Honey as an Environmental Indicator of Radionuclide Contamination

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Owing to the present proliferation of nuclear power plants much concern has been generated about possible radioactive contamination during normal operation or especially in the event of equipment malfunction. While they are many fewer in number, nuclear reprocessing plants have had a much poorer record of operation as regards radionuclide contamination of their surrounding area and this has been investigated (COCKRAN, 1970). The Western New York Nuclear Service Center located in Cattaraugus County includes a nuclear reprocessing plant and burial ground for low level dry packaged radioactive waste. This plant has been shut down for several years because of earlier operation which did not meet specifications for clean operation.

In the work reported an attempt was made to assess the extent of possible radioactive contamination of areas surrounding this facility. Whereas various other indicators of radionuclide pollution might have been investigated it was decided to conduct measurements for low level radioactivity in honey samples collected from hives in the vicinity of the plant. Bees from an individual colony may forage over several square miles contacting myriad flowering plants, sources of water and resin-producing trees from which they collect propolis used to seal cracks and crevices in the hive and to strengthen honey comb (MORSE, 1975). It was therefore felt that they may serve as magnifiers of surrounding elemental contaminants and the composition of the honey they produce might reflect this. Other studies have been published suggesting the analysis of bees, pollen or honey to indicate the extent of radioactive or other contamination (POPA et al., 1969; SVOBVDA et al., 1968; MISKLIWICZ and WOZNIAK, 1970; RACOVEANU et al., 1965, 1967a, 1967b; TONG et al., 1975).

Experimental

Twelve honey samples were collected during the fall of 1975. Table I lists the approximate distance and direction from the plant that each sample derived. The area surrounding the plant is largely agricultural with fruit, vegetable and dairy farms located there. A honey sample collected at Ithaca, N.Y. was used as the control. As judged by taste the honeys were derived from nectar from clover, alfalfa, golden rod, some buckwheat or a blend of various of these.

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The honey samples were diluted with an equal volume of water. Twenty ml of Biofluor (New England Nuclear) was added to 0.5 ml of the diluted honey prior to beta radiation counting using a Packard Model 3310 liquid scintillation counter (lsc) in the integral counting mode. A second 0.4 ml portion of the diluted honey samples was digested with 1 ml of Protosol (New England Nuclear) for 4 hours at 60° C in a tightly closed tube. Twenty ml of a solution containing 0.01% p-bis-(o-methylstyryl)benzene and 0.6% 2,5-diphenyloxazole were added to the digest prior to lsc. Detection efficiency for C^{14} in the 1:1 v/v honey:water samples and the Protosol digestion mixtures was 70 and 28%, respectively. Two ml of the water distillate of each honey sample was also subjected to lsc after addition of 20 ml of Biofluor. The lsc could measure 22 p Ci of tritium per ml of the honey water distillate at a level that was twice that of the background beta count. The lsc tritium counting efficiency for the distillate was 39%.

One hundred grams of each honey sample was also analyzed for gamma radiation using a Nuclear Chicago large sample (whole body) gamma counter equipped with a Model 8725 single channel analyzer. Measurement was made in the integral counting mode for 60 minutes. Gamma emission was also measured on a 400-channel gamma counter.

Results and Discussion

No detectable beta or gamma emission above that of the control honey was found in any of the sample collected in the vicinity of the reprocessing plant. The absence of significant radioactivity in the honeys may be related to the numerous curtailments in operations at the plant since 1969 or simply to the absence of significant radioactivity in nectar, pollen, propolis and water upon which the bees foraged.

Specific radionuclides have been identified in honey, pollen or bees by various workers. SVOBVDA et al., (1968) determined strontium^{90} in each. POPA et al (1969) reported potassium^{40} and cesium^{137} in honey and MISKLIWICZ (1970) attributed radioactivity in honey to the presence of potassium^{40}. RACOVEANU et al., (1965, 1967a) attributed beta and gamma radioactivity in honeys to fallout from atmospheric testing of nuclear devices. Since radionuclides can accumulate in bees, pollen or honey further monitoring of each may be valuable in relation to the expected future proliferation of nuclear power plants and therefore reprocessing facilities.

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Table I

Sampling locations of honeys collected near nuclear reprocessing plant (NRP).

Sample No.	Distance and direction from NRP	
	Miles	Direction
1	5	SSE
2	1	ENE
3	3.5	NNW
4	3.3	SSE
5	3.6	SSE
6	5	SSE
7	3.8	SSW
8	3	SW
9	5	NNW
10	4.5	NNW
11	3.5	W
12	3.8	W

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