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Persistent Organochlorine Residues in Game-Ranched Bison in Saskatchewan, Canada

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Recent developments in the marketplace, such as the appearance of products labelled "natural" or "residue-free", are indicative of consumer concern about the presence of traces of pesticides in foods, including meat. Previous studies (Steffey et al. 1984, Frank et al. 1985) have demonstrated a decrease in the percentage of samples of domestic animals which contain detectable levels of persistent organochlorine pesticides and their metabolites, as well as a decline in mean levels observed in positive samples. A similar trend has been found in annual national surveys of pesticide residues in various species of domestic food animals in Canada analyzed in this laboratory.

While bison are not among the species of domesticated food animals normally sampled for residue survey programs, there is a developing market for such meat. Persistent organochlorine residues had previously been shown to be at low part per billion (ppb) levels in wild bison samples in northern Canada (MacNeil et al. 1987). A residue study was therefore undertaken to determine if ranched bison, raised in an agricultural region of southwestern Saskatchewan, would evidence more significant exposure to persistent agricultural chemicals.

MATERIALS AND METHODS

Fat samples (500 g) were collected at slaughter from twelve young healthy male bison (eleven 2-year-old, one 5-year-old) by Agriculture Canada inspection staff. Samples were frozen at the slaughter plant and shipped to the laboratory, where they were stored at -20°. An analytical sub-sample (1 g) was taken from a rendered portion of each fat sample and pesticides and related compounds were removed from the fat matrix by sweep co-

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distillation (Neidert and Saschenbrecker 1984). Volatiles from the distillation procedure, performed using a Kontes Sweep Co-distillation Apparatus, were collected on a Florisil mini-column, eluted with solvents and analyzed by gas chromatography using a Hewlett-Packard HP5880 gas chromatograph equipped with Ni^{63} electron capture detector, as previously described (MacNeil et al. 1987).

Confirmation of residues was done by gas chromatography-mass spectrometry on a Finnegan 4000 GC-MS using both electron impact and chemical ionization modes (MacNeil et al. 1987).

RESULTS AND DISCUSSION

Bison sampled in this study contained trace quantities of a variety of persistent organochlorine insecticides and metabolites in their body fat, as shown in Table 1. In contrast, only lindane and α-BHC residues were found in an earlier study of wild bison in northern Canada (MacNeil et al. 1987). Highest residue concentrations, as well as the greatest variety of compounds, were found in the single 5-year-old range-fed male bison from the ranch operation. All residues observed, however, were well below Canadian tolerances for these compounds in meat products. No polychlorinated biphenyls (PCBs) were detected in any of these samples at a screening level of 50 ppb total PCBs. Concentrations of all residues detected, such as hexachlorobenzene (HCB), were within the range found in national surveys of pesticide residues in cattle in Canada (Agriculture Canada 1988).

It is interesting to note that α-BHC was not found in any ranched animals tested, contrary to our earlier observations with wild northern bison. As all samples in this and the previous study were collected within an approximately 2-year period, differences observed reflect several factors, including different environmental exposure through food, water and skin contact and a younger mean age of the ranched sample.

A survey of persistent organochlorine residues in soils from a mixed farming area in Saskatchewan in 1966 (Saha et al. 1968) found heptachlor, heptachlor epoxide (HCE), chlordane, aldrin, dieldrin and endrin at levels in the range 0.01 - 0.30 ppm. No DDT and metabolites were found in any of the soil samples. Forage crops grown in these soils contained 0.01 - 0.10 ppm dieldrin, indicating some uptake of soil residues by these plants. Water samples collected in monitoring programs in Saskatchewan during the 1970's and tested for organochlorines contained primarily lindane and α-BHC (Gummer 1979). The source of the residues found in the ranched bison is therefore

Table 1. Pesticide residue concentrations in ranched male bison from southwestern Saskatchewan.

		Residue found (ppm)							
Sample No.	Age (yrs.)	HCB	α-BHC	Lindane	Oxychlordane	HCE	DDT	DDE	Dieldrin
1	2	0.002	0.003	0.006	-	0.001	-	-	0.003
2	2	-	0.004	0.003	-	-	-	-	-
3	2	0.002	0.003	0.002	-	0.003	-	-	0.001
4	2	0.005	-	0.003	-	0.002	-	-	-
5	2	0.001	-	0.004	-	-	-	-	-
6	2	0.003	-	0.005	-	-	-	-	-
7	2	-	0.003	0.005	-	-	-	-	-
8	2	-	0.003	0.004	-	-	-	-	-
9	2	0.004	-	0.003	-	0.004	-	-	0.002
10	2	0.004	-	0.002	-	0.004	-	-	0.002
11	2	0.004	-	-	-	0.002	-	-	0.003
12[a]	5	0.010	0.018	0.005	0.004	0.015	0.002	0.002	0.010

[a] This 5-year-old male bison was raised on native grass; all 2-year-old male bison were finished for slaughter in a feedlot.

most probably forage, with a possible contribution from drinking water. Since bison habitually roll in the dust, creating pits for this activity, skin contact with residual pesticides adsorbed on soil particles may also contribute to the residues.

The generally low concentrations of residues found in the ranched bison, the first such study involving ranched bison of which we are aware, demonstrate that trace quantities of these compounds still remain in the environment a decade and longer after their use was discontinued. While these residues found in the fat are well below tolerance levels and should pose no risk to the health of consumers, they do illustrate the problems involved in raising meat animals which can be certified to be free of pesticide residues. At the same time, these concentrations are sufficiently low to suggest that these compounds are in the process of disappearing from the environment and the human food chain in Saskatchewan.

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