

Characterization of samples of healthy cows by means of Fluorescence spectroscopy

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Abstract- Investigated were four different samples of diseased cows, by means of fluorescence spectroscopy. It was found that the most suitable pumping wavelength fluorescence method to test samples of cows is 245 nm. Selected as low pumping wavelength, because the bacteria that cause diseases and infections in cattle have lower emission wavelengths. Through the application of fluorescence spectroscopy establishes accessible and rapid method for analysis of different samples of one animal unit. Equally effective were tested as a blood sample, and samples of abscess, vaginal and nasal discharge. Fluorescence spectroscopy was carried out at the dairy farm are not carried in the laboratory, it was possible because of the mobility of the test this device. The method can be applied to a mass testing because the pattern of spectral analyzer for fluorescence spectroscopy described in this article is easy to operate and quite affordable. Fluorescence spectroscopy can safely replace labor-intensive and expensive tests of trivial microbiology laboratories. The three main advantages of fluorescence spectroscopy is that the method is fast, does not require consumables and can be carried out at the dairy farm.

Index Terms- bacterium, emission wavelengths, fluorescence spectroscopy

I. INTRODUCTION

Recently a big problem for farmers is to reduce the population of animals and quality of animal products produced in their farms. This is due to the lack of methods for early diagnosis of animals before their problems have become intractable. Early diagnosis allows legitimate intervention before serious spread of the disease before the problem become unsolvable. Veterinary pharmaceutical industry offers a wide range of drugs and preparations often prohibitive for farmers. Besides the high cost of the drugs they ensure a high success rate or a type of prevention of animal. As a very important factor for the choice of early diagnosis and it turns out that despite the expensive drugs used to treat the animals they do not guarantee their full recovery and livestock will have to be “scrapped”. Early diagnosis of the problem spectral animal diseases will allow increasing the benefits of livestock and reducing morbidity.

II. MATERIAL AND METODS

A. Fluorescence measurements

The main circuit for monitoring and measuring the fluorescence signal is shown in Figure 1. Since fluorescence is

often very weak, and in addition, in all directions, then in order not to saturate the receiver, the useful fluorescence signal is measured in a direction which is less than 45° relative to the excitation radiation. For measurement of the fluorescence is preferably acting as the source to use a laser diode (LD) as the spectral width is very small. LED used in the experiment has a relatively wide spectral width of radiation from 30-40 nm and angular distribution of the radiation is in the range of large corner $\pm 30^\circ$. Selected to work with LD with a wavelength of 245 nm, since in preliminary studies it was found that bacteria and nutrients in the body of cattle have low emission wavelength. Source irradiate the sample and its emission wavelength is transmitted through the optical fiber to a CMOS detector. The sensitivity of the CMOS detector is in the range of 200 to 1100 nm. Its resolution is about $\delta\lambda = 5$ nm.

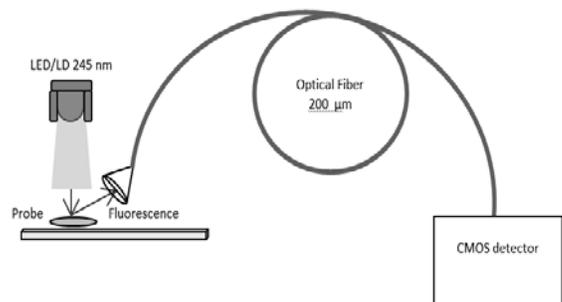


Figure 1. Schematic of the experimental setup.

Fluorescence analysis was carried out at the dairy farm. Is selected to make the field is measured in order to avoid damaging the samples in transit and thus to ensure the more reliable fluorescence assay. With the above described production were studied various liquid samples from sick cows such as vaginal secretions, blood, nasal discharge and abscess.

In fluorescence analysis of a blood sample were registered emission wavelengths of *Fusobacterium necrophorum*, *Corynebacterium pyogenes* (characterizing hoofed cow disease) and *Mannheimia haemolytica* (characterizing pneumonia in cattle) under fluorescent analysis of a sample of the abscess were registered emission wavelengths of *E. Coli* and *S. Aureus* (characterizing infectious contamination). In fluorescence analysis of nasal discharge was registered emission wavelength of β - Hemolytic *Stafilococcus* (characterizing viral infection of the nasal passages) under fluorescent analysis of vaginal

secretions were registered Streptococcus pyogenes and E. Coli (characterizing vaginal infection).

B. Excitation and emission spectra by classical fluorescence spectra.

The excitation spectra For all studied samples of healthy cows (blood sample, sample of the abscess, a sample of vaginal and nasal discharge) is 245 nm. Bacteria in the body of small ruminants have low emission wavelength. They were recorded with emission wavelengths set at: 590 nm for Fusobacterium necrophorum, 338 nm for Corynebacterium pyogenes, 579 nm for E. coli, 330 nm for S. Aureus, 700 nm for β -Hemolytic Staphylococcus, 350 nm for Streptococcus pyogenes and 448 nm for Mannheimia haemolytica.

III. RESULTS AND SIDCUSIONS

Samples of sick cows were analyzed. They were made by veterinarian out at the dairy farm where the fluorescent analysis system was positioned. On Fig.2. and Fig.3. are clearly visible the emission wavelengths of Fusobacterium necrophorum, and Corynebacterium pyogenes, which were registered in a blood sample of one of the cows. Thus the diagnosis was confirmed by a veterinary specialist in emerging hoofed disease.

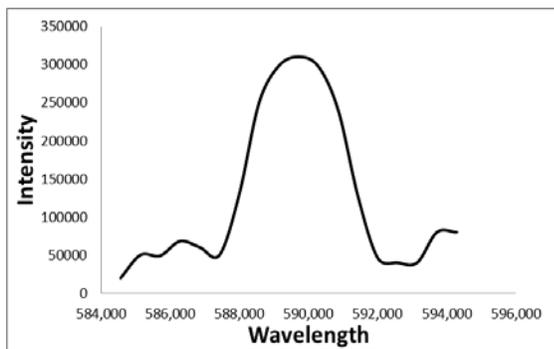


Figure 2. Fluorescence spectroscopy of Fusobacterium necrophorum with the emission wavelength of 590 nm at a wavelength of excitation $\lambda = 245$ nm.

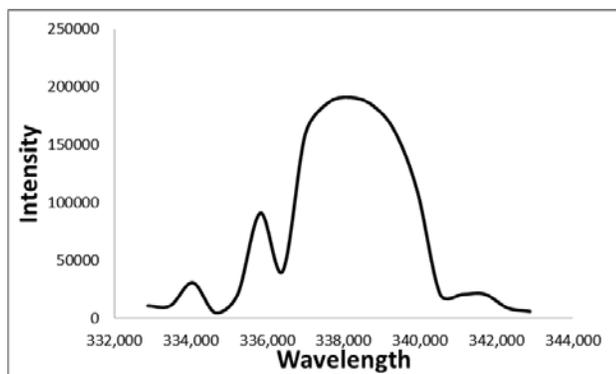


Figure 3. Fluorescence spectroscopy of Corynebacterium pyogenes with the emission wavelength of 338 nm at a wavelength excitation $\lambda = 245$ nm.

On Fig.4. is clearly visible emission wavelength of Mannheimia haemolytica which was registered in the blood sample of one of the cows. This bacterium is the causative agent of respiratory infection. Definitely the disease was in its early stages, as the veterinary specialist didn't found any symptoms for pneumonia but a standard test did. Fluorescence spectroscopy of this particular bacterium proves that the method is suitable for early diagnosis of the presence of bacteria before symptoms of the disease start to appear.

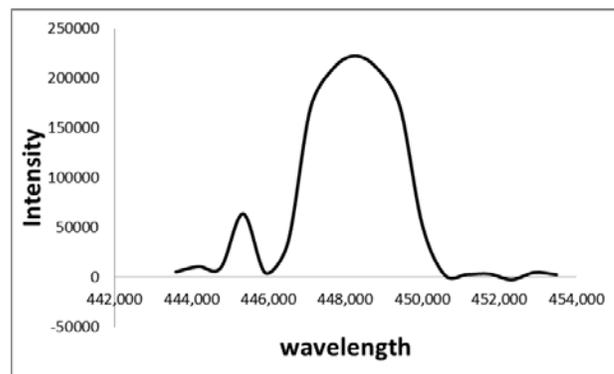


Figure 4. Fluorescence spectroscopy of Mannheimia haemolytica with the emission wavelength of 448 nm at a wavelength excitation $\lambda = 245$ nm.

On Figure 5. Figure 6 is. clearly visible emission wavelengths of E. coli and S. Aureus which were recorded in the sample of abscess of one of the cows. These bacteria are responsible for external infections the effect of which causes superficial abscesses on various parts of the body of the cow.

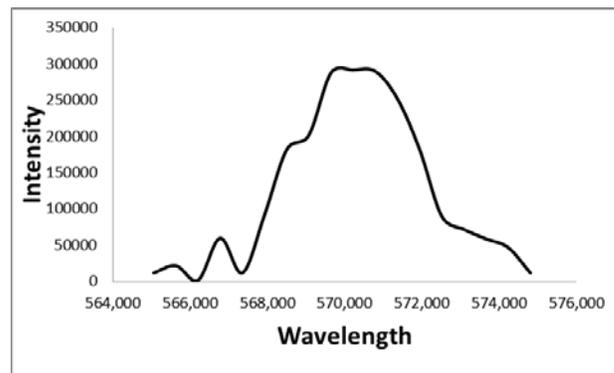


Figure 5. Fluorescence spectroscopy of E. coli with the emission wavelength of 579 nm at a wavelength of excitation $\lambda = 245$ nm.

On Fig.6. and Fig.7 are clearly visible the emission wavelengths of E. coli and Streptococcus pyogenes that have been registered from a sample of vaginal secretion of a cow. These bacteria are causing vaginal infections, whose effects cause malfunctioning of the reproductive system of dairy cows. On Fig.8. is clearly visible emission wavelength of Streptococcus pyogenes, which has been recorded in the sample of nasal discharge of one of the cows. Thus the diagnosis was confirmed by a veterinary specialist for viral infection.

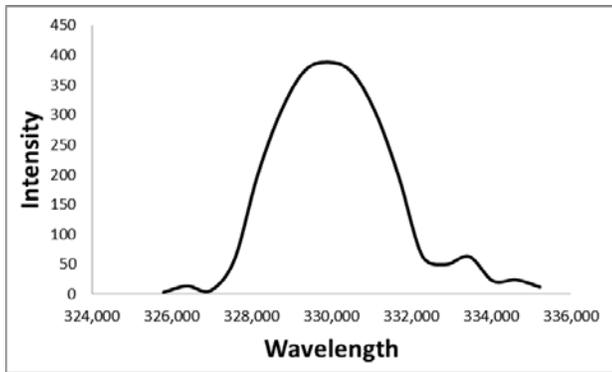


Figure 6. Fluorescence spectroscopy of S. Aureus with the emission wavelength of 330 nm at a wavelength of excitation $\lambda = 245$ nm.

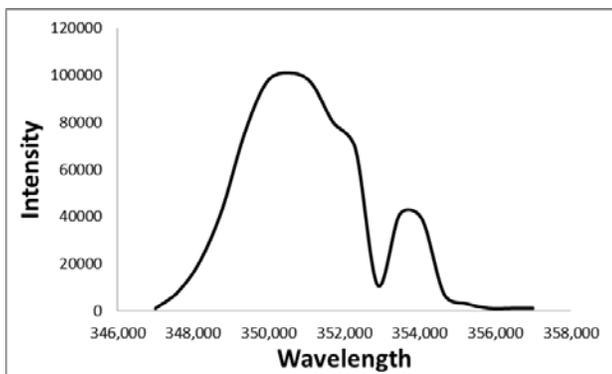


Fig.7. Fluorescence spectroscopy of Streptococcus pyogenes with the emission wavelength of 350 nm at a wavelength of excitation $\lambda = 245$ nm.

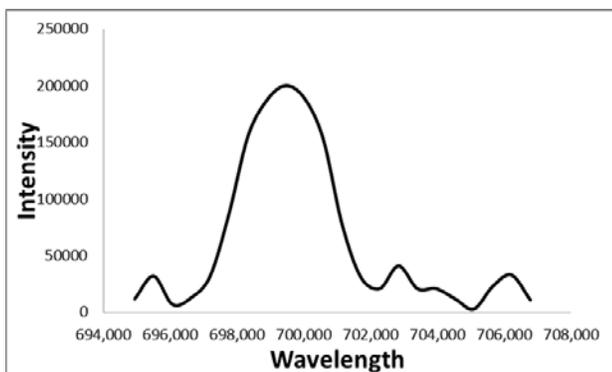


Figure 8. Fluorescence spectroscopy of β -Hemolytic Staphylococcus with the emission wavelength of 350 nm at a wavelength of excitation $\lambda = 245$ nm.

IV. CONCLUSIONS

Advanced is a fast and easily accessible method for field fluorescence microscopy of liquid samples from cattle. The most optimum wavelength for fluorescence analysis of diseased

ruminants is 245 nm. The fluorescence method is suitable for early diagnosis of samples for the presence of bacteria in cattle, before the presence of symptoms of the disease, which causes the respective bacteria. The fluorescence method is suitable for analysis of various samples of cattle

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