factor IX for heterozygous females may reach the mean level for affected males at the one extreme and that for normal males and homozygous females at the other (*2, 3*). These extreme values correspond to the case where the X chromosome carrying the mutant gene happens to be active, or inactive, in all cells of the individual. In our data (Table 1) the range for heterozygous females is in agreement with this expectation, since in a sample of only 17 women the range was 10 to 100 percent (in four affected males studied, results from 3 to 10 percent were obtained). Also, the coefficient of variation (Table 1) was greater for the heterozygous females than for the other two classes (*9*).

O. FROTA-PESSOA
Laboratory of Human Genetics,
University of São Paulo,
São Paulo, Brazil

E. L. GOMES
THEREZINHA R. CALICCHIO
Faculty of Medicine,
University of Brazil,
Rio de Janeiro

References and Notes

1. M. F. Lyon, *Lancet* **2**, 434 (1961); *Nature* **190**, 372 (1961).
2. ———, *Am. J. Human Genet.* **14**, 135 (1962).
3. E. Beutler, N. Yeh, V. F. Fairbanks, *Proc. Natl. Acad. Sci. U.S.* **48**, 9 (1962).
4. S. G. Vandenberg, V. A. McKusick, A. B. McKusick, *Nature* **194**, 505 (1962).
5. S. Ohno and T. S. Hauschka, *Cancer Res.* **20**, 541 (1960).
6. S. Ohno and S. Makino, *Lancet* **1**, 78 (1961). S. Ohno, *ibid.* **2**, 723 (1961).
7. See, for instance, E. M. Barrow, W. R. Bullock, J. B. Graham, *J. Lab. Clin. Med.* **55**, 936 (1960).
8. R. Biggs and A. S. Douglas, *J. Clin. Pathol.* **6**, 23 (1953).
9. Supported in part by the Brazilian National Research Council and the Rockefeller Foundation.

2 October 1962

Variations in Survival Time after Whole-Body Radiation at Two Times of Day

Abstract. *Rats, anesthetized with sodium pentobarbital, given 900 roentgens of x-radiation over the entire body, survived more than 130 days when the radiation was given in the morning. The same dosage killed all the animals within 13 days when the radiation was given at night.*

In the course of experiments designed to study protection against the effects of whole-body radiation, it became necessary to irradiate animals both in the morning and at night. It was noted that untreated, control animals responded quite differently to the same dose of x-radiation administered at two different times of day. The phenomenon was so striking that a more detailed investigation was made. The experimental animals used were female rats (*1*) weighing 172 ± 3 g. All the animals were kept in quarantine in our animal quarters for 2 weeks prior to the tests and routinely checked by culture for parasitic or bacterial infection. Before and after irradiation the animals were maintained one to a cage and fed a standard rat diet. They were allowed to eat and drink all they wanted. The room in which all the animals were kept was artificially illuminated for 9 hours and kept dark for 15 hours each day. There were no windows. The period of illumination began at 7 A.M.; the period of darkness, at 4 P.M.

Table 1. Results for four experiments.

Irradiation		Animals (*N*)	Average survival time (days)	Days after irradiation for 1st death	Days after irradiation for last death
Date (1962)	Time				
11 June	9 A.M.	5	*		
	9 P.M.	5	8.2	5	10
21 June	9 A.M.	5	*		
	9 P.M.	5	9.2	7.5	13
14 August	9 A.M.	5	*		
	9 P.M.	5	11.0	10	12
28 August	9 A.M.	5	*		
	9 P.M.	5	8.0	6	12

* All animals still surviving on 20 October.

The radiation was administered with a Picker Vanguard high-frequency, deep-therapy unit of 280 kilovolt peak, operating at 20 ma, with added filtration of tin (¼ mm), copper (½ mm), and aluminum (1 mm).

The beam had a half-value layer of 2.03 mm of copper. A 50-cm target-to-midline distance and an air dose of 900 roentgens (given at 93 r/min) were used in all cases. The dosage rates were checked at each irradiation with a Victoreen roentgen chamber and meter calibrated by the National Bureau of Standards. The unit was equipped with a dose-rate meter in the useful beam, which measured the constancy of the output.

The animals were anesthetized with sodium pentobarbital given intraperitoneally (30 mg/kg) and examined before and after radiation for signs for cyanosis. They were placed on a rotating table (12 rev/min) in the beam to insure homogeneity of dose to each animal. Table 1 shows the results for four experiments and the dates of irradiation. Of the 20 animals irradiated in the morning, all survive at this writing and continue to appear in good health, whereas none of the animals irradiated at night survived longer than 13 days. No signs of cyanosis as a result of the anesthetic were noted either before or after irradiation, and the animals all revived from anesthesia at about the same time.

Work in this laboratory is being continued to determine the basis of the differences in radiosensitivity that were observed (*2*). We believe that these may be light-dark related and that radiosensitivity may vary as a function of irradiation in the light phase or the dark phase of a 24-hour day. We are also investigating the possibility that sex or species differences are reflected in the results.

DONALD J. PIZZARELLO
RICHARD L. WITCOFSKI
E. ANN LYONS
Department of Radiology,
Bowman Gray School of Medicine,
Winston-Salem, North Carolina

Notes

1. The rats used in this study were obtained from Carworth Farms, New City, New York.
2. This work is supported in part by the U.S. Public Health Service (contract USPHS-CRT 5069).

5 December 1962

Incidence of Gastric Ulcers in Swine

Gastric ulcers have been recognized in man for many years. Sporadic observations made in the past (*1*) have also indicated the occurrence of gastric ulcerations in swine. The ulcers in swine are similar to those found in man, and investigations with pigs may furnish some valuable information applicable to humans. A recent study of 164 hogs slaughtered in Indiana (*2*) showed a 25-percent incidence of esophagogastric ulcers. The condition is

Table 1. Effect of various feed constituents upon the incidence of gastric ulcers and mortality of growing-finishing swine. The lots originally contained six pigs each.

Item	Feed*					
	Raw yellow corn			Heat-treated corn		
	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Av. initial wt. (lb)	34.8	34.8	34.8	35.0	34.8	34.7
Mortality	0	0	0	3	3	1
Incidence of:						
Gastric ulcers/lot	0/6	0/6	0/6	3/6	4/6	3/6
Excessive cornification of mucosa slaughtered pigs	2/6	2/6	2/6	1/3	2/3	5/5
Erosion of mucosa slaughtered pigs	1/6	0/6	0/6	0/3	2/3	1/5

* Main protein sources: lots 1 and 4, soybean oil meal; lots 2 and 5, gelatinized soybean oil meal; lots 3 and 6, heat-treated, unextracted soybeans.

Table 2. Effect of thiamin (lot 3), vitamin B_{12} (lot 4), lysine (lot 5), and fish meal (lot 6) on the incidence of gastric ulcers in swine. Lots 1 and 2 were controls. Lots were originally six pigs each, but the identity of 1 carcass each from lots 1 and 3 was lost in the scalding tank at the time of slaughter.

Item	Lot No.					
	1	2	3	4	5	6
Av. initial wt. (lb)	42.4	42.4	41.8	42.3	43.7	41.4
Mortality	0	1	0	0	1	1
Incidence of:						
Gastric ulcers/lot	3/5	1/6	3/5	2/6	5/6	4/6
Excessive cornification of mucosa/lot	5/5	6/6	5/5	6/6	5/6	6/6
Erosion of mucosa/lot	4/5	2/6	3/5	6/6	3/6	4/6

more prevalent and widespread than commonly recognized.

The first experiment was designed (i) to determine the effects of heat-treated corn and gelatinized soybean oil meal on daily gains and efficiency of feed utilization and (ii) to compare the value of heat-treated soybeans versus regular or gelatinized soybean oil meal as principal protein sources for growing-finishing pigs. Thirty-six selected crossbred pigs were separated into six comparable lots, each consisting of three gilts and three barrows. Because of a high mortality observed early in the experiment (7 of 36 pigs), the alimentary tracts of the remainder of the pigs were collected for histopathological examinations the day of slaughter.

The first three dietary treatments (lots 1, 2, and 3) contained ground, raw, yellow corn in combination with either regular soybean oil meal, gelatinized soybean oil meal, or heat-treated, unextracted soybeans; the other three treatments (lots 4, 5, and 6) contained heat-treated yellow corn in similar combinations with the protein concentrates. (Each 100 lb of ration contained the following ingredients: ground yellow corn, 75; soybean meal, 21; dicalcium phosphate, 1.0; ground limestone, 0.9; iodized salt, 0.5; vitamin and mineral premix, 1.5.) All rations were adequately supplemented with minerals and vitamins and contained protein at recommended levels.

A second experiment also involved 36 pigs divided into six lots. Two lots (controls) were fed a basal ration containing gelatinized corn. The other four lots were fed the same basal ration but with the addition, respectively, of one of the following: 1.5 mg of thiamin HCl per pound of ration; 50 μg vitamin B_{12} per pound of ration; 0.5 percent *l*-lysine; and from 5 to 10 percent fish meal substituted for an equivalent amount of soybean oil meal.

Within 7 weeks after the initiation of the *first* experiment in the three groups fed heat-treated corn (lots 4, 5, 6) there occurred a 39-percent mortality from esophagogastric ulcers. Usually these pigs excreted bloody feces, showed dehydration, and developed severe anemia before death occurred. As is shown in Table 1, necropsy disclosed several other pigs with less acute ulcers in these three lots. The total incidence of ulcers in lots 4, 5, and 6 were 50, 66, and 50 percent, respectively. (This unexpected happening defeated the original purpose of the experiment.) The ulcers were confined to the nonglandular esophageal portion in the cardia of the stomach. No ulcers were detected in the alimentary tract of the pigs fed the diets containing raw corn. The incidence of excessive cornification and erosion of the stratified squamous mucosa was greater among the pigs fed heat-treated corn.

In the second experiment, in which all pigs received gelatinized corn, a 53-percent incidence of gastric ulcers (18 of 34) was found. None of the treatments tested (supplemental thiamin, vitamin B_{12}, *l*-lysine, or fish meal) reduced the incidence of ulceration (*3*).

T. W. PERRY, A. A. JIMENEZ
J. E. SHIVELY
Department of Animal Sciences, Purdue University, Lafayette, Indiana
T. M. CURTIN
Department of Veterinary Physiology and Pharmacology, Purdue University
R. A. PICKETT, W. M. BEESON
Department of Animal Sciences, Purdue University

References and Notes

1. J. F. Bullard, *J. Am. Vet. Med. Assoc.* **119**, 129 (1951); J. N. Berg, *Iowa Vet.* **22**, 77 (1960); L. B. Jensen and L. D. Frederick, *J. Am. Vet. Med. Assoc.* **95**, 167 (1939).
2. T. M. Curtin, unpublished data (1962).
3. Supported by a grant-in-aid from Wenger Mixer Manufacturing Co., Sabetha, Kansas. Journal paper No. 1990 (Purdue University).

5 October 1962