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OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM:

SUBJECT: Atrazine, Special Review. Revised Anticipated Residues in Corn and Sorghum, and Animal Commodities. No MRID No. No CBRS No. No DP Barcode No.

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CBRS recently reviewed a submission from registrant Ciba-Geigy Corporation which included additional data on the nature of the residue of atrazine in corn and sorghum (CBRS 10980, 6/3/93, J. Abbotts). The current position of the HED Metabolism Committee is that exposure assessment for atrazine is to be conducted on the basis of total radioactive residue (Memo, 8/7/92, M.S. Metzger). The previous determination of anticipated residues for atrazine was based on data representing total radioactive residue, and on data from non-radiolabel residue studies, with conservative assumptions for total residue of concern (DEB 5783, 5/3/90, M.S. Metzger). The most recent submission provided additional data which allow a modest refinement of anticipated residues. It should be noted that supporting storage stability data and the resolution of minor deficiencies are required before the most recent data can be considered accepted (CBRS 10980, 6/3/93, J. Abbotts). The

anticipated residues provided herein must therefore be considered conditional upon acceptance of the supporting data. However, the revised anticipated residues here agree reasonably well with the previous determination, and it seems likely that they eventually will be considered acceptable. It should be emphasized that the revised anticipated residues are only for corn and sorghum, and data on additional crops are still required; because corn and sorghum commodities represent major components of animal diets, revised anticipated residues have also been calculated for animal commodities.

Tolerances are established for residues of the herbicide atrazine, 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine, in or on agricultural commodities (40 CFR 180.220(a)), and for combined residues of atrazine and its metabolites 2-amino-4-chloro-6-ethylamino-*s*-triazine, 2-amino-4-chloro-6-isopropylamino-*s*-triazine, and 2-chloro-4,6-diamino-*s*-triazine, in or on specified plant commodities (40 CFR 180.220(b)). Atrazine is a List A Chemical. The Residue Chemistry Chapter was issued 7/25/83; the Registration Standard (Guidance Document) was issued 9/85; a Second Round Review (SRR) Residue Chemistry Chapter was issued 10/18/88.

Conclusions

1. Revised anticipated residues have been determined for corn and sorghum commodities, and for animal commodities. For all animal commodities except milk, corn and sorghum represent the only commodities in national commerce expected to contribute combined atrazine residues to livestock diets. Table 1 provides previous (DEB 5783, 5/3/90, M.S. Metzger) and revised combined anticipated residues of concern for atrazine in commodities edible for humans. Anticipated residues for corn and sorghum commodities are based on total radioactive residues (TRR) from metabolism studies. Anticipated residues for animal commodities are based on TRRs from livestock feed items, adjusted for percent crop treated data and data on transfer of residues from feed to livestock tissues.

Table 1. Revised Anticipated Residues for Atrazine.

Commodity	Combined anticipated residues, ppm:	
	Previous	Revised
Corn grain	0.10	0.06
Sorghum grain	0.13	0.14
Meat, fat, and meat byproducts (except liver and kidney) of cattle, goats, hogs, horses, and sheep	0.004	0.002
Liver of cattle, goats, hogs, horses, and sheep	0.02	0.064
Kidney of cattle, goats, hogs, horses, and sheep	0.006	0.014
Milk	0.004	0.004
Meat, fat, and meat byproducts (except liver) of poultry	0.0006	0.0006
Liver of poultry	0.002	0.007
Whole eggs	0.01	0.007
Egg whites	0.009	0.008
Egg yolks	0.01	0.006

The revised anticipated residues are higher than the previous values for liver and kidney of cattle, goats, hogs, horses, and sheep; and for liver of poultry. We note that the differences are relatively small (≈3-fold), and in addition, meat is the more frequently consumed animal commodity. Other changes in anticipated residues represent no more than a 2-fold increase or decrease.

2. Percent crop treated values used in the previous determination of anticipated residues were 70% for corn and sorghum (DEB 5783, 5/3/90, M.S. Metzger). These values are still appropriate, and have been used to calculate anticipated residues in livestock diets for this revised determination. The most recent value for sweet corn was 60% crop treated (Briefing Paper, Division Director Briefing on the Triazine Herbicides, 4/21/93).

Recommendations

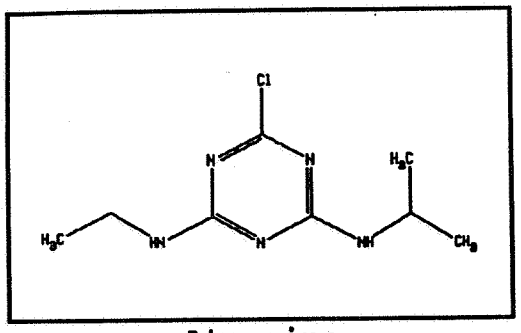
It should be noted that the revised anticipated residues in Table 1 were determined only for corn and sorghum, and for animal commodities. For all animal commodities except milk, corn and sorghum represent the only commodities in national commerce expected to contribute combined atrazine residues to livestock diets. Residue data remain outstanding on additional crops relevant to exposure assessment, including grass, which represents the potential for significant transfer of residues to milk, and sugarcane. If it should be considered desirable to reevaluate dietary risk on an interim basis, CBRS recommends that the revised anticipated residues in Conclusion 1 and the percent crop treated values for corn and sorghum in Conclusion 2 be used.

DETAILED CONSIDERATIONS

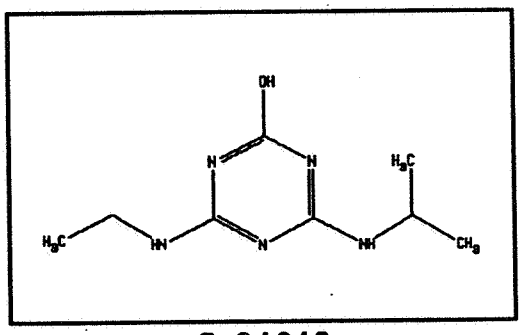
Background

The Residue Chemistry Chapter (7/25/83) concluded that the metabolism of atrazine in plants was adequately understood. Identified metabolites included 2-chloro-4,6-diamino-*s*-triazine (G-28273), 2-amino-4-chloro-6-ethylamino-*s*-triazine (G-28279), 2-amino-4-chloro-6-isoproylamino-*s*-triazine (G-30033), and 2-ethylamino-4-isopropylamino-6-hydroxy-*s*-triazine (hydroxyatrazine, G-34048). The Second Round Review Residue Chemistry Chapter (10/18/88) reported the additional hydroxy metabolites GS-17791, GS-17792, and GS-17794, and concluded that high levels of polar and insoluble residues in mature tissues had not been adequately characterized, and additional data were required depicting the total terminal residue of radiolabeled atrazine in corn. Structures of atrazine and these chloro and hydroxy metabolites are indicated in Figure 1.

A subsequent review (DEB No. 5783, 5/3/90, M.S. Metzger) noted that all metabolites containing the intact triazine ring were now considered of toxicological concern, and data requirements should be revised such that all metabolites which contain the intact triazine ring are determined for all commodities for which atrazine is registered; this review also determined revised anticipated residues for atrazine. The Agency subsequently issued a DCI, received by registrant in 10/90, which superceded the residue chemistry data requirements of all previous DCIs and any other agreements entered into with the Agency pertaining to such requirements. The DCI requirements included data depicting the total terminal residues of radiolabeled atrazine in corn, rye, sugarcane, sorghum, wheat, and pineapple. Registrant Ciba-Geigy's response to this DCI was reviewed and recommendations for conducting studies were provided (CBRS No. 9167, 1/22/92, M.S. Metzger).



Atrazine



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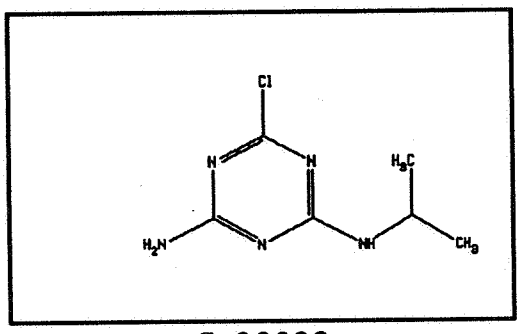

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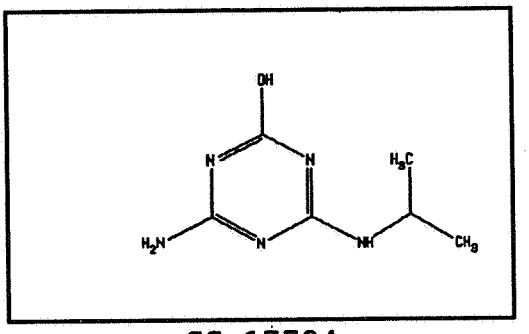

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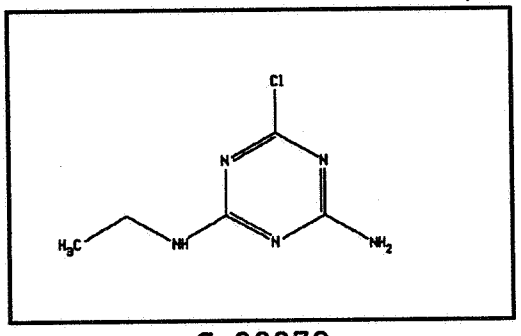

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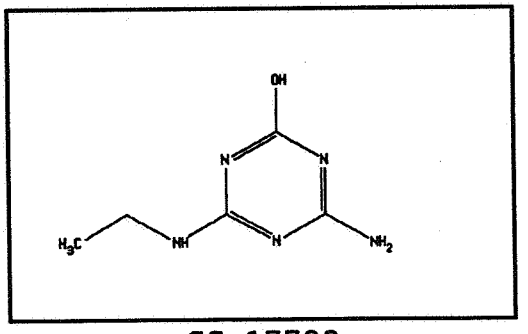

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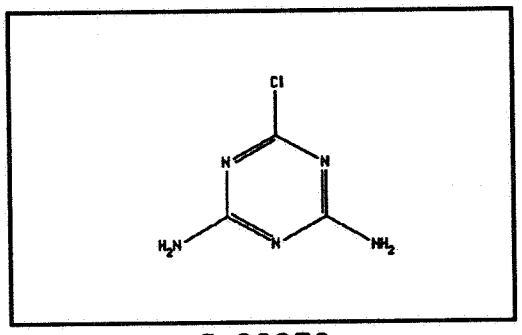

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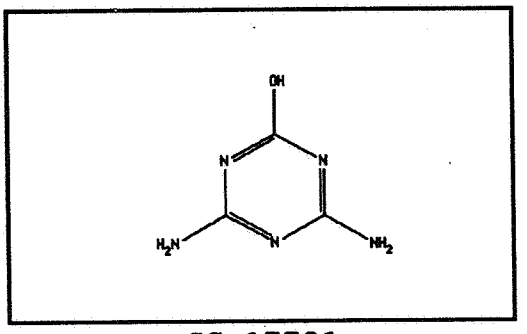

GS-17791

Figure 1. Atrazine, chloro (left), and hydroxy metabolites.

The HED Metabolism Committee addressed issues related to triazine chemicals at a meeting of 7/9/92 (Memo, 8/7/92, M.S. Metzger). The Committee noted that in the absence of data on the toxicity of triazine metabolites, all metabolites containing a triazine ring with a substituent would be assumed toxicologically equivalent to the parent compound. Should data be reviewed and accepted which indicate that hydroxyatrazine is not carcinogenic, then exposure assessment and tolerance expression for atrazine will include only parent and chloro metabolites. No analytical methods were available to determine total residues of metabolites containing triazine rings with substituents. Field studies using ^{14}C-atrazine would allow exposure assessment for total triazine ring residues as the total radioactive residue (TRR), because most of the radioactivity remains as triazine-ring containing metabolites; TRR will be assumed to represent all residues of concern. In addition to measuring TRR in the radiolabel field studies, registrant was also required to identify major components of the total radioactivity in crops. If possible, these data will be used to identify appropriate "marker" metabolites to use in developing analytical methods for enforcement purposes and for non-radiolabeled field residue data. The Metabolism Committee recommended that risk assessment should be conducted with the best data available for determining total residues of metabolites containing the triazine ring.

Anticipated residues for atrazine were previously determined (DEB 5783, 5/3/90, M.S. Metzger). Data used for the previous determination included metabolism studies which provided data on the total radioactive residue, and data from non-radiolabel field trials, with conservative assumptions to estimate the total residue of concern. It should be noted that anticipated residues for corn and sorghum were largely based upon data from metabolism studies, which included greenhouse studies, and where most of the studies had been conducted with pre-emergence application of atrazine. CBRS recently reviewed a submission which included additional data on the nature of the residue in corn and sorghum (CBRS 10980, 6/3/93, J. Abbotts). These data were developed from metabolism studies in the field with post-emergence application. Post-emergence application would be expected to produce greater total radioactive residues, and studies in the field would be expected to provide more realistic data than greenhouse studies. It should be noted that additional data on storage conditions and the resolution of minor deficiencies are required before the most recent data can be considered accepted (CBRS 10980, 6/3/93, J. Abbotts). However, because the outstanding deficiencies are minor, it seems likely that these data will eventually be accepted. The availability of the new data allow a determination of revised anticipated residues, conditional upon the acceptance of data on which the anticipated residues are based.

Corn

The previous determination of anticipated residues was based on data from metabolism studies, where the application in most cases was pre-emergence (DEB 5783, 5/3/90, M.S. Metzger). Data were available from one study in the field where application was post-emergence at 4.0 lb ai/A; residues from this application were higher than from any field study where application was pre-emergence. This study is described in the Second Round Review Residue Chemistry Chapter (10/18/88). Application was to corn plants 30 in tall. The final harvest of mature plants 67 days post-treatment was divided into stalks, cobs, and grain; total radioactive residues were determined. Plants harvested 30 days after treatment showed radioactive residues of approximately 5 ppm.

The more recent submission (CBRS 10980, 6/3/93, J. Abbotts) provided data from field radiolabel studies where application was 3.0 lb ai/A post-emergence to corn plants 8-14 in tall; residues were reported for 30-day forage, silage (46-75 days) forage, mature fodder, and mature grain. In the more recent submission, registrant noted that it has recently revised the label rate to a maximum of 2.5 lb ai/A per calendar year. Because no data on total radioactive residues appear to be available for this lower rate, and because the available data on corn are from rates near this maximum, anticipated residues from the available data can be considered conservative but reasonable estimates. Data on total radioactive residues from post-emergence treatment in the field are summarized in Table 2.

Table 2. Total Radioactive Residues in Corn, Field Studies.

Site	Rate, lb ai/A	Commodity	Days After Treatment	TRR, ppm
(NR)	4.0	Plants	30	≈5.0
		Stalks	67	5.42
		Cobs	67	0.25
		Grain	67	0.07
MS	3.0	Forage	30	0.694
		Silage	75	0.660
		Fodder	98	0.850
		Grain	98	0.045
IL	3.0	Forage	30	0.466
		Silage	46	0.710
		Fodder	85	1.809
		Grain	85	0.071
NY	3.0	Forage	30	2.840
		Silage	72	0.499
		Fodder	106	1.549
		Grain	106	0.034

Table notes: Application was post-emergence for all studies. Data for the first study were reported in the Second Round Review Residue Chemistry Chapter (10/18/88). Data for the other sites were reported in CBRS 10980 (6/3/93).
(NR) = not reported in reference source.

Anticipated residues for corn can be determined by averaging the TRR values for each commodity. Because the higher of forage or fodder residues will be used in determining livestock dietary burdens (see below), the residue data on cobs will be ignored. For the first study in Table 2, anticipated residues for stalks will be translated to fodder, and anticipated residues for forage will be set at 5.0 ppm, in accordance with data from the Second Round Review. Average TRRs for corn commodities can therefore be determined as the following values:
30-day forage, 2.25 ppm; silage forage, 1.72 ppm;
fodder, 2.41 ppm; grain, 0.06 ppm.

It should be noted that these values are not dramatically different from the anticipated residues in corn determined previously: forage, 5.0 ppm; fodder and silage, 3.0 ppm; grain, 0.10 ppm (DEB 5783, 5/3/90, M.S. Metzger).

Sorghum

The previous determination of anticipated residues was based on data from metabolism studies, where the application in most cases was pre-emergence (DEB 5783, 5/3/90, M.S. Metzger). Data were available from one study in the field where application was post-emergence at 3.0 lb ai/A. Residues from this application were lower than from other field studies where application was pre-emergence. However, residues from the most recent field studies with sorghum (CBRS 10980, 6/3/93, J. Abbotts) were generally higher than from any previous field study; averaging residues from the earlier study with those of the most recent submission would not produce dramatically different anticipated residues. The earlier study is described in the Second Round Review Residue Chemistry Chapter (10/18/88). Application was to sorghum 41 days after planting, before the boot stage. The final harvest of mature plants 98 days post-treatment was divided into stalks and grain. Total radioactive residues in plants were also reported as 0.65 ppm at 65 days post-treatment.

The more recent submission (CBRS 10980, 6/3/93, J. Abbotts) provided data from field radiolabel studies where application was 3.0 lb ai/A post-emergence to sorghum plants 10 to 12 in tall; residues were reported for 30-day forage, silage (46-75 days) forage, mature fodder, and mature grain. In the more recent submission, registrant noted that it has recently revised the label rate to a maximum of 2.5 lb ai/A per calendar year. Because no data on total radioactive residues appear to be available for this lower rate, and becasue the available data on sorghum are from rates near this maximum, anticipated residues from the available data can be considered conservative but reasonable estimates. Data on total radioactive residues from post-emergence treatment in the field are summarized in Table 3.

Table 3. Total Radioactive Residues in Sorghum, Field Studies.

Site	Rate, lb ai/A	Commodity	Days After Treatment	TRR, ppm
(NR)	3.0	Plants	65	0.65
		Stalks	98	0.64
		Grain	98	0.018
MS	3.0	Forage	30	2.901
		Silage	75	1.234
		Fodder	98	0.907
		Grain	98	0.392
IL	3.0	Forage	30	0.875
		Silage	46	0.277
		Fodder	85	0.418
		Grain	85	0.128
NY	3.0	Forage	30	5.351
		Silage	72	1.071
		Fodder	106	1.043
		Grain	106	0.033

Table notes: Application was post-emergence for all studies. Data for the first study were reported in the Second Round Review Residue Chemistry Chapter (10/18/88). Data for the other sites were reported in CBRS 10980 (6/3/93).
(NR) = not reported in reference source.

Anticipated residues for sorghum can be determined by averaging the TRR values for each commodity. For the first study in Table 3, anticipated residues for plants will be translated to silage, and anticipated residues for stalks will be translated to fodder. Average TRRs for sorghum commodities can therefore be determined as the following values:
30-day forage, 3.04 ppm; silage forage, 0.81 ppm;
fodder, 0.75 ppm; grain, 0.14 ppm.

It should be noted that these values are not dramatically different from the anticipated residues in corn determined previously: forage, 2.02 ppm; grain, 0.13 ppm (DEB 5783, 5/3/90, M.S. Metzger).

Animal Diets

In the previous determination of anticipated combined residues of atrazine, six diets were postulated for beef cattle based on commodities in national commerce (DEB 5783, 5/3/90, M.S. Metzger). The only commodities in these diets for which atrazine use was registered were corn silage and corn grain. In the previous determination, residues were adjusted for percent crop treated values of 70%, and the higher value of corn forage and fodder was used to represent residues in corn silage; these same conventions will be used here. Dietary burdens are indicated in Table 4. The highest burden, 1.39 ppm, will be used to determine anticipated residues in beef cattle commodities.

Table 4. Beef Cattle Dietary Burdens.

Feed Item	Anticipated Residues in Feed, ppm	Percent in Diet (Residues, ppm):					
		1	2	3	4	5	6
Corn silage	1.69	82.2 (1.39)	58.7 (0.99)	16.7 (0.28)	69.3 (1.17)	38.4 (0.65)	16.8 (0.28)
Corn grain	0.042	0	0	0	11 (0.005)	57.6 (0.024)	80.7 (0.034)
Soybean meal	0	2.7	0.7	0	3.1	1.6	0
Barley	0	13.7	40	80	0	0	0
Alfalfa	0	0	0	0	15.7	0	0
Other	0	1.4	0.6	3.3	0.9	2.4	2.5
Total Dietary Burden, ppm:		1.39	0.99	0.28	1.18	0.67	0.31

Table notes: Anticipated residues in crop commodities are adjusted for percent crop treated to determine anticipated residues in feed items.

In a similar manner, the previous determination of anticipated residues postulated four diets for dairy cattle based on commodities in national commerce (DEB 5783, 5/3/90, M.S. Metzger). Dairy cattle diets included the additional commodities grass hay and wheat middlings which potentially could contain atrazine residues. For these commodities, residue data were available for chloro metabolites only; these were adjusted by assuming that the chloro metabolites represented 5% of the total triazine residue of concern. Anticipated residues for all commodities in feed items were adjusted by percent crop treated data. Using these same conventions with the revised anticipated residues in corn and sorghum commodities, dietary burdens for dairy cattle are determined in Table 5.

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Table 5. Dairy Cattle Dietary Burdens.

Feed Item	Anticipated Residues in Feed, ppm		Percent in Diet (TRR, ppm):			
	Chloro Metabolites	TRR	1	2	3	4
Grass hay	0.09	1.80	0	10 (0.18)	20 (0.36)	30 (0.54)
Alfalfa	0	0	25	17	8	0
Corn silage		1.69	25 (0.42)	25 (0.42)	25 (0.42)	25 (0.42)
Oats	0	0	16	10	5	0
Wheat middlings	0.0002	0.004	10 (<0.001)	7 (<0.001)	3 (<0.001)	0
Corn grain		0.042	15 (0.006)	18 (0.008)	21 (0.009)	23 (0.01)
Soybean meal	0	0	3	7	11	15
Linseed oil	0	0	5	5	5	5
Other	0	0	1	1	2	2
Total dietary burden, ppm:			0.43	0.61	0.77	0.97

Table notes: Anticipated residues in crop commodities are adjusted for percent crop treated to determine anticipated residues in feed items.

In the assumed diets in Table 5, wheat middlings and corn grain are not major contributors to the dietary burden; the major contributors are grass hay and corn silage. For the diet where grass hay is not included, residues from corn alone are 0.43 ppm; in the diet where hay is at maximum, the total burden is 0.97 ppm, and grass contributes the majority of the burden. Further refinement of anticipated residues in milk therefore requires additional data on grass hay. However, anticipated residues can be calculated from the highest burden of 0.97 ppm, where corn alone represents nearly half of that burden.

In the previous determination of anticipated residues, poultry diets were assumed for broilers and laying hens (DEB 5783, 5/3/90, M.S. Metzger). The same diets are assumed in Table 6. Dietary burdens are 0.027 ppm for broilers and 0.036 ppm for laying hens.

Table 6. Poultry Diets

Feed Item	Anticipated Residues in Feed, ppm	Percent in Diet (Residues, ppm):	
		Broilers	Layers
Corn grain	0.042	65.2 (0.027)	61.0 (0.026)
Milo sorghum grain	0.098	0	10.0 (0.010)
Soybean meal	0	26.4	11.5
Other feeds	0	8.4	17.5
Total dietary burden, ppm:		0.027	0.036

Table note: Anticipated residues in crop commodities are adjusted for percent crop treated to determine anticipated residues in feed items.

Summary, Livestock Diets. Anticipated residues in animal commodities can be determined from the following dietary burdens. For dairy cattle, further refinement of anticipated residues requires data on grass hay, which can be a major contributor to residues in the diet. For other livestock diets, corn and sorghum commodities represent the only feed items in national commerce expected to contribute combined atrazine residues.

Beef cattle, 1.39 ppm;
Dairy cattle, 0.97 ppm;
Poultry broilers, 0.027 ppm;
Poultry layers, 0.036 ppm.

Anticipated Residues in Animal Commodities

The previous determination of anticipated residues estimated residues in animal tissues by using data from studies in which livestock were fed with feed items containing "biosynthesized" atrazine residues; these were crops which had been treated with ^{14}C-atrazine, then harvested and fed to livestock (DEB 5783, 5/3/90, M.S. Metzger). The nature of the biosynthesized residues was not determined, but it is assumed that these residues are more representative of actual residues in feed items than parent or any individual metabolite alone. TRRs of these feed items were measured, as were TRRs in tissues of animals fed the feed items with biosynthesized residues. Table 7 summarizes the results of studies where goats were fed biosynthesized residues.

Table 7. Goat Feeding Studies with Biosynthesized Residues.

Dose in Feed, ppm	TRR in tissue, ppm (Ratio, residues in tissue:residues in feed):					
	Liver	Kidney	Meat	Fat	Heart	Milk
0.012	0.0006 (0.05)	<0.0006 (<0.05)	<0.0006 (<0.05)	<0.0006 (<0.05)	0.0006 (0.05)	0.0001 (0.008)
0.32	0.036 (0.11)	0.01 (0.031)	<0.006 (<0.019)	<0.006 (<0.019)	<0.006 (<0.019)	0.003 (0.009)
0.95	0.01 (0.011)	0.003 (0.003)	0.0008 (0.0008)	0.0008 (0.0008)	<0.0006 (<0.0006)	0.004 (0.004)
1.47	0.068 (0.046)	0.015 (0.010)	0.002 (0.0014)	<0.001 (<0.0007)	0.003 (0.002)	0.003 (0.002)

Table note: Data are taken directly from the previous determination of anticipated residues (DEB 5783, 5/3/90).

The previous determination of anticipated residues reported estimates for liver and kidney separately, and a group estimate for meat, fat, and meat byproducts other than liver and kidney, where the anticipated residues for meat were translated to fat and other byproducts. The grouping of the latter categories reflects the observation in Table 7 that the ratios for residues in tissue:residues in feed are comparable at all feeding levels for meat, fat, and heart. In addition, anticipated residues in ruminants were translated to hogs, horses, and sheep (DEB 5783, 5/3/90, M.S. Metzger). The same conventions will be followed for the determination of revised anticipated residues.

The feeding level in Table 7 most appropriate for determining anticipated residues is 1.47 ppm, which is nearly identical to the anticipated residues in cattle feed, 1.39 ppm. The ratios of residues in tissue:residues in feed at the 1.47 ppm feeding level are toward the high end of values for most commodities, and residues for nearly all commodities were detectable at this level. Calculating anticipated residues using the ratio 1.39/1.47 gives the following values for meat commodities of cattle, goats, hogs, horses, and sheep:
liver, 0.064 ppm; kidney, 0.014 ppm; meat, fat, and meat byproducts (except liver and kidney), 0.002 ppm.

We note that these revised anticipated residues for liver and kidney are slightly higher than those previously determined (0.02 ppm and 0.006 ppm, respectively), while revised anticipated residues for other commodities are lower than previously determined (0.004 ppm) (DEB 5783, 5/3/90, M.S. Metzger). The reasons for this modest discrepancy are not clear, but the revised anticipated residues should be valid.

The previous determination calculated anticipated residues in milk by two different methods (DEB 5783, 5/3/90, M.S. Metzger). In the first method, residues in milk from ingestion of chlorometabolites only (for grass hay and wheat middlings, see Table 5) were calculated based on data from feeding studies with atrazine only, and were added to residues resulting in milk from feeding biosynthesized metabolites (for corn grain and silage). In the second method, anticipated residues in grass hay and wheat middlings representing chloro metabolites only were assumed to account for 5% of TRR. TRRs in feed items were then added, and anticipated residues in milk were calculated based on data from feeding studies with biosynthesized metabolites. The previous determination noted that both of these methods gave similar results (Ibid.). Because the anticipated residues in feed for grass hay and wheat middlings have not changed, and because either calculation method is expected to give similar results, the second method will be used here. The anticipated dietary burden for dairy cattle was determined above as 0.97 ppm. This is nearly identical to the feeding level of 0.95 ppm in Table 7. Using the residues in milk at that level, and adjusting by the ratio 0.97/0.95, gives revised anticipated residues in:
milk, 0.004 ppm.

The previous determination of anticipated residues in poultry commodities used data from studies where poultry were fed radiolabeled compounds atrazine, the chloro metabolite G-28273 (see Figure 1), or biosynthesized residues (DEB 5783, 5/3/90, M.S. Metzger). Table 8 summarizes the data from these studies:

Table 8. Poultry Feeding Studies with Atrazine Residues.

Residue in Feed	Dose in Feed, ppm	TRR in tissue, ppm (Ratio, residues in tissue:residues in feed)						
		Liver	Kidney	Meat	Fat	Heart	Egg White	Egg Yolk
Atrazine	58	3.32 (0.057)	4.62 (0.080)	2.76	1.77	2.4	1.4 (0.024)	2.6 (0.045)
	50	3.15 (0.063)		3.40			1.15 (0.023)	2.5 (0.05)
G-28273	5	0.55 (0.11)	0.90 (0.18)	0.50	0.04		0.21 (0.042)	0.36 (0.072)
Biosynthesized	0.047	0.013 (0.27)	0.009 (0.19)	ND	ND		0.008 (0.17)	0.01 (0.21)

Table notes: Data are taken directly from the previous determination of anticipated residues (DEB 5783, 5/3/90). The ratio residue in tissue:residue in feed is calculated only for selected commodities for comparison across all three studies. ND = nondetectable residues, limit of detection was not provided.

The previous determination of anticipated residues reported estimates for poultry liver separately, and a group estimate for meat, fat, and meat byproducts other than liver, where the anticipated residues for meat were translated to fat and other byproducts. The same conventions will be followed for the determination of revised anticipated residues. Chicken kidney is not considered an edible organ.

The feeding level in Table 8 most appropriate for determining anticipated residues is 0.047 ppm of biosynthesized residues, which is close to the anticipated residues in poultry feed, 0.027 ppm for broilers and 0.036 ppm for layers. However, residues in meat and fat were ND for the study with biosynthesized feed residues. The limit of detection was not provided for these data, but the previous determination used the observation that the limit of detection for other animal commodities was as low as ≤0.001 ppm (see, for example, fat in Table 7). Residues in Table 8 were reported for egg whites and egg yolks. They can be converted to residues in whole eggs with the information that the weight proportion of egg components is 60% white:30% yolk:10% shell, and with the assumption that residues in shell are the same as yolk. The values in Table 8 for the feeding study with biosynthesized residues are thus converted to 0.009 ppm in the whole egg for a feeding level of 0.047 ppm. Anticipated residues can be determined using the data in Table 8, and feeding levels of 0.027 ppm for broilers and 0.036 ppm for layers. Anticipated residues in poultry items are then determined as:
meat, fat, and meat byproducts (except liver), 0.0006 ppm;
liver, 0.007 ppm; egg whites, 0.006 ppm; egg yolks, 0.008 ppm;
whole eggs, 0.007 ppm.

These revised anticipated residues for poultry liver are modestly than those previously determined (0.002 ppm) (DEB 5783, 5/3/90, M.S. Metzger). The reasons for this discrepancy are not clear, but the revised anticipated residues should be valid.

Effect on Dietary Risk Estimates

Estimates for dietary risk from atrazine residues have been presented to Division Directors (Briefing Paper, Division Director Briefing on the Triazine Herbicides, 4/21/93). CBRS cautions that comparing ratios of revised anticipated residues to previous anticipated residues would give a rough estimate of revised dietary risk at best. Consumption data or other parameters influencing the DRES program may have changed, and for that reason the precise effect of revised anticipated residues on dietary risk estimates would require a new DRES analysis. In the event that a new DRES analysis is not desired or would be delayed because of resource limitations, approximate estimates may be appropriate. We therefore provide the data in Table 9, which

includes dietary risk estimates (cancer) from the 4/21/93 Briefing Paper, and ratios of revised anticipated residues:previous anticipated residues from this memo. Table 1 indicates that revised anticipated residues are higher than the previous estimate for some animal commodities. For red meat commodities, residues in liver and kidney increase, while residues in meat decrease; residues in poultry liver increase, while residues in poultry meat are unchanged. Because meat is the more frequently consumed item, Table 9 reflects the revised anticipated residues in meat.

Table 9. Cancer Risk Estimates and Revised Anticipated Residues.

Commodity	Dietary Risk Estimates, Total Triazine Ring	Ratio, Revised Anticipated Residues: Previous Anticipated Residues
Corn, sweet	3.1×10^{-6}	0.6
Corn, other	5.2×10^{-6}	0.6
Sorghum	4.8×10^{-7}	1.1
Red meat	2.1×10^{-6}	≈0.5
Poultry meat	6.8×10^{-8}	≈1.0
Milk	9.3×10^{-6}	1.0
Eggs	1.3×10^{-6}	0.7

Table notes: Dietary Risk Estimates are taken from the Briefing Paper of 4/21/93; the ratio of anticipated residues is calculated from Table 1 of this memo.

The ratios in Table 2 represent no more than 2-fold changes in either direction. It should be noted that the commodity which represents the largest single contribution to estimated dietary risk is sugarcane, for which residue data remain outstanding.

cc:Circ, Abbotts, RF, Atrazine List A File, SF
RDI:FBSuhre:6/7/93:MSMetzger:6/7/93
H7509C:CBII-RS:JAbbotts:CM-2:Rm805A:305-6230:6/7/93
JA6:atrazine.3