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A DETECTION SET FOR MEASUREMENTS OF ULTRA-WEAK CHEMILUMINESCENCE OF FOOD PRODUCTS

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A b s t r a c t. This paper presents the description and application of examples of a measuring set for recording ultra-weak chemiluminescence of food products.

INTRODUCTION

In the last few years several studies on the application of luminescence methods to food product evaluation have been carried out [1-6]. Measuring sets recording ultra--weak luminescence are used for this purpose [1,2]. Chemiluminescence detection accompanying free-radical reaction of products containing lipids, allows for quick and convenient determination of some parameters connected with products freshness, thermal stability, resistance to photooxidation as well as the estimation of effectiveness of applied antioxidants [3-5]. The aim of the present paper is the description and application of examples of a measuring set for recording ultra-weak chemiluminescence of food products which was in the Biophysics Laboratory of the Agriculture University in Szczecin.

MATERIALS AND METHODS

Figure 1 showns the block diagram of the measuring set. A photomultiplier (4) EMI 9558 B with a multialkaline photocatode with a sensitive range betwen 300 and 800 nm is the detector of radiation. The measuring probe contains a pulse pre-amplifier (5) which can amplify the voltage signal about 200 times. The photodetection set runs in one electron pulses counting system. In order to reduce the dark current of the photocatode, it is cooled by a thermoelectric cooler (3) supplied and thermostated by means of an electronic system [12]. A sample is placed in a thermostatic stage (2) which is a part of a drawer inserted into the lightproof measuring camera (1). The electronic thermostat (11) controls the temperature in the camera with a sample within the range of 30°C to 90°C at intervals of 10°C exact to ±0.5°C. The photoamplifier and pre-amplifier are supplied by means of a radiometric set (6-8) of STANDARD system made by ZZUJ POLON. Voltage pulses from the pre-amplifier are conveyed through a discriminator (8) to a scaler (9) and then transmitted to a digital printing recorder (10) ERD-103. By means of this set it is possible to measure the intensity of very light flux of a magnitude of 10^{-15}W/cm^2 and to determine spectra of ultra-weak chemiluminesce by means of cut-off filters.

RESULTS AND DISCUSSION

a/ Measuring of chemiluminescence intensity of food products

In Figure 2 intensity values of ultra--weak chemiluminescence of powdered milk products are shown. Samples were made of thin (1-3 mm) layers of powder with a mass of 2.0 g put on Petri dishes of 6.0 cm diameter.

b/ Thermic analysis of chemiluminescence of food products

Measurements of chemiluminescent intensity of samples at a temperature ranging from 30°C to 90°C were carried out. Depend-

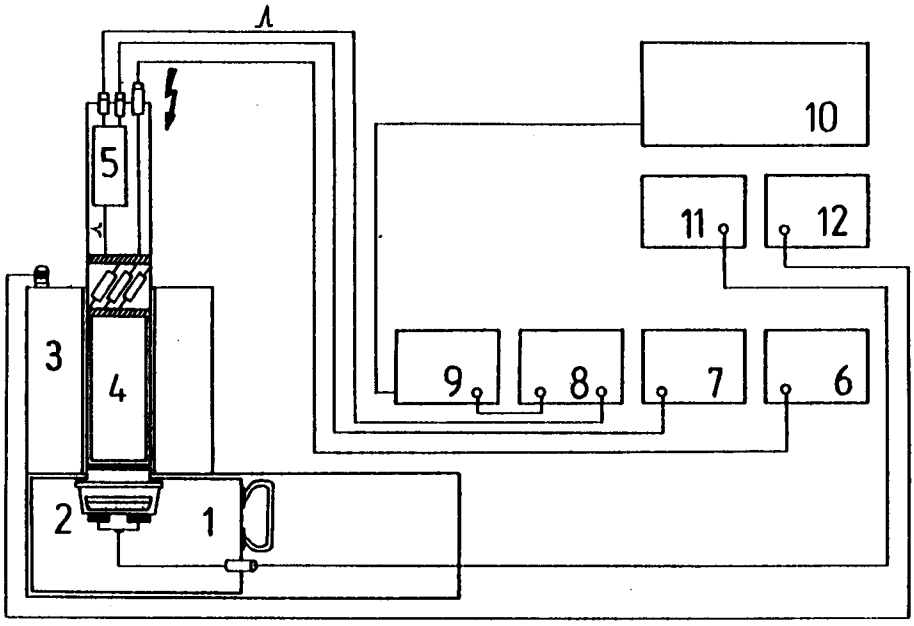

Fig. 1. Block diagram of the measuring set: 1 - lightproof camera with a moving drawer for samples; 2 - thermostatic stage with tested fat sample; 3 - thermoelectric cooler; 4 - photomultiplier; 5 - pulse pre-amplifier; 6 - high voltage supplier; 7 - low voltage supplier; 8 - aplitude discriminator; 9 - electron scaler; 10 - digital printing recorder; 11- thermostat of the measurement stage for samples; 12 - thermostat of the thermoelectric cooler.

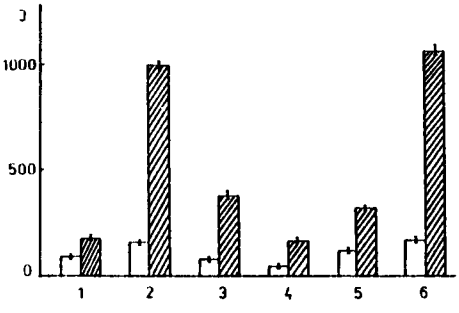

Fig. 2. Ultraweak chemiluminescence intensity of powdered milk products at 30°C (white fields) and 50°C (dashed fields); 1 - fresh powdered milk; 2 - powdered milk stored for 3 years at 20°C; 3 - milk-wheat cereals with raspberries; 4 - milk-rice cereals with bananas; 5 - -"Milupa" nutrient; 6 - powdered cream. The vertical segments designate a standard deviations of 5 measurements.

ence is rectilinear in the Arrhenius axis for powdered cream (Fig.3). For solid fats (Fig.4) it consists of two straight lines, which may be connected with the transition from solid to liquid phase like fluorescence of fats [6].

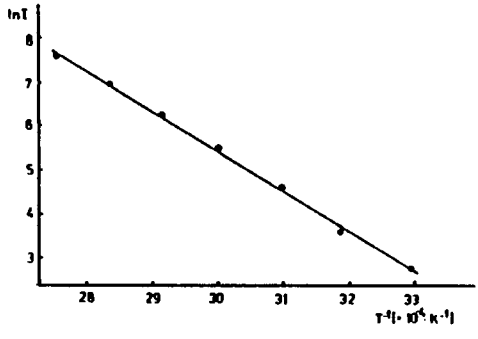

Fig. 3. Chemiluminescence intensity of powdered cream in Arrhenius axis.

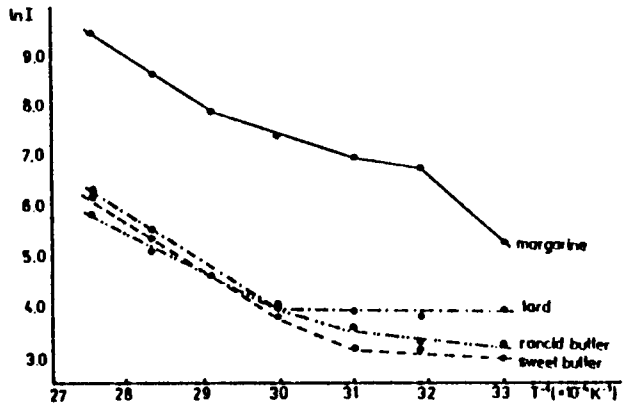

Fig. 4. Chemiluminescence intensity of solid fats in Arrhenius axis.

c/ Spectrum analysis of chemiluminescence of food products

By means of cut-off filters, a spectrum of chemiluminescence of powdered cream in the range of 370 nm to 700 nm (Fig. 5) was obtained. Maximum chemiluminescence occurs within the interval between 540 and 590 nm, ie. in the green-yellow part of the spectrum.

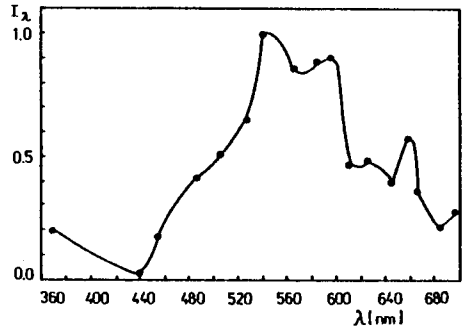

Fig. 5. Chemiluminescence spectrum of powdered cream at 60°C obtained by means of cut-off filtres.

CONCLUSIONS

1. The described measuring set for recording ultra-weak luminescence enables us to test chemiluminescence of food products containing fat substances.

2. The intensity of characteristic chemiluminescence of fatty product samples increases together with temperature increase and satisfies the Arrhenius equation.

3. Chemiluminescence occurs within the visible range. For example, the spectrum of powder cream chemiluminescence shows maximum in the green-yellow part.

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ZESTAW DETEKCYJNY DO POMIARÓW ULTRASŁABEJ CHEMILUMINESCENCJI PRODUKTÓW ZBOŻOWYCH

W pracy opisano zestaw pomiarowy do rejestracji ultrasłabej chemiluminescencji produktów spożywczych zawierających substancje tłuszczowe. Podano przykłady zastosowania tego zestawu do termicznej analizy chemiluminescencji sproszkowanych produktów mlecznych oraz tłuszczów spożywczych. Przedstawiono przykładowe widmo chemiluminescencji sproszkowanej śmietanki w zakresie od 370 nm do 700 nm, wykazujące maksimum w zielono-żółtej części widma.