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## The browning value changes and spectral analysis on the Maillard reaction product from glucose and methionine model system

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# The browning value changes and spectral analysis on the Maillard reaction product from glucose and methionine model system

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**Abstract.** D-glucose has been understood to provide the various effect on the reactivity in Maillard reaction resulting in the changes in physical performance of food product. Therefore this research was done to analyse physical appearance of Maillard reaction product made of D-glucose and methionine as a model system. The changes in browning value and spectral analysis model system were determined. The glucose-methionine model system was produced through the heating treatment at 50°C and RH 70% for 24 hours. The data were collected for every three hour using spectrophotometer. As result, browning value was elevated with the increase of heating time and remarkably high if compare to the D-glucose only. Furthermore, the spectral analysis showed that methionine turned the pattern of peak appearance. As conclusion, methionine raised the browning value and changed the pattern of spectral analysis in Maillard reaction model system.

**Keywords:** D-glucose, methionine, browning value, spectral analysis, Maillard reaction

## 1. Introduction

Maillard reaction has been widely known as a three step of chemical reaction involving both carbonyl groups of reducing sugars and free amino groups of proteins that contributes to a very important role in food industry that applies thermal process. These three steps are early, intermediate and final step [1]. Maillard reaction has been recognized as critical effects on food properties, such as colour, texture, and flavour that might provide attractive odour such as caramel-like and burning [2]. The generation of these senses are rely on the applied amino acid and sugar. The reactivity of Maillard reaction was reported as sugar variety dependent [3, 4] and applied of protein [5].

Besides their generation in specific odour, Maillard reaction provides beneficial functions as antioxidant [6]. The utilization of glucose might generate the production of 3-deoxy-glucosone, as one of the intermediate products of the Maillard reaction. This compound acts as a precursor of 5-hydroxymethylfurfural generation, resulting in the high antioxidant activity and brown colour of Maillard reaction product [2].



Since glucose has been widely known as ingredient in Maillard reaction, this study aimed to determine the browning value and spectral analysis in Maillard reaction between D-glucose and methionine.

## 2. Material and method

D-glucose was obtained from Sigma Aldrich US. Methionine was purchased from Cheil Jedang Indonesia, Co. Ltd with the purity index of 99%. Unless otherwise specified, all other chemicals were reagent grade.

### 2.1 Preparation of D-glucose-methionine model system

The preparation method of D-glucose-methionine model system has been adopted from other researcher with some modifications [7]. The D-glucose as a control and 1:1 D-glucose-methionine were dissolved in 400 mL of 10 mM carbonate buffer (pH 9) solution. The solution was then heated at 50°C and RH 70% for 24 hours.

### 2.2 Spectral analysis of Maillard reaction product

The heated samples were diluted with phosphate buffer until 200  $\mu$ L in microtube to measure the emission spectrum starting from 190 to 620 nm using spectrophotometer (UV-1280; Shimadzu, Kyoto, Japan). This spectroscopic measurement method has been adopted from previous researcher [7].

### 2.3 Browning value measurement

The browning value of the MRPs was measured according to the method of earlier researcher [7] without any modification using spectrophotometer at 420 nm.

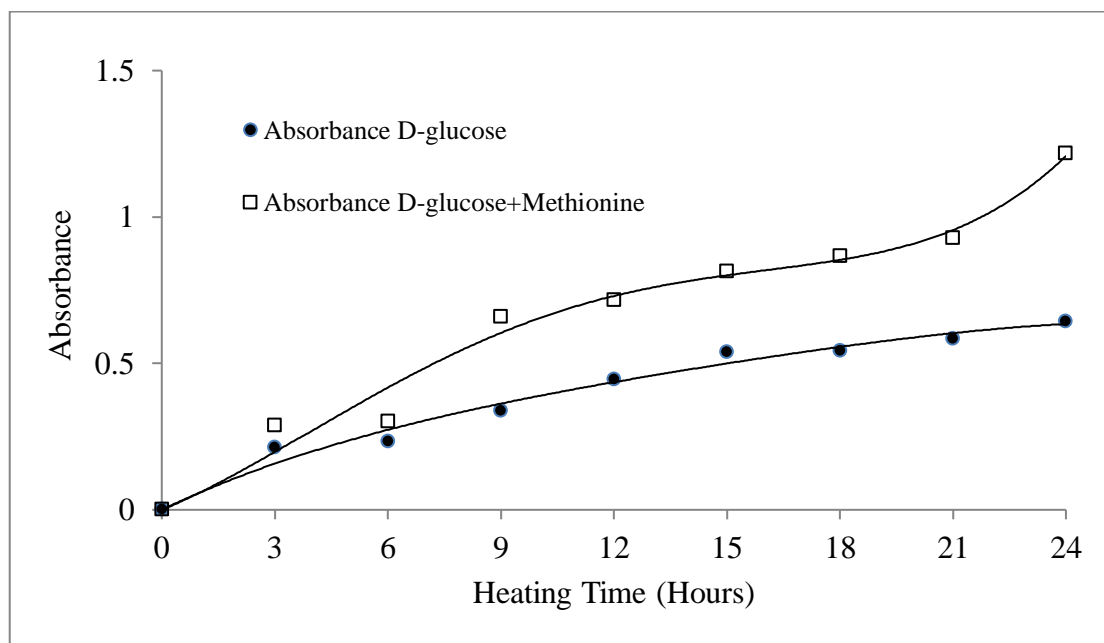
### 2.4 Data analysis

The results were reported in figures and the description upon figure was provided. The data were obtained from at least three time of replication.

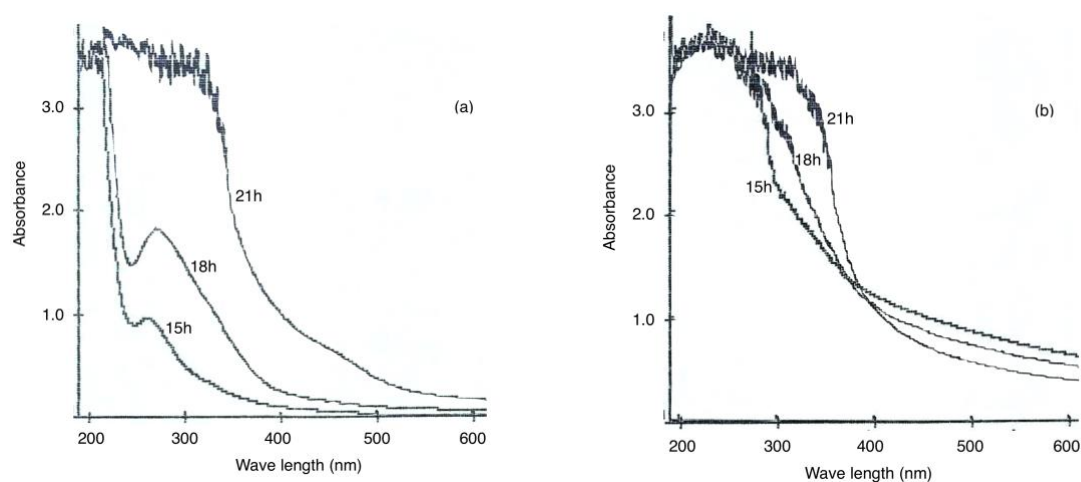
## 3. Result and discussion

Figure 1 shows the browning value through the determination of absorbance at 420 nm on the Maillard reaction product using D-glucose and methionine model system when was heated at 50°C for 24 hour. It can be described that the increase of both sample was able to be detected clearly. D-glucose-methionine model system showed remarkably higher (about two times higher) in the absorbance value than D-glucose only. As seen on this figure, the Maillard reaction model system generating absorbance at 1.218 while sugar alone only generated the absorbance at 0.644. The higher browning value might able to be recognized starting at heating time of 9 hour that was resulting the value of 0.660 while sugar-only-sample provided about a half of absorbance (0.338).

In this research, methionine was chosen to generate the Maillard reaction in model system, due to its high reactivity [5]. D-glucose was applied as the control because it widely used in Maillard reaction process. Hexoses-amino acid system model generated it specific reactivity based on the sugar and amino acid that was used [8]. Methionine was known as the high reactivity of amino acid and it reduced at about 60% when Maillard processing was applied [9]. Spectral analysis showed similar patterns or peak appearance on the D-glucose model system when the heating time of 15 and 18 hour was applied (Fig. 2a). However, the remarkable differences in the pattern or peak appearance was occurred when the methionine was applied (Fig. 2b). This could be seen at the appearance of peak at 18-h heating time. As can be seen, no peak was detected at the D-glucose-methionine model system on 18-h heating time. Therefore, the presence of amino acid in the model system turned the spectral appearance remarkably.



**Figure 1.** Browning development through the determination of absorbance at 420 nm on Maillard reaction product of D-glucose and D-glucose–methionine model system that was heated at 50°C for 24 hour.



**Figure 2.** Spectral analysis of Maillard reaction product of the D-glucose (a) and D-glucose–methionine model system (b) that was heated at 50°C.

It was recognized that the heating process might reduce remarkably the luminosity ( $L^*$ ) in Maillard reaction system [10]. This reduction in the  $L^*$  value was due to the formation of brown pigments from Maillard reaction that might interfere the spectral analysis. Brown pigments was easily detected at 420 nm [11], therefore based on the obtained spectral analysis at 420 nm, the change on the absorbance at those wavelength might be detected with ease.

#### 4. Conclusion

As conclusion, the browning value of D-glucose–methionine model system were higher than D-glucose model system and it could be seen starting at the 9-h of heating time. The heating time at 18 h

showed the change in peak appearance and pattern of spectral analysis. This result may provide the beneficial information about Maillard reaction process during 24 hour.

## 5. Reference

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