Metabolism and Excretion of Bromacil in Milk of Dairy Cows

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The metabolism of the herbicide 5-bromo-3-*sec*-butyl-6-methyluracil (Bromacil) has been studied in dairy cows. When herbicide concentrations in the feed of 5 and 30 p.p.m. were administered, excretion of the intact compound in the milk reached concentrations of 0.019 and 0.13 p.p.m., respectively. Bromacil was absent in urine and feces samples. The herbicide was not degraded when incubated with rumen fluid or with the 10,000-G supernatant homogenized fraction of beef liver.

Bromacil (5-bromo-3-*sec*-butyl-6-methyluracil), also known as Hyvar, is an herbicide chemical useful for control of perennial and annual grasses and other weeds in non-cropland areas. Drift of applied chemicals into cropland areas such as pastures is common. Therefore, it is of practical interest to know the fate of such compounds in dairy cows. The literature does not contain data on the metabolism and fate of Bromacil in cows or other animals. Excretion of a related herbicide, Terbacil (3-*tert*-butyl-5-chloro-6-methyluracil), in milk was indicated in a metabolic study with cows receiving the compound at levels of 5 and 30 p.p.m. in their feed (Gutenmann and Lisk, 1969). In the investigation reported here, Bromacil was fed to lactating cows at two levels to study its excretion-metabolism pattern.

EXPERIMENTAL PROCEDURES

The design of the feeding experiment, in vitro studies, and virtually all of the analytical procedures for analysis of Bromacil were identical to those reported in the metabolic study with Terbacil in lactating cows (Gutenmann and Lisk, 1969) with certain noted exceptions.

Feeding Experiments. A Holstein cow weighing 1550 pounds and with a daily milk production of about 66 pounds was catheterized and fed Bromacil at the 5-p.p.m. level (based on a daily ration of 50 pounds) for four days. The pure, recrystallized compound in absolute ethanol was thoroughly mixed with the evening grain. Morning and evening subsamples of the total mixed milk were taken one day prior to feeding (control sample), daily throughout the feeding period, and for six days thereafter. The total daily urine and manure samples were similarly collected, weighed, mixed, and subsampled during the same test period. The manure samples were collected in specially constructed trays. All samples were immediately frozen prior to analysis. A second Holstein cow weighing 1450 pounds and with a daily milk production of about 59 pounds was similarly fed 30 p.p.m. of Bromacil in the ration for four days but only milk was collected.

In Vitro Studies. The stability of Bromacil in the presence of fresh rumen fluid and also with the 10,000-G supernatant and Lisk, 1969) was used for milk analysis. The retention time for Bromacil was about 18 minutes.

RESULTS AND DISCUSSION

Small amounts of Bromacil were excreted in milk. Table I lists the residue levels and the corresponding total daily excretion of the herbicide in milk. Figure 1 shows chromatograms of milk containing Bromacil, the herbicide recovered from control milk to which the compound was added, and control milk. The sensitivity of the method for Bromacil in milk was about 5 p.p.b.

The excretion of Bromacil only in the evening milk at the 5 p.p.m. feeding level paralleled the results with Terbacil (Gutenmann and Lisk, 1969) at this herbicide dosage. Bromacil was also excreted predominantly in the evening milk

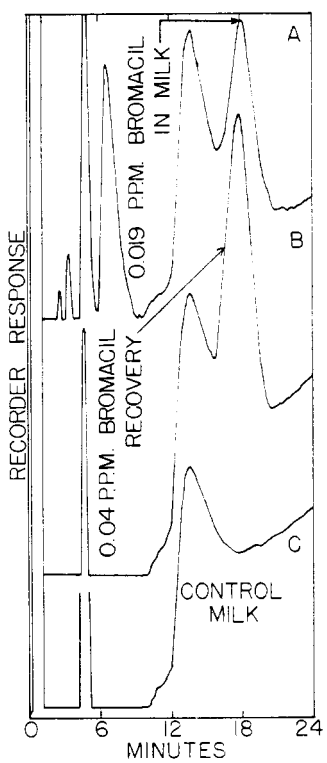

Figure 1. Chromatograms of Bromacil residue found in milk

A. First day milk (PM) from cow receiving 5 p.p.m. Bromacil in feed
B. Control milk fortified with 0.04 p.p.m. Bromacil
C. Control milk

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Table I. Residues of Bromacil in Milk from Cows during and after Ingestion of Bromacil Herbicide

Day	Time of day	Bromacil in Milk p.p.m.		Total Amount of Bromacil Excreted in Milk Daily, mg.	
		Cow fed 5 p.p.m.	Cow fed 30 p.p.m.	Cow fed 5 p.p.m.	Cow fed 30 p.p.m.
1	PM[a]	nd[b]	nd	...	...
2	AM	nd	nd	...	...
2	PM	0.019	0.11	0.12	1.30
3	AM	nd	0.008	...	0.14
3	PM	0.019	0.12	0.13	1.25
4	AM	nd	nd	...	...
4	PM[c]	0.018	0.116	0.12	1.22
5	AM	nd	0.016	...	0.25
5	PM	0.014	0.096	0.11	1.11
6	AM	nd	0.008	...	0.12
6	PM	nd	nd	...	...
7	AM	nd	nd	...	...
7	PM	nd	nd	...	...
8	AM	nd	nd	...	...
8	PM	nd	nd	...	...
9	AM	nd	nd	...	...
9	PM	nd	nd	...	...
10	AM	nd	nd	...	...
10	PM	nd	nd	...	...

[a] First day of feeding Bromacil.
[b] Not detectable.
[c] Last day of feeding Bromacil.

at the 30-p.p.m. feeding level although the elimination of Terbacil at this dosage occurred mainly in morning milk. In both experiments, the herbicides were fed each evening and the excretion pattern would, therefore, appear to represent fraction of homogenized beef liver was studied. The incubation procedures were the same as those described for Terbacil (Gutenmann and Lisk, 1969).

Analytical Procedures. The extraction, isolation, and gas chromatographic analysis of Bromacil in milk, urine, feces, rumen fluid, and the liver fractions were identical to those described for Terbacil except that a single procedure (that involving no evaporative codistillation step) (Gutenmann

Table II. Recovery of Bromacil from Fortified Samples

Sample	Bromacil added, p.p.m.	Recovery, %
Milk	0.04	95, 100
	0.10	85, 86
Urine	0.40	90, 93
Feces	0.20	90

a cycle which required about 24 hours for passage of these compounds into the mammary gland following ingestion. Exceptions to this (e.g., excretion of Terbacil in morning milk at the 30-p.p.m. dose level) may be due to individual physiological variations among the animals. The 5- and 30-p.p.m. feeding levels represented daily totals of 113.5 and 681 mg., respectively, of the herbicide ingested. On a practical basis, these dosage levels are not exaggerated ones when one considers the contamination of forage possible from drift arising from herbicide application.

Bromacil was not detectable in urine or feces samples. The sensitivity of the methods for Bromacil in urine and feces was 0.04 and 0.01 p.p.m., respectively. The recoveries of Bromacil from control samples are listed in Table II.

Decomposition of Bromacil did not occur in the presence of rumen fluid for 7 hours. The compound was stable when incubated with the 10,000-G supernatant homogenized liver fraction for 1 hour.

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