

THE RELATION OF THE WEIGHT OF THE CONTENTS
OF STOMACH AND CECUM TO THE BODY-
WEIGHT IN RABBITS.¹

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In much of our experimental work upon mammals, the dosage of the various drugs used is regulated according to the size of the animal—a given amount being allowed per kilo of body-weight. In the rabbit this is a source of considerable error on account of the large size of the stomach and cecum. After a full feeding, when these organs have become well filled, the weight of their contents bears a relation to the total body-weight which is quite out of proportion to this same relation in other animals.

In order to determine just how great an error would obtain from an inclusion of these contents in the body-weight of a living rabbit, I have removed and weighed the material found in the stomach and cecum in the case of fifty male and fifty female rabbits which were used in the laboratory for other purposes. In each case a record was kept of the sex, body-weight, weight of the stomach, weight of the stomach contents, weight of the cecum, weight of the cecum contents, and the number of hours the weight was taken after feeding.

In removing the contents of the cecum an opening was made near the ileo-colic end, and by compression from the outside, everything was removed which could readily be expelled. Not more than three to five grams were ever left. None of the rabbits in my series were selected or fed beforehand in order to raise the percentage. Every rabbit that was killed in the laboratory was used until one hundred weights were obtained. Some had been

¹ Received for publication September 25, 1908

fed a few minutes before being weighed and used, others had not been fed for five, twelve, seventeen or twenty-three hours.

An examination of the tables below shows the following points concerning the one hundred animals examined:

1. The stomach- and cecum-contents in male rabbits are equal to an average of 10.4 per cent. of the whole body-weight. In female rabbits to 11.4 per cent. of the body-weight.

2. The lowest percentage found between stomach- and cecum-contents and the body-weight in males was 4.74 per cent. in females 6.80 per cent.

3. The highest percentage found in males was 19.32 per cent.; in females 18.04 per cent.

4. The average weight of stomach-contents in males having an average body-weight of 1665 grams is 94 grams. In females with an average body-weight of 1674 grams this average is 106 grams.

5. The average weight of cecum-contents in males is 80 grams; in females 79 grams.

6. Small rabbits have relatively larger stomach- and cecum-contents than heavier rabbits. In the table of averages for female rabbits (Table III, Columns 4 and 5), this is easily seen. The male rabbits (Table II) do not show it so markedly.

The amount of material contained in the stomach and cecum varies greatly in different rabbits, and also in the same rabbit at different times. It is manifestly impossible to lay down a rule which will hold in the case of every rabbit. However, since the inclusion of these contents in the body-weight will invariably cause a considerable error, it is possible to formulate a rule which will reduce the error to a minimum. For practical working purposes (and for the sake of simplicity) it is safe, judging from these tables, to allow ten per cent. of the body weight of any rabbit for the contents of stomach and cecum.

This rule may be stated in another way, although it is then somewhat more complicated. It is as follows: allow 125 grams for the first kilo of body-weight and 25 grams additional for each 300 grams of body-weight above one kilo.

Grober² has recently made a series of similar observations in con-

²Grober, "Untersuchungen zur Arbeitshypertrophie des Herzens." *Deutsches Arch. f. klin. Med.*, 1907, xci, 504.

TABLE I.

Sex.	Average Body-Weight.	Average Weight of Contents of Stomach.	Average Weight of Contents of Cecum.	Average Total Weight of Contents of Stomach and Cecum.	Corrected Body-weight.	Average Percentage of the Stomach- and Cecum-contents to the Body-weight.	Lowest Percentage Found Between Stomach- and Cecum-contents and the Body-weight.	Highest Percentage found Between Stomach- and Cecum-contents and the Body-weight.
	Grams.	Grams.	Grams.	Grams.	Grams.	Per Cent.	Per Cent.	Per Cent.
Male	1,665	94	80	174	1,491	10.41	4.74	19.32
Female	1,674	106	79	185	1,489	11.36	6.80	18.04

TABLE II.

Male Rabbits. Table of Averages.

Body-weight.	Average Weight of Stomach-contents.	Average Weight of Cecum-contents.	Average Weight of Stomach- and Cecum-contents.	Average Percentage of Stomach- and Cecum-contents to the Body-Weight.
	Grams.	Grams.	Grams.	Per Cent.
1,000-1,299	64.0	66	128	10.80
1,300-1,499	85	66	151	10.87
1,500-1,599	89	65	154	9.76
1,600-1,899	93	96	189	11.04
1,900-2,199	112	85	197	9.70
2,200-2,899	133	105	238	9.37

TABLE III.

Female Rabbits. Table of Averages.

Body Weight.	Average Weight of Stomach-contents.	Average Weight of Cecum-contents.	Average Weight of Cecum- and Stomach-contents.	Average Percentage of Stomach- and Cecum-contents to the Body Weight.
	Grams.	Grams.	Grams.	Per Cent.
800-899	65	83	148	18.04
1000-1299	96	64	158	12.82
1300-1399	84	77	155	10.81
1400-1699	110	83	193	12.01
1700-1999	106	78	184	9.85
2000-2399	128	85	213	9.65

nection with some work on hypertrophy of the heart, in which he tied off, removed, weighed and included, the weights of the stomach and cecum with that of their contents. He considers that the inclusion of the weight of the stomach and cecum with the weight of their contents will not be the source of any appreciable error, since there is such a wide variation in the weights of the contents

of stomach and cecum in different rabbits. However, according to my results, the average weight of the empty stomach is 26 grams, and of the empty cecum 36 grams, a total of 62 grams. It is easily seen that the addition of 62 grams to the weight of the contents of stomach and cecum of every rabbit (especially in the case of those whose stomach and cecum were not well filled) would materially change the percentage relationship between these contents and the body-weight.

Again, Grober's³ tame rabbits have an average of 276 grams weight of stomach and cecum plus contents, per kilo of body-weight, or 27.6 per cent. of the body-weight allowed for in these organs. If we suppose that the average weight of the stomach and cecum in his rabbits was the same as my own (62 grams), there would still remain in his rabbits 214 grams per kilo of animal for contents of stomach and cecum, *i. e.*, 21.4 per cent. of the body-weight. Now my rabbits show an average of 103.5 grams of stomach- and cecum-contents, per kilo of body-weight (*i. e.*, 10.35 per cent. of the body-weight), or about 110 grams of stomach- and cecum-contents less than Grober found in his rabbits.

A comparison of Grober's tables with mine shows that for rabbits of any given weight, the heart weight is approximately the same, so that the variation between our percentages for stomach- and cecum-contents must be due to both the inclusion of stomach and cecum with the weight of their contents and also to the presence of a larger amount of food material in the stomach and cecum of his rabbits than in those examined by me. I cannot account for the large figures obtained by Grober unless his rabbits were fed not long before being used or else were fed more heavily than the rabbits at my disposal.

³Grober, in his article, does not give direct figures for the weight of the organs and their contents. He gives only the ratio between the heart-weight and body-weight before and after removal of the stomach and cecum with their contents. The number of grams of heart tissue per kilo of animal (*i. e.*, the ratio) before removing the stomach and cecum he finds to be 2.36; after removal, 3.26. In other words the removal of these two organs with their contents raised the ratio of the heart-weight to the body-weight, 0.9 gm. per kilo of animal. From these figures we find that the weight of the stomach and cecum plus their contents must have been 276 grams per kilo of body-weight.

In the paper published recently⁴ on the ratio between the heart-weight and body-weight in various animals, I made the following statement in commenting on the very low ratio between the heart-weight and body-weight in rabbits: "A ratio derived from rabbits with the weight of the contents of stomach and cecum excluded, would undoubtedly be nearer that found in the other animals (dogs, approximately, 7.5, cats 4.5, guinea-pigs 4.0, rabbits 2.6)."

While making the observations given in the present paper, the heart-weight was taken in each rabbit. I find that the ratio of the heart-weight to the body-weight was increased about .31 gram per kilo of animal by the removal of the stomach- and cecum-contents, *i. e.*, 50 male rabbits with an average body-weight of 1665 grams gave a ratio of 2.60 before removal and 2.91 after removal. Fifty female rabbits with an average body-weight of 1674 grams gave a ratio of 2.55 before and 2.88 after removal of the contents of stomach and cecum. This calculation shows that in rabbits, even after removal of the contents of stomach and cecum, the ratio between heart-weight and body-weight is considerably less than in dogs, cats, or guinea-pigs.

⁴*Jour. of Exper. Med.*, 1908, x, 521.