

Blood Volume of Swine.* (19134)

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Blood volume values for the various species of animals have been reported and summarized by numerous investigators(1,2). So far as is known, however, no such values for swine have appeared in the literature. This paper, therefore, presents blood volumes for healthy growing swine of various body weights as determined by the P^{32} labeled red blood cell method.

Methods. Many procedures for the determination of plasma volume, red blood cell volume and total blood volume have been reported and compared(3-6). The method used in this study was a modification of that discussed in considerable detail by Reeve and Veall(6). The procedures for handling the animals and performing the injections have been previously described(7,8). Precautions were taken where necessary to prevent damage to the red blood cells, such as gentle handling

and the use of heparinized containers and syringes. From the restrained animal, 5 to 10 ml of blood was taken, heparinized and placed in a 50 ml Erlenmeyer flask. Fifty to 100 microcuries of P^{32} in less than one ml of neutralized isotonic saline was added and the blood incubated at 37.5°C for 2 to 4 hours. The blood was centrifuged and the red blood cells washed 4 or 5 times with ice-cold physiological saline which removed all but insignificant amounts of the radioactive plasma. The labeled cells were then reconstituted to the original volume of blood with saline, and, depending upon the size of the animal, a measured volume of from 2 to 5 ml was quantitatively injected intravenously. Venous samples were drawn at 15 minutes after injection. A one ml aliquot of the cell suspension injected was diluted to 250 ml for the standard, and the whole blood sample was usually diluted fivefold for the measurements. The radioactivity was measured with a Geiger counter arranged for external solution counting(9). Cell pack volumes were determined by centrifugation in the usual manner and were corrected for 5% trapped plasma. Since the labeled red cells were usually injected into the animal within 15 minutes of the preparation of the final suspension, no correction was made for free P^{32} in the saline. Blood volumes are expressed as milliliters of blood per 100 g body weight.

In vitro uptake and in vivo loss of P^{32} from porcine red blood cells: It is helpful to be

TABLE I. Uptake of P^{32} by Porcine Red Blood Cells *In Vitro*.

Time, hr	% uptake
.5	10
1	15
1.5	18
2	20
3	22
4	23
4.5	24

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* Published with the approval of the Director of the Tenn. Agric. Exp. Station. Radioactive materials were obtained from the Oak Ridge National Laboratory on allocation from the U. S. Atomic Energy Commission.

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TABLE II. Blood Volume of Swine.

Pig No. and sex	Body wt, lb	Blood vol value*	Cell pack vol
1 ♂	10	7.9	34
2 ♂	11	7	40.2
3 ♀	8	7.3	34
Avg	10	7.4	35
4 ♂	15	6.6	40.2
5 ♂	21	6.6	40.9
6 ♀	20	6.7	42.3
7 ♀	22	6.9	40.6
Avg	20	6.7	41
25 ♀	74	6	31.8
26 ♀	82	5.6	37.8
26 ♀	72	5.9	38.8
27 ♀	78	6.4	37.9
Avg	76	6	36
31 ♂	94	6.6	41.9
28 ♂	97	6.5	43.1
28 ♂	97	6.8	39
30 ♂	102	6.1	30.3
Avg	98	6.5	39.1
31 ♂	134	6.5	37.9
29 ♂	118	5.3	38.2
3 ♂	113	5.9	39.3
Avg	122	5.9	36.8
29 ♂	182	4.6	40
49 ♂	164	6.1	39.3
0 ♀	200	4.9	39.3
Avg	182	5.2	39.5
37 ♂	370	4.4	36.9
45 ♀	333	4.3	38.6
45 ♀	328	4.6	39.7
0 ♀	344	5.1	38.5
Avg	344	4.6	38.4

* ml of blood per 100 g body wt.

able to approximate the percentage of added P^{32} that will enter the cells under the conditions of the experiment. Table I shows the percentage of P^{32} found in the cells after varying periods of incubation of the normal whole blood with P^{32} . The percent uptake leveled off at about 20% at 2 hours. Experiments have indicated that in the final suspension the loss of P^{32} from the cells into the saline was of the order of 5% during the first hour. After injection of the labeled red cells into the animal it was found that the loss of P^{32} during the first hour was approximately 10 to

12%. The loss during the 15 minutes after injection was not found to be significant. These findings indicate the suitability of the method for blood volume estimation in swine.

Results and discussion. Twenty-five determinations were made with 16 Hampshire swine as indicated in Table II: the animals of each group were litter mates. The cell pack volumes have been listed to permit estimation of the plasma and red cell volume. An average blood volume of 7.4 ml/100 g body weight was obtained with the 10 lb pigs, with the values decreasing more or less regularly to an average of 4.6 for the 344 lb animals. Consideration of the data indicated that despite the variation between individuals there was a real decrease of the blood volume value with increasing body size; furthermore, the effect was more pronounced with the lowest weight groups.

Dukes(1) has reported the blood volume value to be independent of body weight in dogs weighing between 7 and 24 lb and in goats between 16 and 67 lb. However, it was also noted by Dukes that blood values in lambs did decrease with age between birth and 190 days with the greatest decrease occurring in the first 30 to 60 days.

In working with swine perhaps the greatest uncertainty is in obtaining a quantitative injection. In this study there were injection losses in four animals, as evidenced by observations during the procedure, which always resulted in blood volume values 50 to 100% higher than expected on the basis of other determinations. These animals were not included in the data presented.

Summary. The P^{32} labeled red blood cell method has proven satisfactory for the determination of blood volumes in swine. Values obtained ranged in regular fashion from 7.4 to 4.6 ml/100 g body weight for 10 to 344 lb animals, respectively.

Received October 4, 1951. P.S.E.B.M., 1951, v78.