

Appendix H: Residues of 1080 in Animal Products for Human Consumption

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Key points

Information on residues of 1080 in meat and tissue are sparse. The Agency used information available for sheep to assess the significance of residue levels.

The 1080 concentrations (based on those found after 2½ hours after a high acute dose) in sheep meat used for risk assessment were **0.05 mg 1080/kg for skeletal muscle** and **0.064 mg 1080/kg for offal (organ meats)**.

No information on the concentration of 1080 in milk from sheep (or cows) after dosing animals was available, so a conservative estimate of the 1080 concentration in milk was based on the concentration in **blood plasma: 0.141 µg/g**.

H1 Introduction

The purpose of this appendix is to summarise the information available on residues of 1080 in tissues of animals exposed to it and subsequently eaten by humans or their companion animals.

H1.1 Types of animal

The Agency identified three main scenarios that may give rise to meat residues. These scenarios relate to different types of animal (or different situations).

- Farm animals (sheep, beef, goats etc) may accidentally get access to 1080-material (due to incorrect placement of baits outside the intended area or failure of a protection strategy for the animals, such as fencing).
- Feral animals, deer or pigs taken by hunters may have been poisoned (whether by intention or not as part of the ‘by-kill’).

- Feral animals, possums, rabbits, taken by hunters for human (or companion animal consumption) may have been sub-lethally poisoned as part of the intended target of the operation.

The distinction between the second and third points relates primarily to the animal species involved.

H1.2 Tissues

Particular attention was given to the following tissues of these animals as these are most likely to be the tissues used for human consumption:

- Skeletal muscle (red meat).
- Organ meats, primarily liver, kidney.
- In the case of farmed dairy animals, milk and dairy product contamination was also considered.

The most relevant information on 1080 residues in meat found was the study by Eason et al (1994). The study established the half-lives of 1080 in sheep (mean 10.8 hours, range 6.6–13.3 hours) and goats (3.9 hours or 6.9 hours). For a fuller discussion of the report see Appendix B. The half-life of 1080 in sheep was found to be substantially longer than in goats, so the tissue residues are likely to be higher in sheep. Therefore, it is appropriate to concentrate on the sheep meat residues.

After exposure of three sheep to a single dose of at 0.1 mg/kg bw, various tissues were analysed for 1080 at two time points, 2.5 hours and 96 days (4 days). The results are reported in Table H1. Serum levels were measured at a larger number of time points as this could be done by taking of a blood sample. Those data were used for determination of the elimination half-life, discussed above.

Table H1: Mean concentrations (ranges) in plasma and tissues in sheep

Tissue	Concentration (ranges) at stated time (µg/g)	
	2.5 hours	96 hours (4 days)
Plasma	0.098 (0.033–0.141) [*]	0.002
Kidney	0.057 (0.046–0.064) [*]	0.002
Heart	0.052	0.003
Muscle	0.042 (0.038–0.050) ¹	0.002
Spleen	0.026	0.003
Liver	0.021 (0.011–0.039) ¹	0.000

Note

- * Results of the same study are also published in Eason et al (1993). The paper includes the range of tissue concentrations in some of the tissues, as set out in the table.

The values provided were mean values, but the ranges provided in the earlier paper are useful. For the purpose of risk assessment, the Agency considered it is preferable to use the highest values from these ranges so as to reflect the ‘worst case’. The reason for this was that only three animals

were used in the study, and there appeared to be considerable variability in the half-life in different animals.

These animals were given a sub-lethal dose of 0.1 mg 1080/kg bw which may be compared to the estimated LD₅₀ in sheep of 0.4 mg/kg bw (O'Connor et al 1999). The concentrations in parts per million (wet weight) are assumed to be relevant to use of meat from slaughtered animals. This assumes that residues do not decline significantly after the animal has died, before or after refrigeration. (Questions have been raised on the basis of slower breakdown of residues under cooler conditions in the field (Weavers 2003) but since the assumption made is that no breakdown has occurred, the Agency considers his criticism is unjustified). Also, it is assumed that if any of the poison remained in the stomach at the time the animal was slaughtered, the absorption and distribution of this material is unlikely to be significant, due to the lack of blood flow.

The finding most relevant to the consumption of animal meat by humans is the skeletal muscle value, but use of organ meats such as liver and kidney for human food is a possibility. Therefore, the tissue concentration in kidney (which appears to have the highest residue) may possibly be relevant also.

It seems appropriate to take the concentration at 2.5 hours for the top of the concentration ranges to give the worst case. This gives 0.05 mg/kg for muscle and 0.064 mg/kg for kidney. For the purposes of calculation the Agency rounded up the latter value to 0.07 mg/kg as the likely highest meat concentration for sheep based on the study.

The intention is to consider the risk presented by the highest meat concentration likely to be encountered. The Agency considered the dose used in these sheep is close enough to the LD₅₀ value that the meat residues are as high as those likely to be encountered (in sheep at least).

Proposed maximum meat residue, for muscle and organ meat for the purposes of human risk assessment are: **0.05 mg 1080/kg for skeletal muscle and 0.064 mg 1080/kg for offal (organ meats) (based on the kidney).**

Some factors affecting the relevance of these findings for other species are discussed below.

H2 Discussion of matters relevant to tissue residues

H2.1 Milk

The Agency notes that it is possible for milking dairy animals to be exposed to 1080 due to human error. No information was available to the Agency relating to residue of 1080 in milk from lactating cows. However, one study has been reported (application H-A26) from residues in lactating ewes (Eason et al 2002b, cited in the application). The Agency did not have access to the original report. According to the application, after an

unspecified dose of 1080 containing pellets to ewes in different exposure groups 1080 was just detectable in the milk of the higher dose animals at 72 hours, with an estimated residue of 0.0005 µg/ml (this is 0.0005 mg/l). The Agency considered that testing at an earlier time period would have been appropriate, given that the elimination half-life of 1080 in sheep has been reported to be mean 10.8 hours, range 6.6–13.3 hours (see above).

Since 1080 is water soluble, the Agency considered that as a worst case scenario, the 1080 concentration in the animal's milk could be the same as that in their blood plasma. (This is likely to be a very conservative assumption.) Using the data for the sheep listed above (no data are available for cows); this would suggest a maximum 1080 residue in milk of 0.141 µg/g. This is the highest plasma concentration from the range at 2.5 hours. (Clearly this worst case estimate is far higher than the barely detectable residue in the sheep reported by Eason (2002b).)

H2.2 Species

Consideration of the relevance of the above value to other species is important. The Agency did not find data on tissue residues in species which would be termed the main human meat sources, such as cattle, pigs, and deer.

The Agency considered how relevant the above figure to other species. If the species are less sensitive to 1080 (has a higher LD₅₀ value) then it is likely that the animal could have higher residues in their tissues than sheep without reaching a lethal dose. Table H2 lists some of the most relevant values for human meat sources. (These values are taken from Appendix B so references are not provided here.)

Table H2: LD₅₀ in human meat sources of relevance*

Species	LD ₅₀
Sheep	0.4 mg/kg bw
Goat	0.6 mg/kg bw
Cattle	0.4 (cows), 0.22 (calves) (Robinson 1970)
Horse ¹	0.32-0.50 mg/kg bw (see Appendix C)
Deer	0.45 mg/kg bw (see Appendix C)
Rabbits (adult/1.5 kg)	0.34-0.50 (see Appendix C)
Possum (<i>Trichosurus vulpecula</i>)*	16.8 mg/kg bw at 10.5°C and 41.2 mg/kg bw at 23.5°C

Note

* See Appendix C for references for these data for terrestrial vertebrates.

Note that the values for cooler temperatures rather than under laboratory conditions are most relevant to the issue under consideration, so the value in possums, in particular, is far higher than laboratory values.

Ideally, toxicokinetic parameters would also be considered, but data are not generally available other than in laboratory rodents (except for the sheep and goat values above).

There are no data for deer or pig which may also be poisoned and then taken, but the assumption is that the residues in sheep give an indication of the likely concentration values that may be encountered.

For animals that have greater tolerance the tissue concentrations may be higher, perhaps this is most significant for possums. Data for possum are of particular interest.

Eason et al (1993) reports the elimination half-life ($t_{1/2}$) in possum as 9.1 hours range (5.8–13.6) based on studies in six possums. The toxicokinetic parameters for possum (elimination half-life, (maximum serum concentrations and time of maximum concentration) very similar to those for sheep, given the same initial dose of 0.1 mg/kg bw. Unfortunately, no possum tissue analyses were reported in this study. The Agency was unable to locate residue result in possum tissues from other sources. Possums are less sensitive to 1080 than sheep, they have high LD₅₀ values, so as noted above, it is likely that possums are able to sustain higher residue levels without lethality, than would be the case for sheep.

H2.3 Metabolites

The Agency considered also whether metabolites of 1080 could be present at a significant concentration in the carcass of sub-lethally poisoned animals.

The concentrations found are such a small proportion of the 1080 tissue concentrations that no detailed consideration is considered appropriate. The small proportion of 1080 converted to fluorocitrate has been commented on in Appendix C. Eason et al 1994 claim only small quantities produced (as little as 2.5% of the 1080 dose converted to fluorocitrate).

The Agency contends that consideration of fluorocitrate or of other metabolites is not necessary and that consideration of the unchanged 1080 is what requires health risk assessment.

H2.4 Latency

The latency period associated with 1080 poisoning is well known. Even in fatally poisoned animal the latency period can be as long as 29 hours (Robison 1970). Therefore, for a sub-lethal dose, it must be possible for the animal may be asymptomatic, for a substantial period even though a significant dose has been administered.

Thus, even after a toxic dose of 1080 has been administered, it is theoretically possible for a person to obtain the animal during the latency period and consider the animal to be in good condition, before toxic symptoms have occurred.

The Agency considers that this scenario needs to be considered given the striking descriptions of animals, apparently well one minute, but showing

serious signs of toxicity the next (Robison 1970). It is also possible a considerable time after 1080 exposure.

H2.5 Secondary poisoning of animals (particularly dogs)

Secondary poisoning of dogs is a well known problem and was raised in many references and submissions. This is somewhat peripheral to the purpose of this appendix, but nevertheless related to it.

The issues associated with dog poisoning are rather different from those with human exposure to meat residues. There are a number of aspects making secondary poisoning of dog more difficult to prevent.

- Dogs are likely to consume meat from fatally poisoned (dead) animals.
- Dogs may get to the carcass before their owner, and due to the high sensitivity of dogs to 1080 may get a fatal dose quite quickly.
- Dogs are likely to consume viscera including stomach contents, which may include 1080 baits.

Nevertheless, in respect to collection of meat for pet food outlets, the issues are quite similar to those applying to feral meat for human consumption, as in this case the meat is being selected as suitable for consumption, and in

One reference (Frick and Boebel 1946) suggested that heart tissue carried particularly high 1080 residues, but this was not clearly demonstrated, but assumed on the basis that one dog died after consumption of 1080 residues in heart tissue from a poisoned horse, while dogs consuming muscle or liver were not. Since there was no indication of how much of each tissue the dogs had consumed no firm conclusion was possible.

H3 New Zealand Food Safety Authority control relating to feral meat residues

The New Zealand Food Safety Authority administers requirements relating to meat products and specific requirements apply to taking feral meat for human consumption.

Of greatest significance in relation to the control of 1080 residues is the advice relating to the withholding times for taking of meat from 1080 application areas.

Don't take wild or game estate animals from an area where **1080** has been laid until

- **four months** after the operation has ended, or
- **two months** after the operation has ended *and* **after 100 mm of rain** has fallen.

For other vertebrate poisons (which may be of interest for the non-1080 scenario), the equivalent requirements are:

Cyanide – no restriction

Phosphorus – 4 weeks

Warfarin/Pindone – wait 2 months

Other anti coagulants – wait 3 years.

(ie anticoagulants other than warfarin or pindone)”

H3.1 Requirements for the taking of possum meat for human consumption

The extent to which possum meat is used for human food is unclear, but the taking of possum for human food is referred to by the New Zealand Food Safety Authority on its website:

<http://www.nzfsa.govt.nz/animalproducts/subject/hunting-wild-animals/hunting-poison-free.htm>

The Agency notes from the wording, that in the case of possums, the animals must be supplied **live** to premises for processing, while other feral animals such as deer, chamois etc, can be shot and the carcasses brought in.

Under the present system, these animals may be supplied live (possums) or hunted and supplied to the premises that process these wild or game estate animal carcasses into meat for human consumption. These premises are **primary processors**.

The Agency considers that this substantially reduces the likelihood of poison residues being present, but notes this requirement may also be a safeguard to ensure the meat is fresh. The Agency is of the view that the likelihood of exposure to contaminated possum meat is greatly reduced since live animals are likely to be identified as unsuitable for human consumption before slaughter, if they had been poisoned by 1080 prior to being captured.

Note that irrespective of the Agency conclusion that residue levels may not be of toxicological significance the New Zealand Food Safety Authority policy is that **“Any meat that contains poison residues is not considered by the government to be safe and so is not acceptable”**.

