

猪用封闭式电路呼吸装置

杨嘉实

A CLOSED-CIRCUIT RESPIRATION APPARATUS FOR SWINE

Yang Jiashi

(The Institute of Animal Husbandry, Jilin Academy of Agricultural Sciences, Gongzhuling, Jilin Province, China)

ABSTRACT

In order to develop a calorimeter and obtain more data for animal nutrition research, Yang Jiashi et al. established a laboratory, designed and assembled two pieces of respiration metabolism apparatus of swine in 1980—1981. Using these apparatuses, results from experiments dealing with energy metabolism associated with fasting, growing and different temperature for swine and poultry were obtained in 1982—1985.

A type of closed-circuit in indirect calorimetry was adopted. The advantages of this type are as following:

1. Cheaper, Simpler, and more practical than the direct calorimetry.
2. Lower in demand of accuracy than open-circuit type and easier to master.
3. Higher in accuracy than the respiration mask method, and easier in the training of the pig.

Using this kind of apparatus, as long as every part of the apparatus is airtight and the reagent is enough, the desired results can be obtained.

Two pieces of closed-circuit respiration apparatuses are RA(C)1 and RA(CO)2. Their common features are: The door is sealed up with a rubber-loop in the back of the chamber; Air conditioner system is above the ceiling and oxygen supplied system is in front of the chamber; Gas-absorbing system is on the right outside the chamber; humidity and air-pressure are adjusted by absorption system and natural moisture is kept in the chamber; the refrigerator is on the outside; some dials recording temperature, humidity and air-pressure are in the chamber; the experimental animals are kept in a metabolism cage; feed supplying system is in the front of the chamber or cage; Faeces and urine are handled with the closed rubber gloves.

This is the first time that this kind of apparatus is designed and manufactured in China so that its technological level is low and it is rather simple. But the cost was very low, and the foreign exchange for introducing apparatus from foreign countries needed otherwise was saved. These apparatuses can also be used for experiments without the self-controlled tracing system. The explanations for the various parts are follows.

1. Respiration chamber: It is built up with two air-tight iron-walls filled with pearl core so as to separate the inside temperature from outside, and the wall is 8 cm. thick. The chamber is $170 \times 120 \times 200 \text{ cm}^3$, contains $3.2\text{--}3.4 \text{ m}^3$ air, the surface of the wall is covered with paint to prevent it from corrosion, the door of RA(CO)2 type can be opened or closed by the chain linked to the crane.

Cooling and heating plates are used to achieve constant temperature automatically. On the sides of the chamber, there are two groups of dry and wet bulb thermometers, the animal's behaviour and excretion of faeces and urine can be observed through the windows.

2. Gas absorbing system; Nine absorptive pots attached to airtight tubes are on the right

side of the chamber. The pots are made of polythene.

Each row of the pots used once in an experiment consists of 9 pots usually. They are divided into three groups. The first 3 pots and last 3 pots contain silica gel to absorb moisture. The second 3 pots contain industrial KOH to absorb CO₂. There are manometers and thermometers on the first and the last ones. The air absorbed enters the chamber once again from tube to circle repeatedly during experiment.

3. The system of oxygen supply or ventilation: It is necessary to the closed-circuit respiration apparatus.

The oxygen supply system is in front of the chamber, and there is an inlet hole for providing oxygen in the wall of the chamber. It's a special bucket to supply oxygen to a large respirometer filled with oxygen, which is transferred into the chamber through the tube of wet-gasflowmeter, therefore, it guarantees the supply of oxygen needed by the animals.

4. Feeding and collecting for faeces and urine: Animals are fixed in the metabolism cage at certain place in the chamber, a zinc-plated board for collecting the faeces and urine is under the cage.

There is a feedthrough in front of the cage. Feeding animals, and treating faeces and urine can be done with the rubber gloves under the windows.

5. Air conditioning system: The temperature of the chamber is adjusted with two electric-conducting thermometers. The four electric fans divided into groups, used by turns, are placed under the ceiling of the chamber. Cooling and heating plates in apparatus are controlled to keep constant temperature at any set point between 10° and 30° with an accuracy of ±1°C.

6. Analysis of gas composition: Three methods are adopted cooperately as following:

Weight method: The absorption bottles are weighed together with gas sample using a large scale balance.

Capacity method: Reformed Haldane gas analyzer is used to determine CH₄.

Gas chromatography: The gas can be analyzed with Chinese-made gas chromatography

7. The analysis of chemical composition et al.: There are also some small rooms used to treat faeces and urine and to make specimen, and rooms for respiration experiment and digestion metabolism experiment. All concerned samples are carried to the regular chemical laboratory to analyze their compositions.

The experimental animals are kept in a metabolism cage; food supplying system is in the front of the chamber or cage; Faeces and urine are handled with the closed rubber gloves.

This is the first time that this kind of apparatus is designed and manufactured in China so that its technological level is low and it is rather simple. For the cost was very low and the foreign exchange for introducing apparatus from foreign countries needed otherwise saved. These apparatuses can also be used for experiments without the self-controlled tracing system. The explanations for the various parts are follows.

1. Respiration chamber: It is built up with two air-tight iron walls filled with pearl core so as to separate the inside temperature from outside and the wall is 8 cm thick. The chamber is 170×150×200 cm³, contains 3.2—3.4 m³ air, the surface of the wall is covered with paint to prevent it from corrosion, the door of RA(CO)₂ type can be opened or closed by the chain linked to the crane.

Cooling and heating plates are used to achieve constant temperature automatically. On the sides of the chamber, there are two groups of dry and wet bulb thermometers, the animals' behaviour and excretion of faeces and urine can be observed through the windows.

2. Gas absorbing system: Nine absorptive pots attached to airtight tubes are on the right