ETHYLENE OXIDE AND OXALURIA

Dr. M. Alice Brown[1]/
Western Regional Research Laboratory[2]/
Albany, California

Ethylene oxide forms glycols when it reacts with water in the fruit and these glycols, in turn, can be converted to oxalate in the animal body. Oxalate may form kidney or bladder stones that can cause irritation at the site of deposit. This irritation may result in the formation of a cancer.

How much of the ethylene oxide added to dried fruits is converted to glycol? The answer to this important question was provided by a series of complex experiments performed by the research staff of California Packing Corporation. Using carbon-14 labeled ethylene oxide they determined that 0.4% was converted to glycols, both ethylene glycol and diethylene glycol (DEG).

Many studies have been made using ethylene glycol; its conversion to oxalate by living cells has been demonstrated. But a conflict as to the fate of DEG in the animal body exists in the literature. Therefore, a study was undertaken to determine whether or not DEG ingestion resulted in oxalate stone formation in the urinary tracts of test animals.

Male rats were placed on diets containing 0, 0.04%, 0.2%, and 1.0% DEG. The lowest level, 0.04%, represents 100 x and the highest level, 1.0%, represents 2,500 x the amount of DEG that an animal would ingest if its diet were composed entirely of ethylene oxide-treated dried fruit.

After 50 days on the diet, two out of the five animals receiving 1% DEG had oxalate bladder stones (Table I). None on the 0.2% and 0.04% diets had stones. After 100 days, one out of the five animals receiving 1% DEG had stones and those on the lower levels had none. After 150 days, the oxalate content of the urine was measured and it was found that the rats on the 1% level of DEG were excreting the same amount of oxalate as the control rats.

This apparent conflict in the data, oxalate stone formation with no increase in the amount of oxalate excreted, was studied further. The normal oxalate excretion of a group of weanling rats was determined and their oxalate excretion followed when they were placed on a diet containing 1% DEG. Their oxalate excretion rapidly increased after they were placed on the DEG diet, reached a peak four to five times that of normal within two weeks, then rapidly fell back to normal within another two weeks and remained normal despite the continued feeding of DEG (Figure 1). Thus, stone formation probably occurs within the first month. The stones formed then remain with the animal or gradually dissolve.

The same experiment was performed using Beagle puppies and the same pattern of oxalate excretion was observed (Figure 2).

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1. Collaborator employed by the Dried Fruit Association of California.
2. A laboratory of the Western Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture.

The data presented in this paper indicate that adaptation to the ingestion of DEG occurs somewhere in the animal body. When feeding of DEG is begun, the animals' excretion of oxalate is greatly increased, but then, as the adaptive mechanism is formed in response to the presence of DEG and/or its breakdown products, the oxalate excretion returns to normal despite continued feeding of DEG.

The biochemistry of this adaptive mechanism and its location in the animal body are not yet known; however, the fact that DEG causes only a temporary increase in oxalate concentration in the urine is favorable evidence for inclusion in the petition for use of ethylene oxide.

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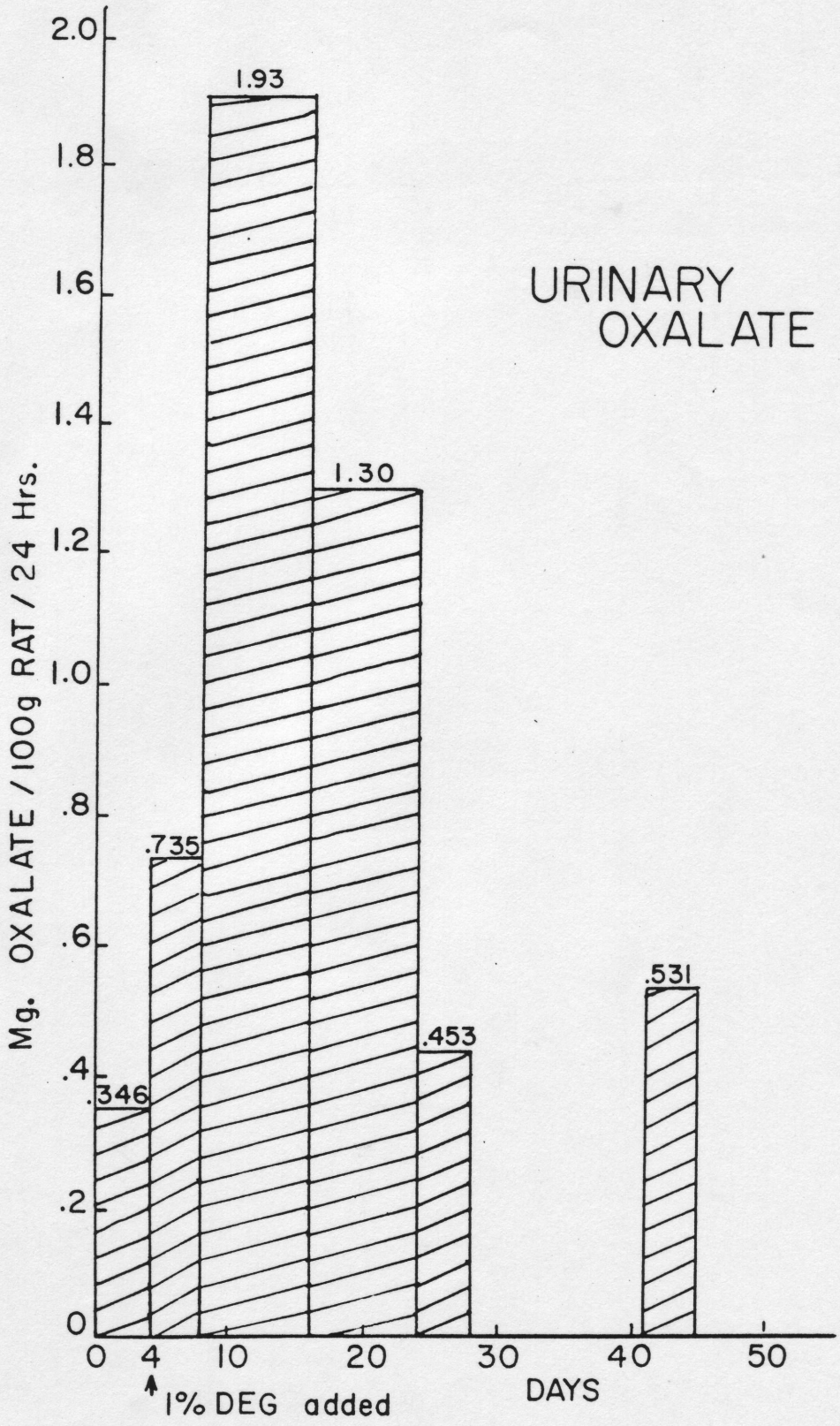
URINARY
OXALATE
Mg. OXALATE / 100g RAT / 24 Hrs.
2.0
1.8
1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
1.93
1.30
.735
.531
.453
.346
0
4
10
20
30
40
50
1% DEG added
DAYS

Fig. 1

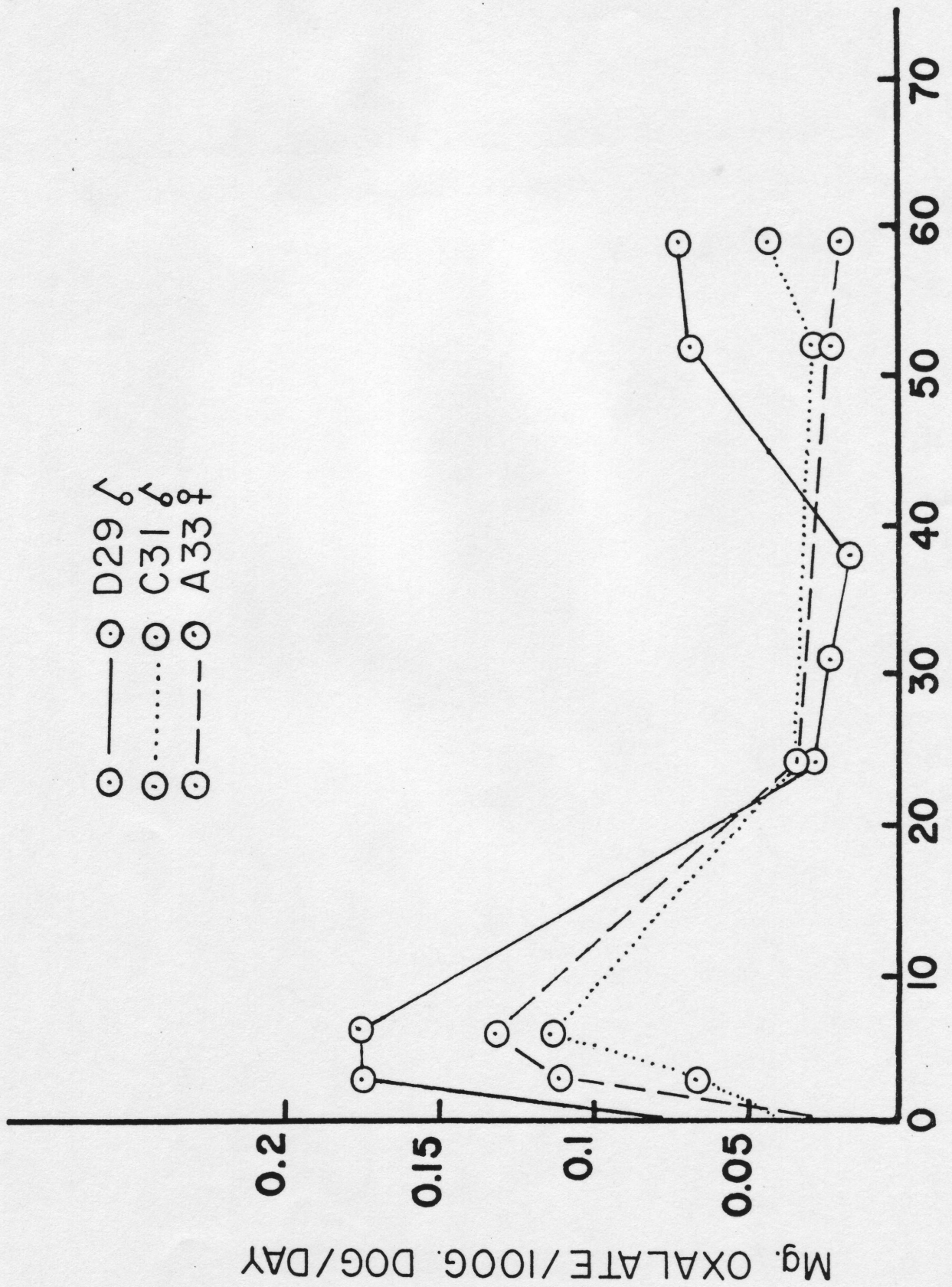
Mg. OXALATE/100G. DOG/DAY
0.2
0.15
0.1
0.05
0
10
20
30
40
50
60
70
DAYS
D29 ♂
C31 ♂
A33 ♀

Fig. 2

Occurrence of calcium oxalate bladder stones in rats receiving diethylene glycol.

Dietary level	Days on diet	Number of rats with bladder stones
1% DEG	50	2/5
.2% DEG	50	0/5
.04% DEG	50	0/5
1% DEG	100	1/5
.2% DEG	100	0/5
.04% DEG	100	0/5

Fig. 3