DETERMINATION OF THE SPECIFIC GRAVITY OF LIVE SHEEP

J. W. U. BEESTON*

I. INTRODUCTION

It has been shown by Behnke (1941), Pace and Rathbun (1945) and others that there is a good relationship between percentage total body fat and specific gravity (S.G.) in a number of different species of animal. Methods of measuring the volumes of live animals to determine S.G., have usually involved immersion in water, but there are difficulties in this procedure due to air retained in the body and pelage of the animal. The displacement of air instead of water was used to measure volume by Kohlrausch (1930) and Bohnenkamp and Schmäh (1931). These workers introduced a measured quantity of gas into a sealed chamber containing the animal whose volume was to be measured. The resultant increase of pressure in the chamber was directly proportional to the volume of the animal.

II. APPARATUS

(a) Principle

The technique of Kohlrausch (1930) was not considered to be accurate enough, and it was decided to increase sensitivity by reducing the amount of air surrounding the animal in a chamber. This was achieved by introducing sufficient water into a chamber to reduce the air volume to the minimum required for respiration. To overcome problems which may arise from immersing the animal, a rubber membrane was used to separate the water and air spaces. Instead of introducing a measured quantity of gas into the chamber a measured quantity of water was injected into the water space, and the change in pressure was measured by a water manometer connected with the air space. When the animal was placed in the chamber water was transferred to maintain the air in the air space at a volume of 15 l, regardless of the size of the animal; the animal’s volume was then equal to the volume of water removed.

(b) Description

The apparatus (Fig. 1) consists of a container A, a manometer E, a pump F, and a tank G, which rests on a weighing machine J. A rubber diaphragm B is stretched across the mouth of the container which is filled with water, all air being excluded from beneath the diaphragm. The pump transfers water from the container to the tank or vice versa, the quantity moved being weighed accurately on the weighing machine. As water is pumped from the container the rubber

*Division of Animal Physiology, C.S.I.R.O., Ian Clunies Ross Animal Research Laboratory, Prospect, N.S.W.

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diaphragm is drawn down as indicated by the broken lines B, leaving a chamber filled with air above it. On closing the lid and injecting a pump-full of water this air is subjected to a pressure rise, measured on the manometer; the rise is inversely proportional to the volume. In practice, a ‘zero’ mark was made on the manometer which corresponded to an initial air volume of approximately 15 l. depending on ambient temperature and pressure.

(c) Procedure

The experimental sheep was sedated with an intravenous injection of nembutal and weighed in the cradle H on the weighing machine J. Water was then pumped from the container into the tank, the amount transferred being a rough estimate of the sheep’s volume; the sheep was then packed into the chamber. The lid was closed, the valve D3 being left open for a minute to allow pressure equilibration of the air in the chamber. At the end of this period the valve was closed and the pump-full of water injected into the container. The initial heat generated by the injection of water was dissipated in about 5-7 sec and fluctuations in the manometer height caused by the animal’s breathing were averaged. The pump-full of water was then withdrawn from the container and the lid opened. The difference between the manometer reading and the zero mark provided a new estimate of the sheep’s volume. The procedure was repeated as often as necessary, usually once, to obtain a zero reading. The volume of water removed from the container was then equal to the volume of the sheep.
III. EXPERIMENTAL AND DISCUSSION

To test the apparatus, the S.G. of 14 sheep was measured by this means. To check these values and their relation to the body fat content the sheep were killed by a large intravenous injection of nembutal. They were then transferred to polythene bags, together with any excreta or saliva voided, frozen, and subsequently were cut up with a band saw and finely minced. The S.G. of the mince was measured by water displacement after evacuation of air, and the fat content was determined by chloroform extraction.

The curves relating fat, expressed as a percentage of body weight, to S.G. measured in the two ways, are shown in Figure 2. That relating fat content and the S.G. of the mince is similar to that reported by Behnke (1941). The curve relating S.G. measured on the live animal to percentage fat diverges from the ‘true’ curve, apparently because of some systematic error in the apparatus. Reasons for this departure are not clear. However, in the 14 animals measured the greatest deviation in fat content from the line of best fit was 4% of body weight. Thus the predictive value of the curve is at least as good as that using the mince S.G.

Fig. 2.-Percentage fat in 14 sheep (% wet weight) plotted against S.G. of the live animals and S.G. of the minced whole animals.
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IV. REFERENCES


