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The application of superweak bioluminescence on freshness degree of chicken egg

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Abstract

The luminescence of chicken egg in storage is studied by a detection system of superweak bioluminescence. The results show that egg has the strongest vigour on the third day after it is laid, subsequently the luminescence presents decay with oscillation. These eggs, which have been stored for 3 days, are most suitable for hatching. Different eggs have different luminescence intensities depending on the vigour of the egg. The stronger the vigour of the egg is, the more intensive the luminescence is. Superweak bioluminescence as a comprehensive index of biology and biochemistry response can be used for inspecting the freshness degree of the egg, and the test is nondestructive and sensitive.

Keywords: Chicken egg; Freshness degree; Superweak bioluminescence

1. Introduction

The quality of fresh chicken egg is different from those of old ones. Study of the freshness gains importance, especially because eggs are nowadays transported considerable distances, stored or processed after they pass appraisal. The study of inspecting technology, method and equipment for checking freshness degree of eggs, is a hot topic of research for the last 20 years or so in egg product industry. At present, the general inspection method of checking the freshness of egg is mostly to depend on manpower through some physical natures, prone to be influenced considerably by subjective factors e.g. by the practical experience of inspector. Therefore, it is very important that the effective detection method to suit the needs of industrialization production is developed.

Plenty of researches show [1] that superweak bioluminescence is closely related with the life movement course. It is a kind of extremely weak ray radiation that exists universally in biology organism (from person to cell) and it can offer important information on the organismal metabolism and energy transform. Egg is a large vital oocyte; the freshness degree of the egg and its luminescence intensity are strongly related. The superweak bioluminescence can be used for detecting the freshness level of egg, and the test is nondestructive and sensitive.

2. The image detection system of superweak bioluminescence

The testing principle of the detection system is to put the biological sample in a dark environment, record the superweak bioluminescence which comes from sample using very high sensitivity photon detector, change it into electricity signal, then enlarge it with a circuit, analyze and handle these signals with computer, and thus gain the luminescence information of the sample [2]. The system used in this paper is a product of HAMAMATSU company (Japan). The system is composed of image intensifier controller, Argus20 image processor, photon-counting ICCD camera C2400-30 series, etc. The structure of image detection system is shown in Fig. 1.

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3. The relationship between luminescence intensity and storage time of eggs

3.1. Experiment data

For testing the chicken eggs were chosen laid in 6 h. They are obtained from certain hennery in Changchun, and their luminescence intensity was measured once every day. The weight of every egg was between 50 and 60 grams and egg shape index (the ratio of length to breadth) between 1.28 and 1.36. Eggs were preserved at room temperature (20 °C). The work lasts in all 30 days. Some testing results are shown in Fig. 2. It can be found that the luminescence intensity drops on the second day, and rises on the third day, then presents decay with oscillation.

3.2. Analysis and discussion

(1) Table 1 shows the law, namely more the number of storage days, lower the hatch rate of the eggs. Our

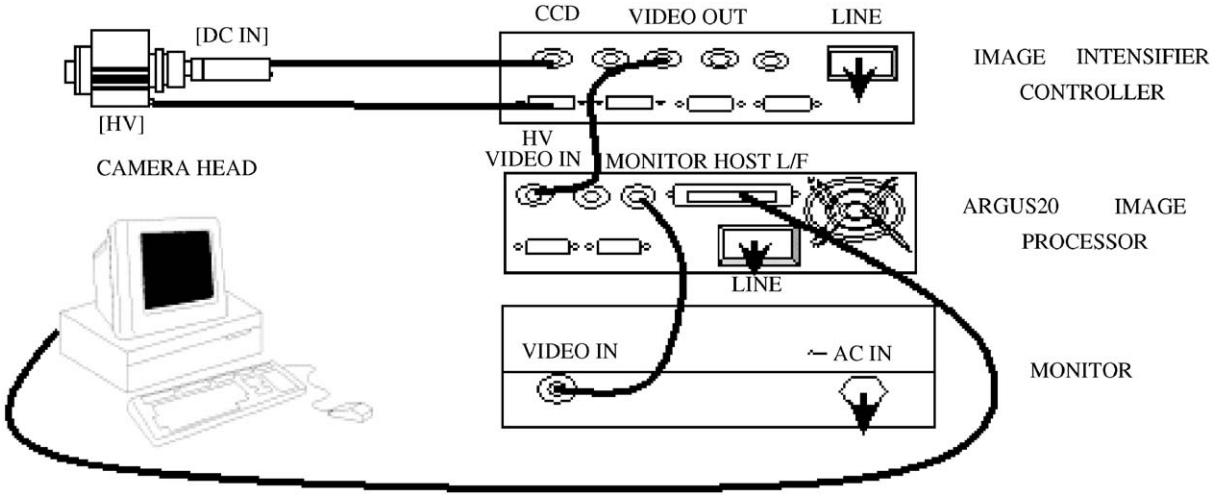

Fig. 1. Image detection system of superweak bioluminescence.

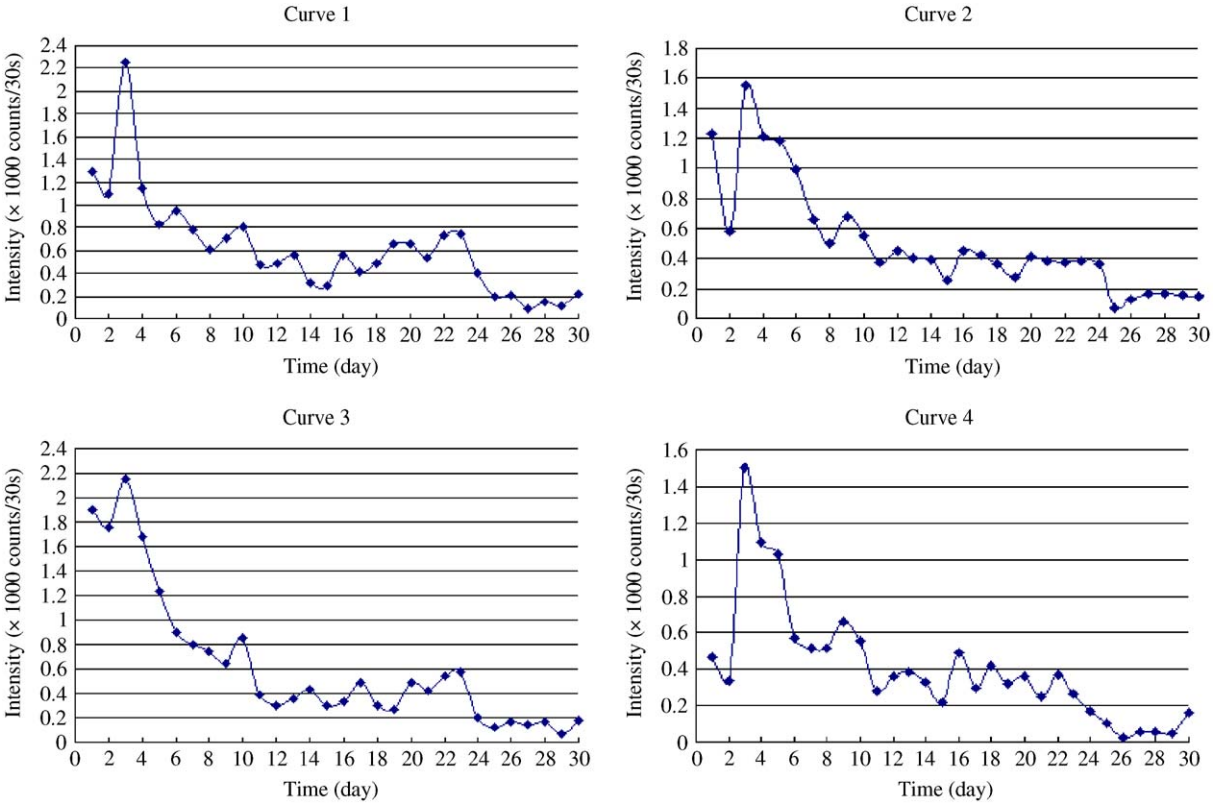

Fig. 2. The change curve of egg superweak bioluminescence intensity.

Table 1
The influence on specific egg of storage time vs. hatch rate

Number of storage days (days)	1	4	7	10	13	16	19	22	25
Hatch rate (%)	88	87	79	68	56	44	30	26	0

experiment result is consistent with this conclusion; namely, luminescence intensity can reflect freshness degree and physiological vigour of egg. Superweak bioluminescence intensity of egg has a tendency to drop with time; the vigour also drops. The standpoint hatch effect of egg is best in 3 days was introduced in this book of poultry egg research [3], which even if kept under the most adaptive condition, it can also get influenced when preserved more than 10 days. It is because egg composition changes continuously with storage time. The moisture of egg white decreases, and the moisture of yolk also increases. Moisture permeation makes the yolk membrane become thin and thereby loses elasticity. This causes yolk membrane to break. In this situation, the egg cannot undertake the mission of continuing life.

(2) We often hear this viewpoint that egg has the biggest hatch potential immediately after being laid. However, it is not a fact. Asmundson et al. [4] found that turkey eggs stored at 12.8 °C hatched better after 3 days of storage than if set fresh. Similarly, Funk et al [5]. found that 1 or 2 days of storage of chicken eggs was better than setting eggs fresh. From the luminescence intensity curve (Fig. 2), we can find out that egg has the biggest vigour on the third day after being laid, namely, eggs that had been stored for 3 days are most suitable for hatching. Egg gets the influence of the surroundings when it is discharged from egg body, cannot but occur a series of change, however, there is still no theory available to explain these phenomena at present.

4. Conclusion

The egg luminescence in storage is studied by a detection system of superweak bioluminescence. The results show that egg has the storngest vigour on the third day after it is laid; namely, the eggs that had been stored for 3 days are most suitable for hatching. The luminescence intensity of egg presents decay with oscillation. Different egg have different luminescence intensities; it depends on the vigour of the egg. The stronger the vigour of egg is, the more intensive the luminescence is. Superweak bioluminescence as a colligate index of biology and biochemistry response can be used for inspecting the freshness degree of the eggs, and the test is simple, nondestructive and sensitive.

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