind	growth stage	number (range)	kg a.i./hl	water l/ha	kg a.i./ha		
(a)	(b)	(c)	(d - f)	(i)	(f - h)	(j)					(k)	(l)
Maize	F	Broadleaf Weeds and Grasses	SL	600 g a.i./L & 500 g a.i./L	Broadcast high volume hydraulic spraying & Broadcast aerial	BBCH 07 to 99	1-4	0.23 – 15	28 – 374	0.87 – 4.1	7	Maximum glyphosate per season: 6.77 kg a.i./ha
Soya bean	F	Broadleaf Weeds and Grasses	SL	600 g a.i./L & 500 g a.i./L	Broadcast high volume hydraulic spraying & Broadcast aerial	BBCH 08 to 99	1-4	0.22 - 12	28 - 374	0.82 – 3.33	14	Maximum glyphosate per season: 6.77 kg a.i./ha

Remarks:
(a) In case of group of crops the Codex classification should be used
(b) Outdoor or field use (F), glasshouse application (G) or indoor application (I)
(c) e.g. biting and sucking insects, soil born insects, foliar fungi
(d) Suspension concentrate (= flowable concentrate) (SC)
(e) Use CIPAC/FAO Codes where appropriate
(f) All abbreviations used must be explained
(g) Method, e.g. high volume spraying, low volume spraying, spreading, dusting, drench
(h) Kind, e.g. overall, broadcast, aerial spraying, row, individual plant, between the plants
(i) g/kg or g/l
(j) Growth stage at last treatment
(k) PHI = Pre-harvest interval

(l) Remarks may include: Extent of use/economic importance/restrictions (e.g. feeding,grazing)/minimal intervals between applications

APPENDIX B – PESTICIDE RESIDUES INTAKE MODEL (PRIMO)

Glyphosate			
Status of the active substance:		Code no.	
LOQ (mg/kg bw):	0,1	proposed LOQ:	
Toxicological end points			
ADI (mg/kg bw/day):	**0,3**	ARfD (mg/kg bw):	**n.n.**
Source of ADI:	**2002**	Source of ARfD:	**2002**
Year of evaluation:	**COM**	Year of evaluation:	**COM**

Calculation performed with the existing MRLs (status July 2009). For soybeans, rape seed and maize, AMPA was included after recalculation to glyphosate.

The risk assessment has been performed on the basis of the MRLs collected from Member States in April 2006. For each pesticide/commodity the highest national MRL was identified (proposed temporary MRL = pTMRL).

The pTMRLs have been submitted to EFSA in September 2006.

Chronic risk assessment - refined calculations

TMDI (range) in % of ADI minimum - maximum	
1	47
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)
46,5	WHO Cluster diet B	28,5	Wheat	5,7	Soya bean	4,9	Sunflower seed	0,6
36,7	DK child	18,3	Wheat	14,7	Rye	2,6	Oats	0,5
33,8	WHO cluster diet D	21,7	Wheat	3,5	Soya bean	3,3	Sunflower seed	0,3
32,9	WHO cluster diet E	13,1	Wheat	5,5	Soya bean	5,4	Barley	0,3
29,0	WHO Cluster diet F	12,0	Wheat	6,2	Soya bean	4,0	Barley	0,3
24,2	IE adult	8,3	Barley	7,7	Wheat	2,0	Maize	0,7
23,4	UK Toddler	13,1	Wheat	7,6	Sugar beet (root)	0,6	Potatoes	0,6
23,2	IT kids/toddler	22,2	Wheat	0,1	Potatoes	0,1	Wild fungi	0,3
21,6	DE child	13,7	Wheat	2,6	Rye	1,4	Oats	1,0
21,0	PT General population	13,1	Wheat	2,9	Soya bean	1,9	Sunflower seed	0,2
21,0	NL child	15,8	Wheat	1,0	Potatoes	0,7	Oats	1,1
17,8	ES child	14,8	Wheat	0,8	Sunflower seed	0,4	Peas	0,5
16,7	UK Infant	8,7	Wheat	3,4	Sugar beet (root)	1,7	Oats	0,9
16,1	WHO regional European diet	9,9	Wheat	2,2	Barley	0,9	Sunflower seed	0,4
14,6	IT adult	13,8	Wheat	0,2	Wild fungi	0,1	Potatoes	0,2
14,5	FR all population	11,0	Wheat	2,2	Sunflower seed	0,7	Wine grapes	0,2
13,1	SE general population 90th percentile	10,7	Wheat	1,0	Rye	0,7	Potatoes	0,6
13,0	ES adult	7,8	Wheat	3,3	Barley	0,7	Sunflower seed	0,3
12,2	FR toddler	8,7	Wheat	1,1	Sunflower seed	0,8	Potatoes	1,1
11,5	NL general	6,9	Wheat	2,5	Barley	0,5	Potatoes	0,3
10,5	DK adult	6,7	Wheat	2,3	Rye	0,8	Oats	0,2
9,7	UK vegetarian	6,8	Wheat	1,3	Sugar beet (root)	0,3	Oats	0,2
9,2	LT adult	3,6	Rye	3,5	Wheat	0,6	Oats	0,2
8,1	UK Adult	5,6	Wheat	1,3	Sugar beet (root)	0,2	Potatoes	0,2
7,1	FI adult	3,3	Wheat	2,3	Rye	0,6	Oats	0,2
4,6	FR infant	2,8	Wheat	0,7	Potatoes	0,4	Milk and cream,	0,8
1,0	PL general population	0,6	Potatoes	0,1	Peas	0,1	Apples	0,2

Conclusion:

The estimated Theoretical Maximum Daily Intakes (TMDI), based on pTMRLs were below the ADI.
A long-term intake of residues of Glyphosate 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 MRL
***) pTMRL: provisional temporary MRL for unprocessed commodity

Conclusion:

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

APPENDIX C – EXISTING EC MRLS

Glyphosate

pesticide residues and maximum residue levels (mg/kg)
(*) Indicates lower limit of analytical determination

Pesticides - Web Version - EU MRLs (File created on 20/07/2009 11:52)

Code number	Groups and examples of individual products to which the MRLs apply (a)	Reg. (EC) No 839/2008
100000	1. FRUIT FRESH OR FROZEN; NUTS	
110000	(i) Citrus fruit	
110010	Grapefruit (Shaddocks, pomelos, sweeties, tangelo, ugli and other hybrids)	0,1*
110020	Oranges (Bergamot, bitter orange, chinotto and other hybrids)	0,5
110030	Lemons (Citron, lemon)	0,1*
110040	Limes	0,1*
110050	Mandarins (Clementine, tangerine and other hybrids)	0,5
110990	Others	0,1*
120000	(ii) Tree nuts (shelled or unshelled)	0,1*
120010	Almonds	0,1*
120020	Brazil nuts	0,1*
120030	Cashew nuts	0,1*
120040	Chestnuts	0,1*
120050	Coconuts	0,1*
120060	Hazelnuts (Filbert)	0,1*
120070	Macadamia	0,1*
120080	Pecans	0,1*
120090	Pine nuts	0,1*
120100	Pistachios	0,1*
120110	Walnuts	0,1*
120990	Others	0,1*
130000	(iii) Pome fruit	0,1*
130010	Apples (Crab apple)	0,1*
130020	Pears (Oriental pear)	0,1*
130030	Quinces	0,1*
130040	Medlar	0,1*
130050	Loquat	0,1*
130990	Others	0,1*
140000	(iv) Stone fruit	0,1*
140010	Apricots	0,1*
140020	Cherries (sweet cherries, sour cherries)	0,1*
140030	Peaches (Nectarines and similar hybrids)	0,1*
140040	Plums (Damson, greengage, mirabelle)	0,1*
140990	Others	0,1*
150000	(v) Berries & small fruit	
151000	(a) Table and wine grapes	**0,5**
151010	Table grapes	**0,5**
151020	Wine grapes	**0,5**
152000	(b) Strawberries	0,1*
153000	(c) Cane fruit	0,1*
153010	Blackberries	0,1*
153020	Dewberries (Loganberries, Boysenberries, and cloudberries)	0,1*
153030	Raspberries (Wineberries)	0,1*
153990	Others	0,1*
154000	(d) Other small fruit & berries	0,1*
154010	Blueberries (Bilberries cowberries (red bilberries))	0,1*
154020	Cranberries	0,1*
154030	Currants (red, black and white)	0,1*
154040	Gooseberries (Including hybrids with other ribes species)	0,1*
154050	Rose hips	0,1*
154060	Mulberries (arbutus berry)	0,1*
154070	Azarole (mediteranean medlar)	0,1*
154080	Elderberries (Black chokeberry (appleberry), mountain ash, azarole, buckthorn (sea sallowthorn), hawthorn, service berries, and other treeberries)	0,1*
154990	Others	0,1*
160000	(vi) Miscellaneous fruit	
161000	(a) Edible peel	
161010	Dates	0,1*
161020	Figs	0,1*
161030	Table olives	1
161040	Kumquats (Marumi kumquats, nagami kumquats)	0,1*
161050	Carambola (Bilimbi)	0,1*
161060	Persimmon	0,1*
161070	Jambolan (java plum) (Java apple (water apple), pomerac, rose apple, Brazilean cherry (grumichama), Surinam cherry)	0,1*
161990	Others	0,1*
162000	(b) Inedible peel, small	0,1*
162010	Kiwi	0,1*
162020	Lychee (Litchi) (Pulasan, rambutan (hairy litchi))	0,1*
162030	Passion fruit	0,1*
162040	Prickly pear (cactus fruit)	0,1*
162050	Star apple	0,1*
162060	American persimmon (Virginia kaki) (Black sapote, white sapote, green sapote, canistel (yellow sapote), and mammey sapote)	0,1*
162990	Others	0,1*
163000	(c) Inedible peel, large	0,1*
163010	Avocados	0,1*
163020	Bananas (Dwarf banana, plantain, apple banana)	0,1*
163030	Mangoes	0,1*
163040	Papaya	0,1*
163050	Pomegranate	0,1*
163060	Cherimoya (Custard apple, sugar apple (sweetsop) , llama and other medium sized Annonaceae)	0,1*
163070	Guava	0,1*
163080	Pineapples	0,1*
163090	Bread fruit (Jackfruit)	0,1*
163100	Durian	0,1*
163110	Soursop (guanabana)	0,1*
163990	Others	0,1*
200000	2. VEGETABLES FRESH OR FROZEN	
210000	(i) Root and tuber vegetables	
211000	(a) Potatoes	0,5
212000	(b) Tropical root and tuber vegetables	0,1*
212010	Cassava (Dasheen, eddoe (Japanese taro), tannia)	0,1*
212020	Sweet potatoes	0,1*
212030	Yams (Potato bean (yam bean), Mexican yam bean)	0,1*
212040	Arrowroot	0,1*
212990	Others	0,1*
213000	(c) Other root and tuber vegetables except sugar beet	0,1*
213010	Beetroot	0,1*
213020	Carrots	0,1*
213030	Celeriac	0,1*

Code number	Groups and examples of individual products to which the MRLs apply (a)	Reg. (EC) No 839/2008
213040	Horseradish	0,1*
213050	Jerusalem artichokes	0,1*
213060	Parsnips	0,1*
213070	Parsley root	0,1*
213080	Radishes (Black radish, Japanese radish, small radish and similar varieties)	0,1*
213090	Salsify (Scorzonera, Spanish salsify (Spanish oysterplant))	0,1*
213100	Swedes	0,1*
213110	Turnips	0,1*
213990	Others	0,1*
220000	(ii) Bulb vegetables	0,1*
220010	Garlic	0,1*
220020	Onions (Silverskin onions)	0,1*
220030	Shallots	0,1*
220040	Spring onions (Welsh onion and similar varieties)	0,1*
220990	Others	0,1*
230000	(iii) Fruiting vegetables	0,1*
231000	(a) Solanacea	0,1*
231010	Tomatoes (Cherry tomatoes,)	0,1*
231020	Peppers (Chilli peppers)	0,1*
231030	Aubergines (egg plants) (Pepino)	0,1*
231040	Okra, lady’s fingers	0,1*
231990	Others	0,1*
232000	(b) Cucurbits - edible peel	0,1*
232010	Cucumbers	0,1*
232020	Gherkins	0,1*
232030	Courgettes (Summer squash, marrow (patisson))	0,1*
232990	Others	0,1*
233000	(c) Cucurbits-inedible peel	0,1*
233010	Melons (Kiwano)	0,1*
233020	Pumpkins (Winter squash)	0,1*
233030	Watermelons	0,1*
233990	Others	0,1*
234000	(d) Sweet corn	0,1*
239000	(e) Other fruiting vegetables	0,1*
240000	(iv) Brassica vegetables	0,1*
241000	(a) Flowering brassica	0,1*
241010	Broccoli (Calabrese, Chinese broccoli, Broccoli raab)	0,1*
241020	Cauliflower	0,1*
241990	Others	0,1*
242000	(b) Head brassica	0,1*
242010	Brussels sprouts	0,1*
242020	Head cabbage (Pointed head cabbage, red cabbage, savoy cabbage, white cabbage)	0,1*
242990	Others	0,1*
243000	(c) Leafy brassica	0,1*
243010	Chinese cabbage (Indian (Chinese) mustard, pak choi, Chinese flat cabbage (tai goo choi), peking cabbage (pe-tsai), cow cabbage)	0,1*
243020	Kale (Borecole (curly kale), collards)	0,1*
243990	Others	0,1*
244000	(d) Kohlrabi	0,1*
250000	(v) Leaf vegetables & fresh herbs	0,1*
251000	(a) Lettuce and other salad plants including Brassicacea	0,1*
251010	Lamb´s lettuce (Italian cornsalad)	0,1*
251020	Lettuce (Head lettuce, lollo rosso (cutting lettuce), iceberg lettuce, romaine (cos) lettuce)	0,1*
251030	Scarole (broad-leaf endive) (Wild chicory, red-leaved chicory, radicchio, curld leave endive, sugar loaf)	0,1*
251040	Cress	0,1*
251050	Land cress	0,1*
251060	Rocket, Rucola (Wild rocket)	0,1*
251070	Red mustard	0,1*
251080	Leaves and sprouts of Brassica spp (Mizuna)	0,1*
251990	Others	0,1*
252000	(b) Spinach & similar (leaves)	0,1*
252010	Spinach (New Zealand spinach, turnip greens (turnip tops))	0,1*
252020	Purslane (Winter purslane (miner’s lettuce), garden purslane, common purslane, sorrel, glassworth)	0,1*
252030	Beet leaves (chard) (Leaves of beetroot)	0,1*
252990	Others	0,1*
253000	(c) Vine leaves (grape leaves)	0,1*
254000	(d) Water cress	0,1*
255000	(e) Witloof	0,1*
256000	(f) Herbs	0,1*
256010	Chervil	0,1*
256020	Chives	0,1*
256030	Celery leaves (fennel leaves , Coriander leaves, dill leaves, Caraway leaves, lovage, angelica, sweet cisely and other Apiacea)	0,1*
256040	Parsley	0,1*
256050	Sage (Winter savory, summer savory,)	0,1*
256060	Rosemary	0,1*
256070	Thyme (marjoram, oregano)	0,1*
256080	Basil (Balm leaves, mint, peppermint)	0,1*
256090	Bay leaves (laurel)	0,1*
256100	Tarragon (Hyssop)	0,1*
256990	Others	0,1*
260000	(vi) Legume vegetables (fresh)	0,1*
260010	Beans (with pods) (Green bean (french beans, snap beans), scarlet runner bean, slicing bean, yardlong beans)	0,1*
260020	Beans (without pods) (Broad beans, Flageolets, jack bean, lima bean, cowpea)	0,1*
260030	Peas (with pods) (Mangetout (sugar peas))	0,1*
260040	Peas (without pods) (Garden pea, green pea, chickpea)	0,1*
260050	Lentils	0,1*
260990	Others	0,1*
270000	(vii) Stem vegetables (fresh)	0,1*
270010	Asparagus	0,1*
270020	Cardoons	0,1*
270030	Celery	0,1*
270040	Fennel	0,1*
270050	Globe artichokes	0,1*
270060	Leek	0,1*
270070	Rhubarb	0,1*
270080	Bamboo shoots	0,1*
270090	Palm hearts	0,1*
270990	Others	0,1*
280000	(viii) Fungi	
280010	Cultivated (Common mushroom, Oyster mushroom, Shi-take)	0,1*
280020	Wild (Chanterelle, Truffle, Morel ,)	50
280990	Others	0,1*
290000	(ix) Sea weeds	
300000	3. PULSES, DRY	
300010	Beans (Broad beans, navy beans,	2

Code number	Groups and examples of individual products to which the MRLs apply (a)	Reg. (EC) No 839/2008
	flageolets, jack beans, lima beans, field beans, cowpeas)	
300020	Lentils	0,1*
300030	Peas (Chickpeas, field peas, chickling vetch)	10
300040	Lupins	10
300990	Others	0,1*
400000	4. OILSEEDS AND OILFRUITS	
401000	(i) Oilseeds	
401010	Linseed	10
401020	Peanuts	0,1*
401030	Poppy seed	0,1*
401040	Sesame seed	0,1*
401050	Sunflower seed	20
401060	Rape seed (Bird rapeseed, turnip rape)	10
401070	Soya bean	20
401080	Mustard seed	10
401090	Cotton seed	10
401100	Pumpkin seeds	0,1*
401110	Safflower	0,1*
401120	Borage	0,1
401130	Gold of pleasure	0,1
401140	Hempseed	0,1*
401150	Castor bean	0,1
401990	Others	0,1*
402000	(ii) Oilfruits	
402010	Olives for oil production	1
402020	Palm nuts (palmoil kernels)	0,1
402030	Palmfruit	0,1
402040	Kapok	0,1
402990	Others	0,1*
500000	5. CEREALS	
500010	Barley	20
500020	Buckwheat	0,1*
500030	Maize	1
500040	Millet (Foxtail millet, teff)	0,1*
500050	Oats	20
500060	Rice	0,1*
500070	Rye	10
500080	Sorghum	20
500090	Wheat (Spelt Triticale)	10
500990	Others	0,1*
600000	6. TEA, COFFEE, HERBAL INFUSIONS AND COCOA	
610000	(i) Tea (dried leaves and stalks, fermented or otherwise of Camellia sinensis)	2
620000	(ii) Coffee beans	0,1
630000	(iii) Herbal infusions (dried)	2
631000	(a) Flowers	2
631010	Camomille flowers	2
631020	Hybiscus flowers	2
631030	Rose petals	2
631040	Jasmine flowers	2
631050	Lime (linden)	2
631990	Others	2
632000	(b) Leaves	2
632010	Strawberry leaves	2
632020	Rooibos leaves	2
632030	Maté	2*
632990	Others	2*
633000	(c) Roots	2*
633010	Valerian root	2*
633020	Ginseng root	2*
633990	Others	2*
639000	(d) Other herbal infusions	2*
640000	(iv) Cocoa (fermented beans)	0,1*
650000	(v) Carob (st johns bread)	0,1*

Code number	Groups and examples of individual products to which the MRLs apply (a)	Reg. (EC) No 839/2008
700000	7. HOPS (dried) , including hop pellets and unconcentrated powder	0,1*
800000	8. SPICES	0,1*
810000	(i) Seeds	0,1*
810010	Anise	0,1*
810020	Black caraway	0,1*
810030	Celery seed (Lovage seed)	0,1*
810040	Coriander seed	0,1*
810050	Cumin seed	0,1*
810060	Dill seed	0,1*
810070	Fennel seed	0,1*
810080	Fenugreek	0,1*
810090	Nutmeg	0,1*
810990	Others	0,1*
820000	(ii) Fruits and berries	0,1*
820010	Allspice	0,1*
820020	Anise pepper (Japan pepper)	0,1*
820030	Caraway	0,1*
820040	Cardamom	0,1*
820050	Juniper berries	0,1*
820060	Pepper, black and white (Long pepper, pink pepper)	0,1*
820070	Vanilla pods	0,1*
820080	Tamarind	0,1*
820990	Others	0,1*
830000	(iii) Bark	0,1*
830010	Cinnamon (Cassia)	0,1*
830990	Others	0,1*
840000	(iv) Roots or rhizome	0,1*
840010	Liquorice	0,1*
840020	Ginger	0,1*
840030	Turmeric (Curcuma)	0,1*
840040	Horseradish	0,1*
840990	Others	0,1*
850000	(v) Buds	0,1*
850010	Cloves	0,1*
850020	Capers	0,1*
850990	Others	0,1
860000	(vi) Flower stigma	0,1
860010	Saffron	0,1*
860990	Others	0,1*
870000	(vii) Aril	0,1*
870010	Mace	0,1*
870990	Others	0,1*
900000	9. SUGAR PLANTS	
900010	Sugar beet (root)	1*
900020	Sugar cane	0,1*
900030	Chicory roots	0,1*
900990	Others	0,1*
1000000	10. PRODUCTS OF ANIMAL ORIGIN-TERRESTRIAL ANIMALS	
1010000	(i) Meat, preparations of meat, offals, blood, animal fats fresh chilled or frozen, salted, in brine, dried or smoked or processed as flours or meals other processed products such as sausages and food preparations based on these	
1011000	(a) Swine	
1011010	Meat	0,05*
1011020	Fat free of lean meat	0,05*
1011030	Liver	0,05*
1011040	Kidney	0,5
1011050	Edible offal	0,05*
1011990	Others	0,05*
1012000	(b) Bovine	
1012010	Meat	0,05*
1012020	Fat	0,05*

Code number	Groups and examples of individual products to which the MRLs apply (a)	Reg. (EC) No 839/2008
1012030	Liver	0,2
1012040	Kidney	2
1012050	Edible offal	0,05*
1012990	Others	0,05*
1013000	(c) Sheep	0,05*
1013010	Meat	
1013020	Fat	
1013030	Liver	
1013040	Kidney	
1013050	Edible offal	
1013990	Others	
1014000	(d) Goat	0,05*
1014010	Meat	
1014020	Fat	
1014030	Liver	
1014040	Kidney	
1014050	Edible offal	
1014990	Others	
1015000	(e) Horses, asses, mules or hinnies	0,05*
1015010	Meat	0,05*
1015020	Fat	0,05*
1015030	Liver	0,05*
1015040	Kidney	0,05*
1015050	Edible offal	0,05*
1015990	Others	0,05*
1016000	(f) Poultry -chicken, geese, duck, turkey and Guinea fowl-, ostrich, pigeon	
1016010	Meat	0,05*
1016020	Fat	0,05*
1016030	Liver	0,05*
1016040	Kidney	0,1*
1016050	Edible offal	0,05*
1016990	Others	0,05*
1017000	(g) Other farm animals (Rabbit, Kangaroo)	0,05*
1017010	Meat	0,05*
1017020	Fat	0,05*
1017030	Liver	0,05*
1017040	Kidney	0,05
1017050	Edible offal	0,05
1017990	Others	0,05
1020000	(ii) Milk and cream, not concentrated, nor containing added sugar or sweetening matter, butter and other fats derived from milk, cheese and curd	**0,05***
1020010	Cattle	**0,05***
1020020	Sheep	**0,05***
1020030	Goat	**0,05***
1020040	Horse	**0,05***
1020990	Others	**0,05***
1030000	(iii) Birds' eggs, fresh preserved or cooked Shelled eggs and egg yolks fresh, dried, cooked by steaming or boiling in water, moulded, frozen or otherwise preserved whether or not containing added sugar or sweetening matter	**0,05***
1030010	Chicken	
1030020	Duck	**0,05***
1030030	Goose	**0,05***
1030040	Quail	**0,05***
1030990	Others	**0,05***
1040000	(iv) Honey (Royal jelly, pollen)	
1050000	(v) Amphibians and reptiles (Frog legs, crocodiles)	
1060000	(vi) Snails	
1070000	(vii) Other terrestrial animal products	

ABBREVIATIONS

a.s.	active substance
ADI	acceptable daily intake
AMPA	Aminomethyl phosphonic acid
ARfD	acute reference dose
BBCH	Federal Biological Research Centre for Agriculture and Forestry (Germany)
BVL	Bundesamt für Verbraucherschutz und Lebensmittelsicherheit, Germany
Bw	body weight
CAC	Codex Alimentarius Commission
CAS	Chemical Abstract Service
CF	conversion factor for enforcement residue definition to risk assessment residue definition
CIPAC	Collaborative International Pesticide Analytical Council Limited
CXL	codex maximum residue limit
D	day
DAR	Draft Assessment Report (prepared under Directive 91/414/eec)
DAT	days after treatment
DM	dry matter
DT_{90}	period required for 90 percent dissipation (define method of estimation)
DTU	Danish Technical University
EC	European Community
ECD	electron capture detection
EDI	estimated daily intake
EFSA	European Food Safety Authority
EMS	Evaluating Member State
EPSPS	5-enolpyruvylshikimate-3-phosphate synthase
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FID	flame ionization detection
GAP	good agricultural practice
GAT	Glyphosate-N-acetyl-transferase
GC	gas chromatography
GS	growth stage
ha	hectare
hL	hectolitre

HPLC	high performance liquid chromatography
HR	highest residue
ILV	independent laboratory validation
ISO	International Organization for Standardization
IUPAC	International Union of Pure and Applied Chemistry
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
K_{oc}	organic carbon adsorption coefficient
L	litre
LC	liquid chromatography
LC-MS	liquid chromatography-mass spectrometry
LC-MS-MS	liquid chromatography with tandem mass spectrometry
LOAEL	lowest observed adverse effect level
LOD	limit of detection
LOQ	limit of quantification
MRL	maximum residue limit
MS	Member States
NEU	Northern European Union
NOAEL	no observed adverse effect level
PF	processing factor
PHI	pre harvest interval
ppm	parts per million (10^{-6})
PRIMo	Pesticide Residues Intake Model
PSD	Pesticide Safety Directorate, United Kingdom
RMS	Rapporteur Member State
SC	suspension concentrate
SEU	Southern European Union
SG	water soluble granule
SL	soluble concentrate
STMR	supervised trials median residue
TMDI	theoretical maximum daily intake
TMDI	theoretical maximum daily intake
TRR	total radioactive residue
UVD	ultra-violet detection
WG	water dispersible granule
WHO	World Health Organisation

WP	wettable powder
a.s.	active substance