

## Effect of Structure Parameters and Wavelength on the Casein Concentration Detected by the Method of Scattered Transmitted Ratio

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**Abstract.** The objectives of this study were to investigate the effect on the casein concentration detected by the method of scattered transmitted ratio (STR) at different structure parameters and wavelength. Detection experiments were performed at four kinds of testing devices and five kinds' different wavelength lasers. All measurements had good reproducibility. Both structure parameters and wavelength had a significant effect on the measured effective concentration of the casein. The design of four different structure of the testing device was measured and analyzed. And the structure parameter of the testing device was determined in this paper. Compared measured value with standard value, it was determined by more effective wavelength. The accuracy of the method of scattered transmitted ratio, evaluated through the correlation coefficient (R) and the root mean square error of prediction (RMSEP) for five kinds different wavelength lasers. Overall, the results of this study suggest that the suitable structure parameter was experimented for testing devices.

**Keywords:** casein concentration, structure parameters, scattered transmitted ratio, laser wavelength

### 1 Introduction

Rapid and direct determination of casein is of great interest and has brought numerous attentions. Currently, there are lots of methods to measure the milk ingredients. The dynamic light scattering method is most prevalent nowadays and more precise [1-3]. However, sensor structure parameters have direct impacts to detection accuracy on the device. The sensor was mainly including sample room and sample pool in casein concentration detection system [4,5]. Through light scattering experiments of casein samples, related parameters of the sensor device were analyzed in this paper. These analyses can improve the precision of the testing instrument and provide data support for sensor design.

## 2 Casein Composition Detection System

In order to achieve the detection of casein, casein colloids are homogenized before detection to guarantee that casein colloids evenly distribute in the solution during light scattering test. Through the analysis of different angles, we install the photoelectric sensors at 0° and 90° position to detect the scattering light intensity after fixed-wavelength laser across the sample. And these sample room and sample pool were combined according to four different combinations that is shown in Table 1.

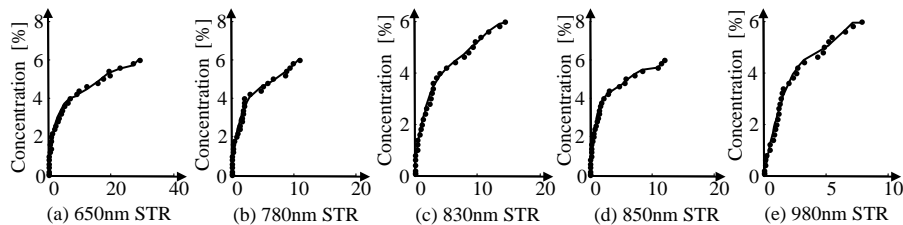
**Table 1.** Four different combinations testing devices (mm)

Unit	Sample room size	Sample pool size
1	SR: 90×90 SP: 40×40	7×7
2	SR: 170×170 SP:120×120	10×10
3	SR: 130×130 SP:80×80	10×10
4	SR: 90×90 SP:40×40	5×5

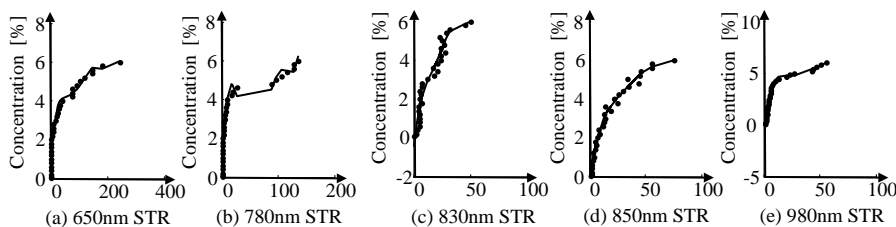
\* where, SR is the length of sample room, SP is the length of sample pool

## 3 Experiment

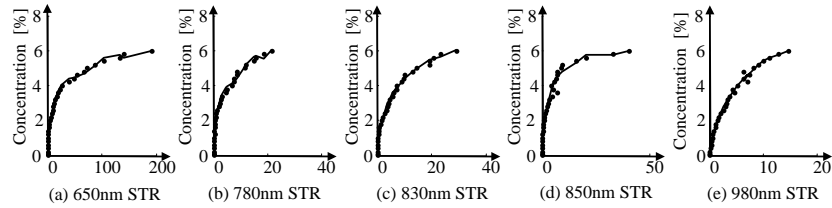
There were five typical of lasers in experiment, such as 650nm, 780nm, 830nm, 850nm, 980nm, which were selected as experimental light source. Curve of casein concentration and STR of four testing devices were shown as Figure 1, Figure 2, Figure 3 and Figure 4.



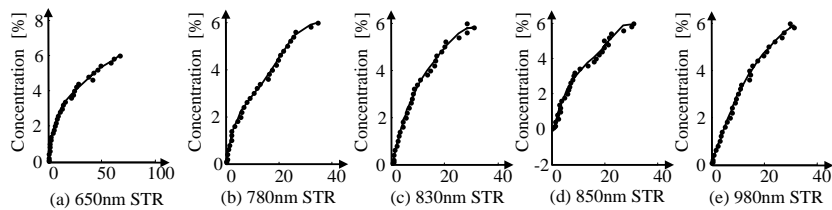
**Fig.1.** Curve of relation of casein concentration and STR for 1# device



**Fig. 2.** Curve of relation of casein concentration and STR for 2# device



**Fig. 3.** Curve of relation of casein concentration and STR for 3# device



**Fig. 4.** Curve of relation of casein concentration and STR for 4# device

By above four figures of the original data, when laser wavelength was fixed, this is correlation between curve of casein concentration and STR using the different testing device. The concentration of casein has the same trend as STR. The STR rises with the increase of the concentration of the casein solution. Experiment data show that different structure size parameters of testing device also have differences in the same wavelength. When the same size testing device were be scattered in different wavelength laser, fitting curves are also different. In order to be able to achieve a more accurate concentration measure, parameters matching testing device is important. In comparison, the 4# testing device fitting effect was better than other testing devices.

### 5 Analysis the influences of concentration measurement in different wavelengths

According to this curve, it can fast detect casein concentration in any an unknown concentration of casein solution. Measurement results and analysis are shown in Table 2.

**Table 2.** casein concentration in different wavelength using method of STR

	Standard value	measured value				
		650nm	780nm	830nm	850nm	980nm
1	0.5008	0.4901	0.5896	0.3857	0.4240	0.4924
2	1.5009	1.4101	1.2715	1.6674	1.3113	1.8263
3	2.5095	2.4503	2.3091	2.7716	2.3775	2.8300
4	3.5143	3.7892	3.7191	3.2404	3.6288	3.7252
5	4.5087	4.5176	4.8471	4.7044	4.7636	4.5684

6	5.5107	5.4353	5.7971	5.8179	5.2763	5.8149
	R	0.9974	0.9961	0.9941	0.9930	0.9973
	RMSEP	0.0548	0.1046	0.1012	0.0788	0.0769

The values of correlation coefficient (R) of between measured values with standard values are above 0.99. There were significant correlations between measured values with standard values.

## 6 Conclusions

In this paper, using the method of scattered-transmitted ratio (STR) to measure casein concentration, it is critically important to find suitable structure parameters and wavelength. Through experiments and analysis, that suitable testing device was identified. The values of correlation coefficient (R) of between measured values with standard values are above 0.99.

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