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Non-Effect of Massachusetts Cement Kiln Dust Upon the Food Intake, Body Weight, or Activity of Female Rats[1]

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GOLD, R. M., M. G. KLEIN, B. A. RINGUETTE, B. B. LOWELL AND R. KATZ. *Non-effect of Massachusetts cement kiln dust upon the food intake, body weight, or activity of female rats*. PHARMAC. BIOCHEM. BEHAV. 10(1) 1-3, 1979.—The addition of Georgia cement kiln dust to the diet of cattle or weanling male rats has been reported to increase body weight and feed efficiency. We attempted to replicate these effects by adding kiln dust to the Purina laboratory chow of adult female rats. Massachusetts cement kiln dust caused no significant change in food intake, weight gain, or activity. The kiln dust effect appears, therefore, to depend upon (a) ingredients peculiar to Georgia kiln dust, (b) age (juveniles vs. adults), (c) sex and/or (d) deficiencies of the control diet.

Obesity   Cement dust   Appetite   Diet

IN THE production of Portland Cement, a finely powdered dust byproduct with few previously known uses is generated. The largest component of the dust by far is calcium which makes up 27% of the dry weight. The dust has a high buffering capacity [5,7] (see [3]). Several hundred tons of the stuff are generated daily by each Portland cement plant in the United States. This can present a waste disposal headache. Undocumented reports from Georgia farmers claim improved weight gains in steers fed a diet of soybean, hay, corn, and cement kiln dust. Wheeler and Oltjen [7] replicated these observations in a controlled study using 14 finishing steers. Their kiln dust supplemented group gained 27.9% more weight and was 20.8% more feed efficient than their controls. One possible difficulty in the interpretation of their data, however, is that the base diets of the experimental and control groups were not identical. The control diet was formulated to satisfy all currently known dietary requirements for finishing steers, while the kiln dust supplemented diet did not, for example, contain the 3.7% soybean seed and 1% salt that was added to the control diet. Perhaps some feature of the nutritional supplementation of the control diet actually retarded growth, thus producing only the appearance of enhanced growth in response to kiln dust.

The reports of the kiln dust effect are not limited to ruminants. Roginski and Wheeler [6] supplemented weanling male rats' diets with 1 to 7% Georgia kiln dust. The rats getting 1% dust gained 23.7% more weight over 5 weeks than did controls. Weight gains were 4.8 vs 3.8 g/d. Higher concentrations of kiln dust were less effective.

In the present study we intended to observe whether the kiln dust effect might not be mediated via a decrease in activity, or conversely, perhaps prevented by providing access to activity wheels. We found instead that we could not replicate the basic kiln dust effect in adult female rats, in or out of activity wheels, using the optimal 1% dust supplement with kiln dust obtained from a local (Massachusetts) branch of the same firm that supplied the kiln dust to the more successful experimenters in Georgia. Neither food intake, body weight, nose-anal lengths, estrus cycling, or body weight were affected by the kiln dust dietary supplement.

METHOD

Eight mature female Charles River CD laboratory rats were kept singly in hanging stainless steel cages, and fed ad lib for 17 days with powdered Purina Laboratory Chow in spill-resistant food jars [2], and water in inverted bottles (sipper tube). Vaginal smears (for stage of estrus cycle), food and water consumption, and body weight were measured daily for the first week of this period. Food spillage, which was minimal, was collected on paper towels and deducted from the intake measure. The rats were maintained on a photoperiod of 12 hr light, 12 hr dark. At the end of this adaptation period nose-anal lengths were measured under ether anesthesia. Two days later half the rats were randomly selected to receive Portland cement kiln dust (Marquette Cement Mfg. Co., Westwood, MA) mixed thoroughly with their regular chow diet. Food and water consumption, and

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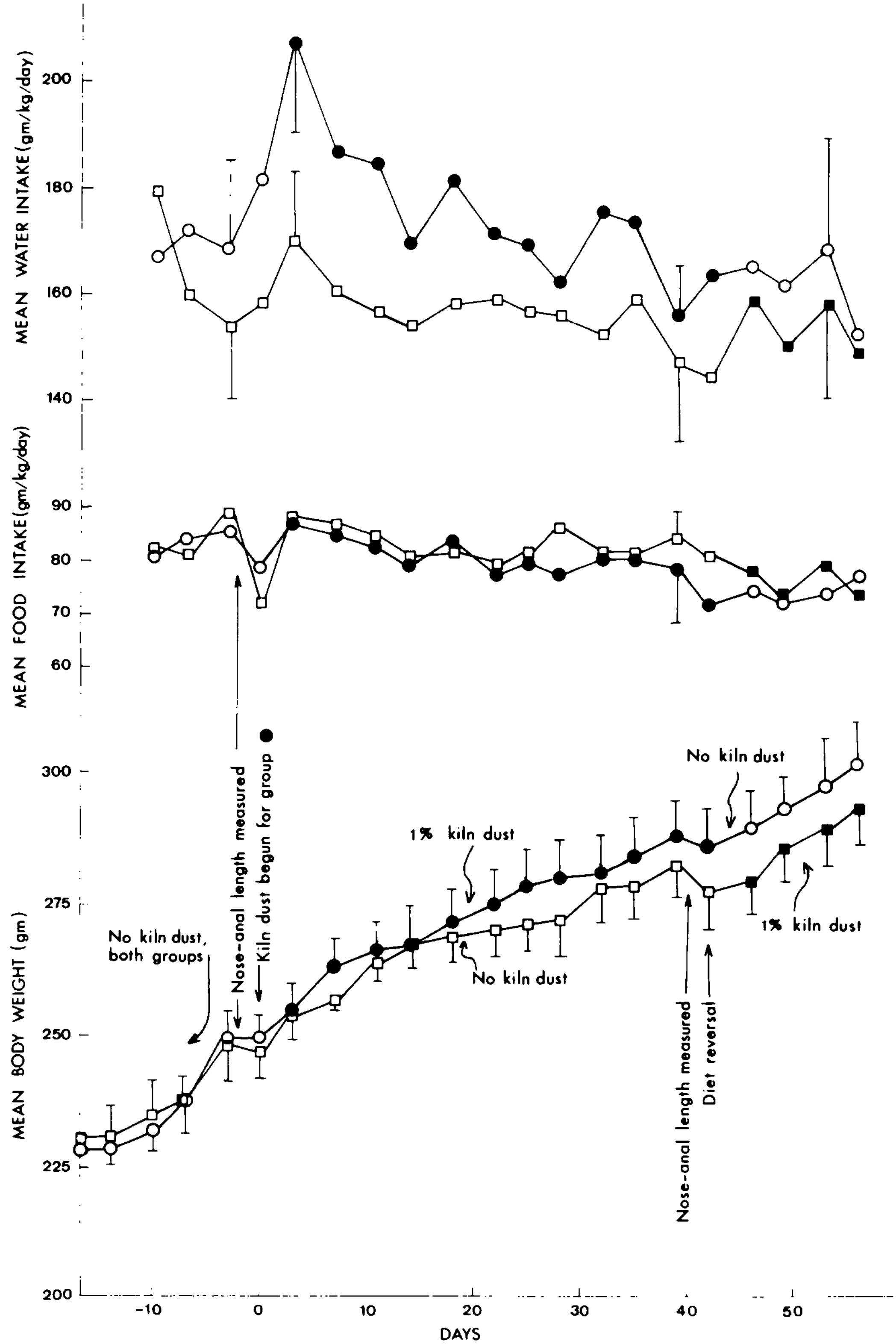

FIG. 1. Mean body weights, food intakes, and water intakes for 1% kiln dust dietary supplement vs unsupplemented Purina chow fed controls. None of the differences were statistically significant.

TABLE 1

MEAN (± SEM) GROWTH BEFORE AND AFTER KILN DUST SUPPLEMENTATION

	Obesity Index			Naso-Anal Length			Body Weight			
	Before	After	Δ	Before	After	Δ	Before	After	Δ	g/d
1% Kiln Dust	295.4	306.2	10.8	21.29	21.50	.21	249.4	285.3	35.9	.87
	(1.4)	(2.9)	(2.1)	(.16)	(.16)	(.09)	(6.5)	(6.6)	(4.2)	(.10)
Control Diet	296.4	302.5	6.1	21.19	21.67	.48	247.9	281.7	33.8	.82
	(1.6)	(2.2)	(2.2)	(.13)	(.22)	(.17)	(6.9)	(6.2)	(2.9)	(.07)

body weight, were then recorded biweekly for forty-two days. Vaginal smears were again monitored during the last week. A second nose-anal measure was taken on the 39th day. The diet conditions were then reversed for 11 days. Six additional rats went through identical procedures (3 kiln dust, 3 no-kiln dust) except that they were housed individually in Wahman activity wheels. Wheel revolutions were recorded daily.

RESULTS

Those rats that received the cement kiln dust in addition to their regular diet exhibited no significant (Mann-Whitney-U test) change in food intake, water intake, or in body weight gain as compared with the chow-fed controls (Fig. 1). Activity (wheel revolution) levels were also not significantly affected, and exhibited the characteristic 4–5 day cyclicity. Vaginal smears revealed regular 4–5 day cycles for all the rats. The troughs in body weight and food intake seen on Days 0 and 42 are due to the ether anesthesia that accompanied the nose-anal length and body weight measurements which were made on Days −2 and +39. The most accurate body weights were those taken when the rats were anesthetized. The weight gains between the two anesthetizations were 0.87 ± 0.10 (SEM) and 0.82 ± 0.07 g/day for the kiln dust and control groups, respectively (see Table 1), or only 0.05 g/d of excess weight gain ($p=0.355$, U=21, Mann-Whitney-U Test, ns) as compared with the 1.0 g/d excess weight gain reported by Roginski and Wheeler over their 35 day period of observation.

Although the differences did not quite reach statistical significance, there was a tendency towards greater obesity under kiln dust as measured by the Lee [4] obesity index (OI). The normal ceiling for this measure (310), which is body weight (BW) corrected for nose-anal length (NAL) ($OI=10^4(\sqrt[3]{BW(gm)}/NAL$ (mm), was not exceeded [1]. The obesity index of the dust treated group did however increase 76% more than that of the controls ($p=0.71$, U=12.5). Most of this obesity index increase is attributed to a 56% decrease in linear (nose-anal length) growth ($p=0.12$, U=14.5) as compared with the controls. The kiln dust group's body weight increased only 6% faster than controls, $p=0.355$, U=21, ns. Thus, cement kiln dust supplementation may retard linear growth. When the diets were reversed, again, there were no discernable effects (only 0.07 g/d excess weight gain, $p=0.475$, U=23.5). The wheel vs sedentary housing also had no discernable differential influence upon whether or not kiln dust affected growth. The wheel and sedentary housed data were therefore combined for Fig. 1, Table 1, and statistical purposes.

DISCUSSION

The possible reasons why kiln dust caused no weight increase are: (a) The Massachusetts cement kiln dust used may have lacked essential Georgia ingredient(s), or the critical ingredient(s) may exist at a lower or higher concentration in Massachusetts. We unfortunately were unable to obtain kiln dust from Georgia. (b) The age and/or sex of the rats may determine whether kiln dust causes a weight increase. The successful Georgia experiments involved weanling males, (l), whereas we used mature females. (c) Our base diet (powdered Purina lab chow) may already have contained the critical ingredient(s) supplied by kiln dust. (d) Perhaps a kiln dust effect would have occurred if our rats had been housed in groups, instead of single cages.

Based on our negative findings we cannot currently recommend the use of Massachusetts cement kiln dust as a dietary additive for livestock. It is not beneficial. It may indeed be detrimental. Although we cannot pinpoint the reason why our kiln dust supplementation failed to enhance growth, we have shown that the growth enhancing influence of kiln dust may be more restricted then previous reports might lead one to expect, and that kiln dust supplementation may adversely affect bone growth. Possible adverse effects upon the eventual human consumer also need to be considered.

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