



# Colorimetric determination of the activity of starch-debranching enzyme via modified Tollens' reaction

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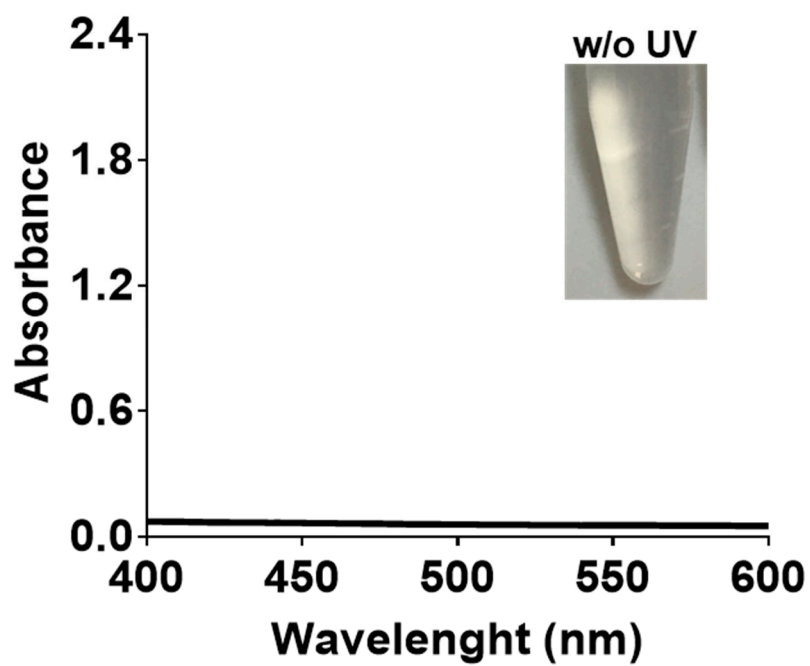
Received: date; Accepted: date; Published: date

**Table S1.** The ratio of small and large glucan molecules in supernatant, precipitate, and whole debranched solution (DS).

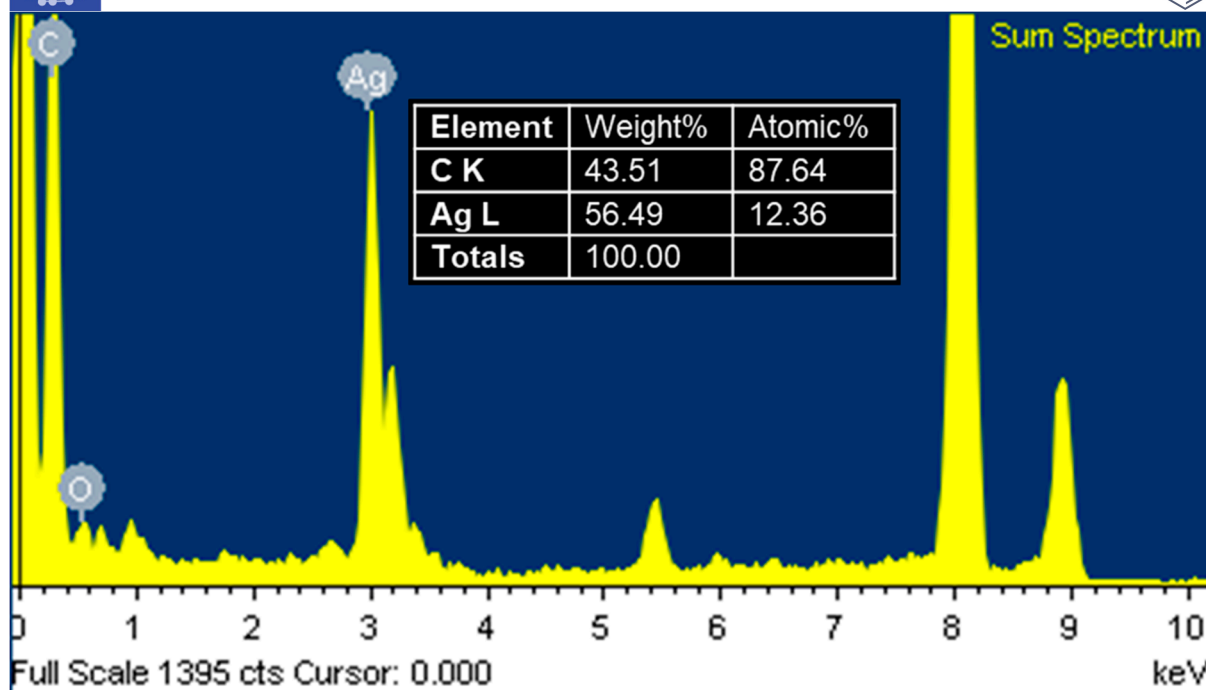
Samples	Peak 1			Peak 2			Peak 3		
	Peak area (%)	MW (g mol <sup>-1</sup> )	DP <sup>a</sup>	Peak area (%)	MW (g mol <sup>-1</sup> )	DP	Peak area (%)	MW (g mol <sup>-1</sup> )	DP
<b>DS</b>	26.74	82212	457	35.31	29619	165	37.95	2540	14
<b>Supernatant</b>	43.22	83178	462	47.37	28167	157	9.41	2409	13
<b>Precipitate</b>	ND <sup>b</sup>	ND	ND	ND	ND	ND	99.2	2413	13

<sup>a</sup> Degree of polymerization.

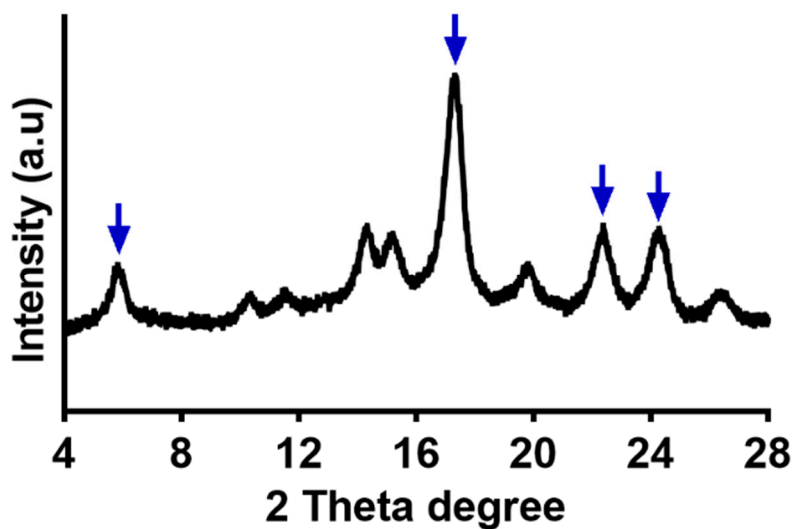
<sup>b</sup> Peak is not detected.



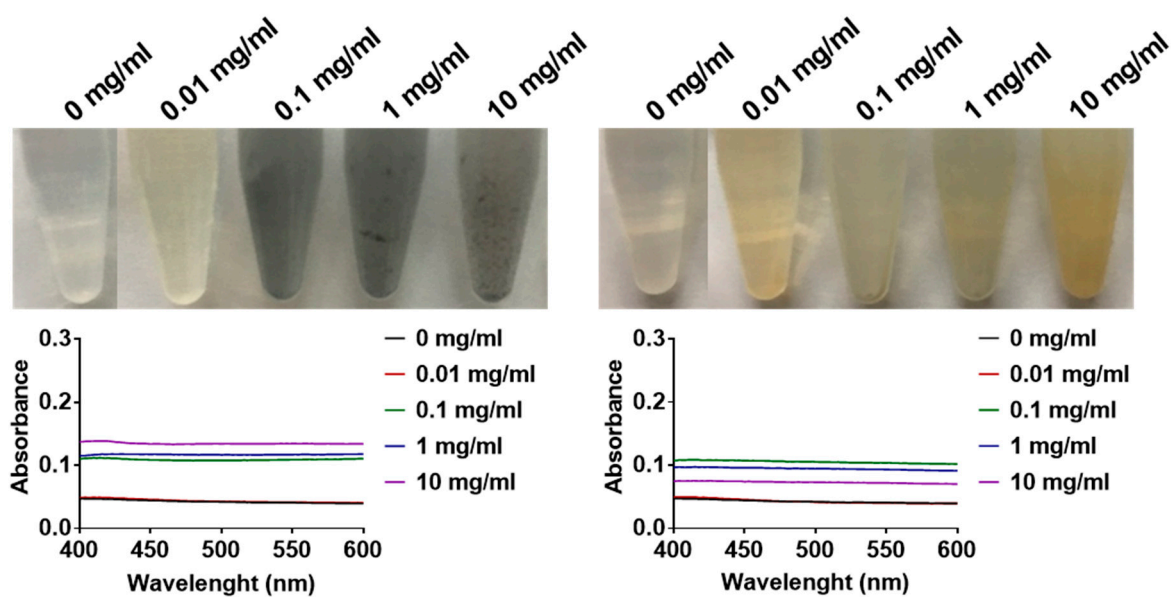
**Figure S1.** UV-vis absorption spectra of AgNPs formed without UV irradiation for 30 min.



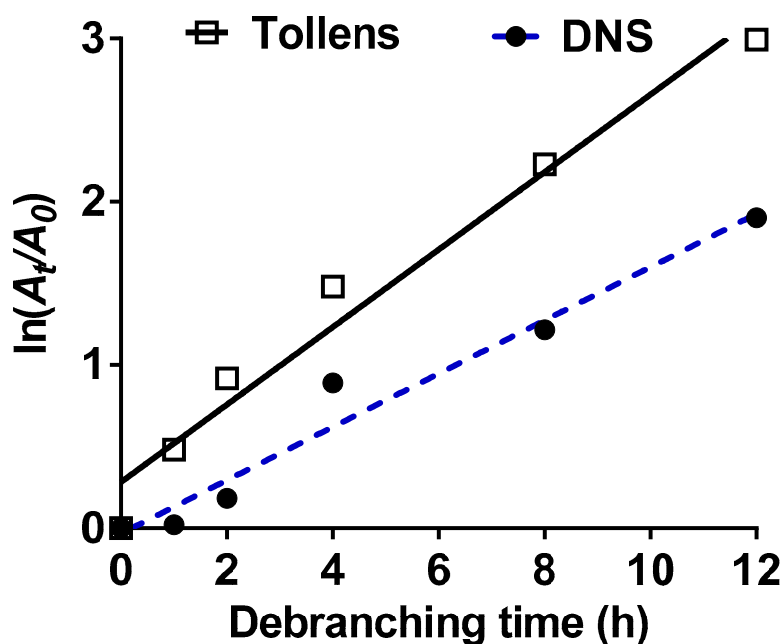
**Figure S2.** EDX spectra of DS-AgNPs formed with the debranched SCGs. Inset shows the weight and atomic percentages of carbon and silver in DS-AgNPs.



**Figure S3.** XRD analysis of white precipitate obtained by freezing the debranched starch solution at  $-20\text{ }^{\circ}\text{C}$  for 5 min. The blue arrows represent the characteristic peaks for B-type crystal. The crystal type of SCG precipitates were analyzed from  $4^{\circ}$  to  $28^{\circ}$  ( $2\theta$ ) using  $\text{Cu-K}\alpha$  radiation on a Bruker D8 Advance X-ray diffractometer (Bruker, Karlsruhe, Germany). All samples were fully dehydrated in a vacuum desiccator before XRD analysis.



**Figure S4.** Photographic images of reaction tubes (up) and UV-vis absorption spectra (down) of AgNPs formed with varying concentration of glucose (left) and fructose (right) through the modified Tollens' reaction under UV irradiation for 5 min.



**Figure S5.** The plot of  $\ln(A_0/A_t)$  from modified Tollens reaction (hollow square) and DNS assay (filled circle) versus debranching time.

The debranching rate constant of pullulanase was calculated by using a first-order kinetic model [1]:

$$\ln(A_t/A_0) = kt \quad (1)$$

where  $A_0$  donates the initial absorption at 426 nm and 540 nm in the Tollens' reaction and DNS assay, respectively, and  $A_t$  is the absorption at a given time point,  $t$ , and  $k$  is the reaction rate constant.

## References

1. Simonin, J.-P. On the comparison of pseudo-first order and pseudo-second order rate laws in the modeling of adsorption kinetics. *Chem. Eng. J.* **2016**, *300*, 254-263.