Bentazone (172)

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EXPLANATION

Bentazone is a post-emergent herbicide that acts by interfering with photosynthesis. The IUPAC name for bentazone is 3-isopropyl-1H-2,1,3-benzothiadiazin-4(3H)-one-2,2-dioxide. It was first evaluated for toxicology and residues by the JMPR in 1991, and was evaluated by JMPR in 2012 and 2013 as part of the periodic review programme of the CCPR. The 2012 JMPR established an ADI for bentazone of 0–0.09 mg/kg bw and concluded that no ARfD was necessary. At the 2016 JMPR, the WHO Core Assessment Group reviewed new data and established an ARfD for bentazone of 0.5 mg/kg bw. The residue definition for compliance with the MRL and dietary risk assessment for plant and animal commodities is the parent bentazone. The residue is not fat-soluble.

The 2013 JMPR withdrew its maximum residue level recommendation for peas (dry). Bentazone was listed by the Forty-ninth Session of the CCPR for the evaluation of additional uses by the 2018 JMPR. The Meeting received a dairy cow feeding study, GAP information and supervised residue trials on dry peas.

METHODS OF RESIDUE ANALYSIS

Analytical methods

Analytical methods for determining bentazone residues in various raw agricultural commodities, feed commodities and animal commodities were evaluated by the 2013 JMPR. All methods were sufficiently validated. LOQs of 0.01 mg/kg were achievable in most matrices (Method BASF 438/2, L0044/02).

The Meeting received a dairy cow feeding study. The analytical method (Method L0044/02) used in the feeding study was validated for all animal matrices including kidney and fat. The method used the same extraction, clean-up and determination as previously reported but examined kidney and fat matrices, which were not covered previously. Additional independent laboratory validation was performed for kidney and fat only. In all matrices tested, the mean recovery values of Method L0044/02 (438/2) were 70–110% for bentazone at fortification levels of 0.01–0.1 mg/kg. The relative standard deviations were <20% at all fortification levels. The data is summarised in Table 1.

Table 1 Recovery data for animal commodities including kidney and fat

Matrix	Quantification (Mass Transition)	Fortification Level (mg/kg)	Number of Replicates	Recovery Mean (%)	Precision RSD (%)
Kidney	Quant. Ion (m/z 239-132)	0.01	5	89.4	2.3
		0.1	5	91.9	3.7
	Conf. Ion (m/z 239-175)	0.01	5	89.8	4.3
		0.1	5	92.7	3.4
Fat	Quant. Ion (m/z 239-132)	0.01	5	93.9	2.6
		0.1	5	98.3	0.77
	Conf. Ion (m/z 239-175)	0.01	5	95.1	3.1
		0.1	5	97.7	0.65

Stability of pesticide residues in stored analytical samples

The 2013 JMPR concluded that bentazone residues were stable at -20 °C for at least 24 months in representative plant matrices. No storage stability study on bentazone in animal matrices was provided to 2013 JMPR.

The current Meeting received residue stability data for animal commodities performed along with the dairy cow feeding study. Muscle was spiked with bentazone and stored for analysis at different sampling intervals. The effects of storing incurred milk, fat, liver and kidney samples were investigated by re-analysing milk, fat, liver and kidney samples frozen at -20 °C. Bentazone was deemed to be stable in incurred samples of liver after 316 days and kidney after 305 days of frozen storage. In other animal matrices including milk, cream, muscle and fat bentazone residues were stable for at least 120 days (Charles River GLP Study No. 223990). The data is summarized in Table 2.

Table 2 Storage stability data for bentazone in various animal commodities

Matrix a	Sampling interval (days)	Residue Levels and Recovery in Stored Samples							Procedural Recovery
		Individual results (mg/kg)			Percentage Remaining (%)			Mean% Remaining	Mean (%)
Milk	0	0.0976	0.0949	0.108	97.6	94.9	108	100	92.4
	62	0.0836	0.0807	0.0786	83.6	80.7	78.6	81.0	74.7
	121	0.0710	0.0921	0.0794	71.0	92.1	79.4	80.8	65.0
Muscle	0	0.0815	0.0948	0.0883	81.5	94.8	88.3	88.2	94.3
	63	0.0742	0.0759	0.0765	74.2	75.9)	76.5	75.5	74.5
	120	0.0717	0.0718	0.0713	71.7	71.8	71.3	71.6	71.7
Liver	0	0.0861	0.0830	0.0921	86.1	83.0	92.1	87.1	81.7
	63	0.0722	0.0722	0.0666	72.2	72.2	66.6	70.3	79.4
	120	0.0694	0.0744	0.0728	69.4	74.4	72.8	72.2	73.2
Kidney	0	0.0930	0.0969	0.0983	93.0	96.9	98.3	96.1	97.3
	60	0.0812	0.0827	0.0847	81.2	82.7	84.7	82.9	76.8
	125	0.0780	0.0689	0.0863	78.0	68.9	86.3	77.7	82.6
Fat	0	0.0739	0.0748	0.0766	73.9	74.8	76.6	75.1	77.0
	63	0.0794	0.0795	0.0858	79.4	79.5	85.8	81.6	81.8
	124	0.0727	0.0720	0.0873	72.7	72.0	87.3	77.3	

[a] re-analysis of feeding study samples for milk (from day 21) and for fat, liver and kidney samples from high dose animals on days 10, 11 and 12, respectively.

USE PATTERNS

The Meeting received information on authorised uses on pulses (subgroup of dry peas) in various countries. The relevant national GAPs for dry peas are summarised in Table 3.

Table 3 National registered uses of bentazone on pulses (subgroup dry peas)

#	Country	Formulation code	Application			Application rate per treatment			PHI [days] min
			Method	No. per crop and season min max	Application interval [days]	kg ai/hL max	Water L/ha min max	kg ai/ha min max	
	Belarus [a]	480 g/L SL	Spray	1	-	-	-	1.44	-
	Belarus [a]	250 g/L SL	Spray	1	-	-	-	0.75	-
	Belgium [a]	87% SG	Spray	1	-	0.319	300–400	0.957	40
	Belgium [a]	480 g/L SL	Spray	-	-	-	-	0.6	-
	Bulgaria [a]	480 g/L SL	Spray	1	-	-	-	0.06	35
				2	7–14			0.03	
	Canada [b]	480 g/L SL	Spray	1	-	1.08	100–400	0.4–1.08	-
	Canada [b]	480 g/L SL	Spray	1	-	0.6	100–300	0.48–0.6	-
	Canada [b]	429 g/L SL	Spray	1	-	0.429	100	0.429	60
	Chile [b]	480 g/L SL	Spray	1	-	0.32	300–500	0.96	35
	Czech Republic [a]	480 g/L SL	Spray	1	-	0.48	200–400	0.96	Secured by time of application
	Czech Republic [a]	480 g/L SL	Spray	1	-	0.6	200–400	0.6	Secured by time of application
	Denmark [a]	250 g/L SL	Spray	1	-	-	-	0.375	-
	France [a]	87% SG	Spray	-	-	0.609	200–400	1.218	42
	Greece [a]	480 g/L SL	Spray	1	-	0.12	50–75	0.06	35
	Hungary [a]	480 g/L SL	Spray	1	-	0.48	200–400	0.96	not required when used according to specifications

#	Country	Formulation code	Application			Application rate per treatment			PHI [days] min
			Method	No. per crop and season min max	Application interval [days]	kg ai/hL max	Water L/ha min max	kg ai/ha min max	
	Hungary [a]	480 g/L SL	Spray	1	-	0.3	200–300	0.6	42
				2	7–14	0.1512		0.3024	
	Ireland [a]	87% SG	Spray	1	-	0.653	220–450	1.436	-
	Israel [a]	480 g/L SL	Spray	1	-	0.48	200–400	0.48–0.96	-
	Italy [a]	87% SG	Spray	1	-	0.385	200–600	0.552–0.77	30
	Italy [a]	480 g/L SL	Spray	1	-	0.3	200–300	0.6	35
				2	7–14	0.24		0.48	
	Kazakhstan [a]	480 g/L SL	Spray	1	-	-	-	0.96	-
	Kyrgyzstan [a]	480 g/L SL	Spray	1	-	-	-	0.96	-
	Malawi [a]	480 g/L SL	Spray	1	-	0.48	300	0.96–1.44	-
				2	7–10	0.48		1.44	
	Moldavia [a]	480 g/L SL	Spray	1	-	0.36	200–400	1.2–1.44	-
	Netherlands [a]	480 g/L SL	Spray	2	7	-	-	0.48–1.44	21
	Netherlands [a]	87% SG	Spray	2	7	0.239	200–400	0.479–0.957	21
	Netherlands [a]	480 g/L SL	Spray	1	-	-	-	0.6	-
				2	7			0.3	
	Norway [a]	87% SG	Spray	-	-	0.261	200–400	0.43–0.522	28
	Poland [a]	480 g/L SL	Spray	1	-	0.72	200–300	1.2–1.44	-
	Poland [a]	480 g/L SL	Spray	1	-	0.3	200–400	0.6	35
	Republic of Serbia [a]	480 g/L SL	Spray	1	-	0.48	200–400	0.72–0.96	35
	Russia [a]	480 g/L SL	Spray	1	-	0.144	100–300	0.96–1.44	60
						5.76	25–100 aerial		
	Spain [a]	480 g/L SL	Spray	1	-	-	-	0.72–0.96	-
	Spain [a]	480 g/L SL	Spray	1	-	0.6	100–400	0.6	-
	Switzerland [a]	87% SG	Spray	1	-	0.957	200–400	0.957–1.914	-
				2	8–14	0.435		0.653–0.87	-
	Ukraine [a]	480 g/L SL	Spray	2	8–14	0.435	200–400	0.653–0.87	-
	United Kingdom [a]	87% SG	Spray	1	-	0.479	220–400	0.957	-
				2	7–10	0.319	150–220	0.479	
	United States [a]	480 g/L SL	Spray	1	-	2.806	50 aerial	0.701–1.403	30
						1.5	93.53–187.1		
	United States [a]	600 g/L SL	Spray	1	-	2.224	50 aerial	0.561–1.112	30
						1.199	93.53–187.1		
	United States [a]	600 g/L SL	Spray	2	-	4.488	50 aerial	1.12	30
						2.399	93.53		
	United States [a]	478 g/L SL	Spray	1	-	1.883	50 aerial	0.384–0.942	30
						0.88	93.53–187		

[a] dry pea

[b] Peas (field and processing)

RESIDUES RESULTING FROM SUPERVISED TRIALS

The Meeting received information on supervised field trials involving foliar treatments of bentazone on dry peas.

Group	Crop	Countries	Table no
Pulses (Subgroup 15B)	Dry Pea	United States	4

Results from replicated field plots are listed and mean values are calculated. The results from trials used for the estimation of maximum residue levels (underlined) have been rounded to two significant digits (or if close to the LOQ, rounded to one significant digit). If a higher residue value was observed at a longer PHI (than GAP) this higher value was selected for estimating maximum residue levels and for dietary exposure assessment. The higher residue was selected from trials which were considered to be not independent.

Pulses (Subgroup15B Dry Peas)

The results of 6 supervised trials on peas conducted in the USA were provided to the Meeting. The 2013 JMPR reviewed field trials on dry peas, concluding that two trials with residue levels less than <0.02 mg/kg met the GAP of 2*1.12 ai/ha. There were insufficient trials to recommend maximum residue levels at the 2013 JMPR. These 2 additional trials were considered alongside the submitted data.

Dry Peas

In the dry pea field trials two foliar applications of 1.12 kg ai/ha bentazone (600g/L SL) were applied at a 6–8 day retreatment interval in water volumes of 131–187 L/ha to single replicate plots. Crop oil was used as surfactant.

Table 4 Residues in dried peas from supervised trials in the United States involving 2 foliar applications of bentazone (SL formulation). (1 ha=2.47 acre; 1 gallon US=3.785 L)

Pea Country, year Location (Variety)	Application				Matrix	DAT	Residues (mg/kg)		Reference & Comments
	N (RTI)	kg ai/ha	BBCH	water (L/ha)			bentazone	mean	
GAP: USA	2	1.12		50/aerial or 93.53 – 187.1		PHI: 30			
USA, 2015 Fargo, D (Blue Moon)	2 (8)	1.12	90% pod fill, 8–10 nodes; 5% green pods	140 140	Dry pea	28	0.187 0.155	0.17	2016/7011261; ND281
USA, 2015 Aurora, SD (Montech 4152)	2 (6)	1.12	Mid pod-filling, 3 pairs leaves, 4 nodes; Seed fill nearly complete	168 158	Dry pea	32	0.200 0.188	0.19	2016/7011261; SD419
USA, 2015 Arlington, WI (Agassiz)	2 (6)	1.12	Vegetative, 7–8 nodes ; Vegetative	159 150	Dry pea	37	<0.01 <0.01	<0.01	2016/7011261; WI468
USA, 2015 Kimberly, ID (Ice Breaker)	2 (8)	1.12	Vegetative, just past 4–5 leaf stage; Maturing pod-fill	140 140	Dry pea	21	0.17 0.065	0.12	2016/7011261; ID211
USA, 2015 Hillsboro, OR (WW2)	2 (8)	1.12	Peas present ; Peas beginning to turn yellow and dry	178 187	Dry pea	27	0.323 0.252	0.29	2016/7011261; OR366
USA, 2015 Prosser, WA (Banner)	2 (7)	1.12	Fruiting; Fruiting	131 131	Dry pea	30	0.050 0.054	0.052	2016/7011261; WA443

Farm animal feeding studies

Lactating Dairy Cows

In a dairy cow feeding study, animals were fed bentazone and 6-OH-bentazone to determine the magnitude of the residues in tissues and milk. Animals were dosed once daily by administering the target amount of the test item. The capsule dose was adjusted each week based on the average feed consumption for each animal in the previous week.

Fifteen lactating cows were orally dosed via gelatin capsules for 28 consecutive days with the diets containing test compound. The nominal bentazone dose levels in the dry food were 12, 36 and 120 mg/kg on the basis of an individual feed intake of 3 kg of feed per animal per day and incorporating an allowance for the percentage dry matter of the offered diet. The actual dose levels achieved in the study are shown in Table 5. Milk samples were collected twice a day, and combined as one pooled sample. On day 21, milk was also separated into cream and skim milk. Test animals were killed within 22–24 hours after the final dosing and tissue samples were taken. In the depuration group animals were killed two, five and seven days after the withdrawal of dosing. All samples were stored frozen until analysis. Analysis of the samples was carried out with Method 438/2.

Table 5 Actual dose levels of bentazone in the dairy cow feeding study

Animal ID	Nominal dose (mg/kg feed)	Actual concentration (mg/kg body weight)	Actual concentration (mg/kg feed)
Average group I	0	0	0
Average group II	12	0.3	11.6
Average group III	36	1.0	37.2
Average group IV	120	3.2	118.1
Average group IV (depuration)	120	2.9	120.4

Analysis for the parent bentazone

In milk samples, no residues above the limit of quantification of 0.01 mg/kg were detected in the control, 1×, 3× and 10× dose groups including the depuration phase.

In skim milk samples, no residues were detected in the 1× and 3× dose groups. In the 10× dose group a single finding above the limit of quantification was observed at 0.012 mg/kg.

In cream samples, no residues above the limit of quantification of 0.01 mg/kg were detected in the 1×, 3× and 10× dose groups.

In muscle samples, no residues above the limit of quantification of 0.01 mg/kg were detected in the control group or in the 1×, 3× and 10× dose groups including the depuration phase.

In liver samples, no residues above the limit of quantification of 0.01 mg/kg were detected in the control and 1× dose groups. In the 3× dose group a single finding above the limit of quantification was observed at 0.011 mg/kg. In the 10× dose group, residues between 0.022 mg/kg and 0.049 mg/kg (average 0.034 mg/kg) were found. No residues above the limit of quantification of 0.01 mg/kg were detected during the depuration phase.

In kidney samples, no residues were detected in the control group. Residues were found in the 1× dose group with a single finding above the limit of quantification of 0.010 mg/kg. In the 3× dose group, residues were between 0.019 mg/kg and 0.040 mg/kg (average 0.028 mg/kg) and in the 10× dose group residues were between 0.067 mg/kg and 0.144 mg/kg (average 0.094 mg/kg). Two days after the withdrawal of dosing a bentazone residue of 0.016 mg/kg was found in kidney. No residues above the limit of quantification of 0.01 mg/kg were detected five and seven days after the withdrawal of dosing.

In fat samples, no residues above the limit of quantification of 0.01 mg/kg were detected in the control group or in the 1×, 3× and 10× dose groups including the depuration phase.

Matrices	Average bentazone residue (mg/kg) 1× 11.6 ppm in feed	Average bentazone residue (mg/kg) 3× 37.2 ppm in feed	Average bentazone residue (mg/kg) 10× 118.1 ppm in feed
Milk	<0.01	<0.01	<0.01
Skim milk	<0.01	<0.01	<0.01
cream	<0.01	<0.01	<0.01
muscle	<0.01	<0.01	<0.01
liver	<0.01	0.010	0.034
kidney	0.01	0.028	0.094

	Average bentazone residue (mg/kg) 1×	Average bentazone residue (mg/kg) 3×	Average bentazone residue (mg/kg) 10×
Matrices	11.6 ppm in feed	37.2 ppm in feed	118.1 ppm in feed
fat	<0.01	<0.01	<0.01

Residues in milk

Residues of bentazone in milk, collected throughout dosing, were each <0.01 mg/kg (<LOQ) in all samples collected from Group II (1×), Group III (3×) and Group IV (10×) cows.

Residue levels of 6-OH-bentazone in Group IV (10×) increased rapidly and reached a plateau after three days of dosing. Thereafter the average residue level remained constant and above 0.01 mg/kg, though there was some variation between individual cows. After the withdrawal of dosing, residues rapidly declined. No residues above 0.01 mg/kg were detected during the depuration phase.

No residues were detected in samples from the control group.

Table 6 Residues of bentazone and 6-OH-bentazone in milk

Study day	Group mean residues (maximum individual) (mg/kg)							
	Group 1 (control)		Group 2 1× (0.3 mg/kg)		Group 3 3× (1.0 mg/kg)		Group 4 10× (3.2 mg/kg)	
	Bentazone	6-OH Bentazone	Bentazone	6-OH Bentazone	Bentazone	6-OH Bentazone	Bentazone	6-OH Bentazone
-1	<0.01	<0.01	<0.01	<0.01 (<0.002)	<0.01	<0.01	<0.01	<0.01
1	<0.01	<0.01 (<0.002)	<0.01	<0.01	<0.01	<0.01	<0.01	0.019 (0.028)
3	<0.01	<0.01	<0.01 (<0.002)	<0.01	<0.01 (<0.002)	<0.01	<0.01	0.025 (0.035)
5	<0.01	<0.01	<0.01	<0.01	<0.01	0.011 (0.012)	<0.01	0.024 (0.034)
7	<0.01 (<0.002)	<0.01	<0.01 (<0.002)	<0.01	<0.01	<0.01	<0.01	0.022 (0.032)
10	<0.01	<0.01	<0.01 (<0.002)	<0.01	<0.01	<0.01	<0.01	0.023 (0.031)
14	<0.01	N/A	<0.01	<0.01	<0.01	<0.01	<0.01	0.022 (0.034)
17	<0.01	<0.01	<0.01	<0.01	<0.01	0.01 (0.010)	<0.01	0.024 (0.037)
21	<0.01	<0.01	<0.01	<0.01	<0.01	0.012 (0.015)	<0.01	0.023 (0.040)
24	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.024 (0.036)
28	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.023 (0.044)
29	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	<0.01	<0.01
32	<0.01 (<0.002)	<0.01	n.a.	n.a.	<0.01	<0.01	<0.01 (<0.002)	<0.01
34	<0.01 (<0.002)	<0.01 (<0.002)	n.a.	n.a.	n.a	n.a.	<0.01 (<0.002)	<0.01

n.a. Not analysed

Skim milk and cream

No residues of bentazone and its metabolite 6-OH-bentazone were detected in skim milk and cream above the LOQ of 0.01 mg/kg in Group II (1×) and Group III (3×).

In Group IV, no residues of bentazone were found in cream, whereas in skim milk a single finding for bentazone above the LOQ (0.012 mg/kg) was detected. Residues of the metabolite 6-OH-bentazone ranged between <0.01 mg/kg and 0.021 mg/kg (average 0.013 mg/kg) in cream and from <0.01 mg/kg to 0.026 mg/kg (average 0.020 mg/kg) in skim milk.

Table 7 Residues of bentazone and 6-OH-bentazone in skim milk and cream

	Group mean residues (maximum individual) (mg/kg)							
	Group 1 (control)		Group 2 1× (0.3 mg/kg)		Group 3 3× (1.0 mg/kg)		Group 4 10× (3.2 mg/kg)	
	Bentazone	6-OH Bentazone	Bentazone	6-OH Bentazone	Bentazone	6-OH Bentazone	Bentazone	6-OH Bentazone
Skim milk	<0.01	n.a.	<0.01	<0.01 (<0.01)	<0.01	<0.01 (<0.01)	<0.01	0.020 (0.026)
Cream	<0.01	n.a.	<0.01	<0.01 (<0.01)	<0.01	<0.01 (<0.01)	<0.01	0.013 (0.021)

n.a Not analysed

Residues in tissues (fat, liver, muscle and kidney)

Residues of bentazone and its metabolite 6-OH-bentazone in animal tissue are summarized in Table 8.

Residues of bentazone and its metabolite 6-OH-bentazone were each below the LOQ of 0.01 mg/kg in muscle matrices of all treatment groups (1×, 3× and 10×). No residues were detected in the matrices of the control animals.

In kidney, a single bentazone residue at the LOQ of 0.01 mg/kg was observed in Group 2 (1×), whereas residues of the metabolite 6-OH-bentazone ranged between 0.014 mg/kg and 0.023 mg/kg. In higher dose groups, residues of bentazone ranged between 0.019 mg/kg and 0.040 mg/kg (average 0.028 mg/kg) in Group 3 (3×) and between 0.067 mg/kg and 0.144 mg/kg (average 0.094 mg/kg) in Group 4 (10×). Residues of the metabolite 6-OH-bentazone ranged from 0.028 mg/kg to 0.098 mg/kg (average 0.063 mg/kg) in Group 3 (3×) and between 0.089 mg/kg and 0.324 mg/kg (average 0.171 mg/kg) in Group 4 (10×). Two days after the withdrawal of dosing, residues of bentazone and 6-OH-bentazone at 0.016 mg/kg and at 0.039 mg/kg were found, respectively. At five and seven days after the withdrawal of dosing no residues of bentazone or 6-OH-bentazone were detected above the LOQ of 0.01 mg/kg.

In liver, no residues above the LOQ of 0.01 mg/kg were detected in Group 2 (1×). A single finding of residues of bentazone above the LOQ at a level of 0.011 mg/kg was observed in Group 3 (3×), whereas residues of 6-OH-benazone ranged between 0.012 mg/kg and 0.018 mg/kg (average 0.015 mg/kg). In the 10× dose group, residues of bentazone ranged between 0.022 mg/kg and 0.049 mg/kg (average 0.034 mg/kg) and residues of 6-OH-bentazone ranged between 0.026 mg/kg and 0.042 mg/kg (average 0.036 mg/kg). No residues of bentazone and its metabolite 6-OH-bentazone were found above the LOQ of 0.01 mg/kg in liver during the depuration phase.

In fat, no residues above the LOQ of 0.01 mg/kg were detected in any treatment group (bentazone) and in dose group 2 and 3 (6-OH-bentazone). In dose group 4 (10×), residues of 6-OH-bentazone ranged between <0.01 mg/kg and 0.048 mg/kg (average 0.024 mg/kg). Two, five or seven days after the withdrawal of dosing, no residues of bentazone or 6-OH-bentazone above the limit of quantitation were detected.

Table 8 Residues of bentazone and its metabolite 6-OH-bentazone in tissues

Treatment group	Group mean (maximum individual) residues in tissue (mg/kg)							
	Fat		Liver		Muscle		Kidney	
	Bentazone	6-OH Bentazone	Bentazone	6-OH Bentazone	Bentazone	6-OH Bentazone	Bentazone	6-OH Bentazone
1 (Control)	<0.01	<0.01	<0.01	<0.01	<0.01 (<0.002)	<0.01	<0.01 (<0.002)	<0.01
2 (1×)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.010 (0.010)	0.017 (0.023)
3 (3×)	<0.01	<0.01	0.010 (0.011)	0.015 (0.018)	<0.01	<0.01	0.028 (0.040)	0.063 (0.098)
4 (10×)	<0.01	0.024 (0.048)	0.034 (0.049)	0.036 (0.042)	<0.01	<0.01	0.094 (0.144)	0.171 (0.324)
4 (10×, 2 days withdrawal)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	0.039
4 (10×, 5 days withdrawal)	<0.01	<0.01	<0.01	<0.01	<0.01 (<0.002)	<0.01	<0.01 (<0.002)	<0.01
4 (10×, 7 days withdrawal)	<0.01	<0.01	<0.01 (<0.002)	<0.01	<0.01 (<0.002)	<0.01	<0.01	<0.01

APPRAISAL

Bentazone is a selective herbicide belonging to the thiadiazine group of chemicals. Bentazone was first evaluated for toxicology and residues by JMPR in 1991, and was re-evaluated in 2012 and 2013, as part of the periodic review programme of the CCPR. The 2012 Meeting established an ADI for bentazone of 0–0.09 mg/kg bw, and the 2016 Meeting established an ARfD of 0.5 mg/kg bw. The residue definition for compliance with the MRL and for dietary risk assessment for plant and animal commodities is the parent bentazone. The residue is not fat-soluble.

Bentazone was scheduled at the Forty-ninth Session of the CCPR for the evaluation of additional uses by the 2018 JMPR. The Meeting received a dairy cow feeding study, GAP information and supervised residue trials on dry peas.

Methods of analysis

Analytical methods for determining bentazone residues in various raw agricultural commodities, feed commodities and animal commodities were evaluated by JMPR in 2013. The methods typically use an initial extraction and a further conjugate hydrolysis step, followed by clean-up and GC-MS, or LC-MS/MS determination. LOQs of 0.01 mg/kg were achievable in most matrices.

The analytical method used to determine bentazone residues in kidney and fat matrices was evaluated previously by JMPR in 2013.

The available methods are sufficiently validated and are suitable to measure bentazone in the commodities being considered.

Stability of pesticide residues in stored analytical samples

The 2013 JMPR concluded that bentazone residues were stable at -20 °C for at least 24 months in representative plant matrices.

The current Meeting received residue stability data in animal commodities performed alongside the dairy cow feeding study. Bentazone was shown to be stable in incurred samples of liver after 316 days and kidney after 305 days in frozen storage. In other animal matrices including milk, cream, muscle and fat bentazone residues were stable for at least 120 days.

The Meeting agreed that the demonstrated storage stability in various representative plant and animal commodities covered the residue sample storage intervals used in the studies.

Results of supervised residue trials on crops

The Meeting received information on supervised residue trials for bentazone in dry peas.

Dry peas

The critical GAP for bentazone in pulses (including dry pea) in the USA is for two foliar application at 1.12 kg ai/ha with a PHI of 30 days.

In six trials conducted in the USA and matching cGAP, abamectin residues in dry peas were (n=6): < 0.01, 0.052, 0.12, 0.17, 0.19 and 0.29 mg/kg.

The 2013 JMPR reviewed field trials on dry peas, concluding that two trials with residue levels less than < 0.02 mg/kg met the GAP of 2×1.12 kg ai/ha. There were insufficient trials to recommend maximum residue levels at the 2013 JMPR. These two trials were considered alongside the submitted data.

The combined data set were (n=8): < 0.01, < 0.02(2), 0.052, 0.12, 0.17, 0.19 and 0.29 mg/kg.

The Meeting estimated a maximum residue level of 0.5 mg/kg, and STMR of 0.09 mg/kg for bentazone in the subgroup of Dry peas. As the USA GAP is also applicable to the subgroup of dry beans, the Meeting decide to extrapolate the recommendations to subgroup Dry beans, and withdraw the previous recommendations of 0.04 mg/kg for dry beans, and 0.01(*) mg/kg for soya bean.

Residues in animal commodities

Farm animal feeding studies

The Meeting received a dairy cow feeding study. Bentazone was administered orally once daily to dairy cows for 28 days at levels equivalent to 11.6, 37.2 and 118.1 ppm dry weight in the feed. The cows in the control group received placebos (empty capsules) concurrently with the treated animals. Three additional cows from the high dose group were maintained for up to 7 days after the 28 day dosing period to provide depuration information.

Bentazone residues were observed in liver at up to 0.011 mg/kg and 0.049 mg/kg in the mid and high dose groups, respectively. Bentazone residues were observed in kidney at up to 0.010, 0.040 and 0.144 mg/kg in the low-, mid- and high-dose groups respectively. In all other matrices, including milk, residues were less than LOQ (0.01 mg/kg) in each dose group and (for milk) at all time points. The only bentazone residue detected above LOQ in any matrix, including milk, during the 7 day depuration phase was 0.016 mg/kg after 2 days in kidney.

Estimation of livestock dietary burdens

The 2013 JMPR estimated the animal burden resulting from feed commodities however decided not to estimate maximum residue levels for mammalian tissues and milk. In the current evaluation, new recommendations are made for dry peas and dry beans. The addition of these items did not significantly add to the estimated burden therefore the Meeting decided to use the livestock dietary burdens calculated by the 2013 JMPR and the dairy cow feeding study to estimate potential residues in mammalian tissues and milk.

Animal commodity maximum residue levels

The calculations used in estimating maximum residue levels, STMR and HR values in mammalian tissues and milk are shown below.

	Feed level (ppm) for milk residues	Residues (mg/kg) in milk	Feed level (ppm) for tissue residues	Residues (mg/kg) in			
				Muscle	Liver	Kidney	Fat
maximum residue level beef or dairy cattle							
Feeding study [a]	11.6	< 0.01	11.6	< 0.01	< 0.01	0.010	< 0.01
	37.2	< 0.01	37.2	< 0.01	0.011	0.040	< 0.01
Dietary burden and high residue	21.8	< 0.01	32.0	< 0.01	0.011	0.035	< 0.01
STMR beef or dairy cattle							
Feeding study [b]	11.6	< 0.01	11.6	< 0.01	< 0.01	0.010	< 0.01
	37.2	< 0.01	37.2	< 0.01	0.010	0.028	< 0.01
Dietary burden and median residue estimate	0.76	< 0.01	0.80	< 0.01	< 0.01	< 0.01	< 0.01

[a] highest residues for tissues and mean residues for milk

[b] mean residues for tissues and mean residues for milk

The Meeting estimated maximum residue levels of 0.01(*) mg/kg for milks, mammalian meat and mammalian fats (except milk fats). The meeting estimated a maximum residue level of 0.04 mg/kg for edible offal (mammalian).

The Meeting estimated STMRs of 0 mg/kg for milk, mammalian meat and mammalian fats (except milk fats). The meeting estimated a STMR of 0.01 mg/kg for edible offal (mammalian).

The Meeting estimated HRs of 0 mg/kg, 0 mg/kg, and 0.035 mg/kg for mammalian muscle, mammalian fat, and edible offal (mammalian), respectively.

RECOMMENDATIONS

On the basis of the data from supervised trials the Meeting concluded that the residue levels listed below are suitable for establishing maximum residue limits and for IEDI and IESTI assessment.

Definition of the residue for compliance with the MRL and dietary risk assessment in plant and animal commodities: *bentazone.*

The residue is not fat soluble.

	Commodity	Recommended Maximum residue level (mg/kg)		STMR or STMR-P (mg/kg)	HR (mg/kg)
CCN	Name	New	Previous		
VD 0071	Beans (dry)	W	0.04		
VD 2065	Dry beans, subgroup of (includes all commodities in this subgroup)	0.5	-	0.09	-
VD 2066	Dry peas, subgroup of (includes all commodities in this subgroup)	0.5	-	0.09	-
MO 0105	Edible offal (Mammalian)	0.04	-	0.01	0.035
MF 0100	Mammalian fats (except milk fats)	0.01*	-	0	0
MM 0095	Meat (from mammals other than marine mammals)	0.01*	-	0	0
ML 0106	Milks	0.01*	-	0	-
VD 0541	Soya bean	W	0.01*		

DIETARY RISK ASSESSMENT

Long-term dietary exposure

The ADI for bentazone is 0–0.09 mg/kg bw. The International Estimated Daily Intakes (IEDIs) for bentazone were estimated for the 17 GEMS/Food Consumption Cluster Diets using the STMR or STMR-P values estimated by the previous and present JMPR. The results are shown in Annex 3 of the 2018 JMPR Report. The IEDIs ranged 0–1% of the maximum ADI.

The Meeting concluded that the long-term dietary exposure to residues of bentazone from uses considered by the JMPR is unlikely to present a public health concern.

Short-term dietary exposure

The ARfD for bentazone is 0.5 mg/kg bw. The International Estimate of Short Term Intakes (IESTIs) for bentazone were calculated for the food commodities and their processed commodities for which HRs/HR-Ps or STMRs/STMR-Ps were estimated by the present JMPR and for which consumption data were available. The results are shown in Annex 4 of the 2018 JMPR Report. The IESTIs were 0% of the ARfD.

The Meeting concluded that acute dietary exposure to residues of bentazone from uses considered by the pesent JMPR is unlikely to present a public health concern.

REFERENCES

Reference	Author(s)	Year	Title
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287148, 709417	Karen Bancroft et al.,	2016	Magnitude of Residues in Milk and Tissues of Dairy Cows Following Multiple Oral Administrations of Bentazone and 6-OH-Bentazone(M351H001)
223990, 2016/1221006	Karen Bancroft et al.,	2016	Determination of Bentazone and 6-OH-Bentazone Storage Stability in Bovine Liver, Kidney, Muscle, Fat and Milk
2016/7011261	Samoil K.S.	2016	Bentazone: Magnitude of the residue on Pea (dry)