Binding force between yeast cell and lectin

Electromagnetophoretic force measurement is actually the observation of the detachment current of yeast cells from the lectin functionalized silica surface by applying electromagnetophoretic buoyancy less than 60 pN, or in the current less than 1200 μA. At first, by this method, the binding force, F_A, between Con A and mannan polysaccharide on a yeast cell surface has been measured. The observed binding force histogram of Con A-mannan polysaccharude complex at yeast cell surface measured was shown in Fig. S1(a), which gave the averaged interaction force of 41 pN. In the present study, the binding forces of yeast cells with GNL, HHL, monomeric and dimeric NPL, which were all mannose recognized lectins like as Con A, were measured. In all cases, the yeast cells bound to the lectin functionalized silica surfaces could be desorbed by the electromagnetic buoyancy by applying forces of less than 60 pN. Figures S1(b) and S1(c) show the histograms of the binding force of yeast cells to the GNL and HHL functionalized surfaces. The bins of histograms in Fig. 3(b) and 3(c) are distributed to the weaker forces than 20 pN, different from the result for Con A, which showed distribution in the range of 20-60 pN with converging around 40 pN. This suggests that the binding forces in GNL and HHL systems are weaker than Moreover, the histograms for GNL and HHL seemed to include some small peaks.

Figure S2 shows the histograms of the interaction force of yeast cells with the monomeric and dimeric NPL molecules. The interaction force distributed in the range from 10 pN to 60 pN, suggesting the inclusion of different types of interactions. One may expect that the interaction force between yeast cells and a dimeric NPL molecule is twice as large as the force between yeast cell and monomeric NPL molecule. However, the observed interaction force for the dimeric NPL was as same as that for monomeric

NPL as shown in Fig. S2. This result suggests that the observed binding force just reflect the breaking of the first and the second bonding of polysaccharide of yeast cell after breaking other bondings, which is actually the single binding interaction force.

Relationship between binding force and dissociation rate constant

Figure S3 shows an apparent linear relationship between the logarithmic values of the observed spontaneous dissociation rate constant and the mannnan-lectin binding force observed at the constant loading rate of 3 pN s^{-1}.

As shown in Fig. S3, the spontaneous dissociation rate constant was smaller in the lectin-mannan polysaccharide complex with larger interaction force. This is understood from a linear relationship between the life time of the bonding, the inverse of $k_{off}(F)$, and the force required for the breaking of the bond. The probability of spontaneous bond breaking is higher in the weak interaction. It was suggested that the binding force and the dissociation rate constant between a mannan polysaccharide-lectin complexes on the surface of yeast cells depended on each other.

Figure caption

Figure S1 The histogram of the number of desorbed yeast cells against the pulling force, F_A, with the loading rate of 3 pN s^{-1} in 1.0 M KCl solution. The capillary was treated by (a) Con A dimer (pH=5), (b) GNL tetramer (pH = 7) or (c) HHL tetramer (pH = 7).

Figure S2 The desorption force histograms of yeast cells, which were initially bound to monomeric NPL in pH = 4 (a) and dimeric NPL in pH = 7 (b), under the pulling rate of 3 pN s^{-1} in 1.0 M KCl solution.

Figure S3 A linear relationship between the logarithmic value of the observed spontaneous dissociation rate constant, $k_{off}(0)/s^{-1}$, and the mannan-lectin binding force, ΔF_A/pN, observed under the constant pulling rate of 3 pN s^{-1}.

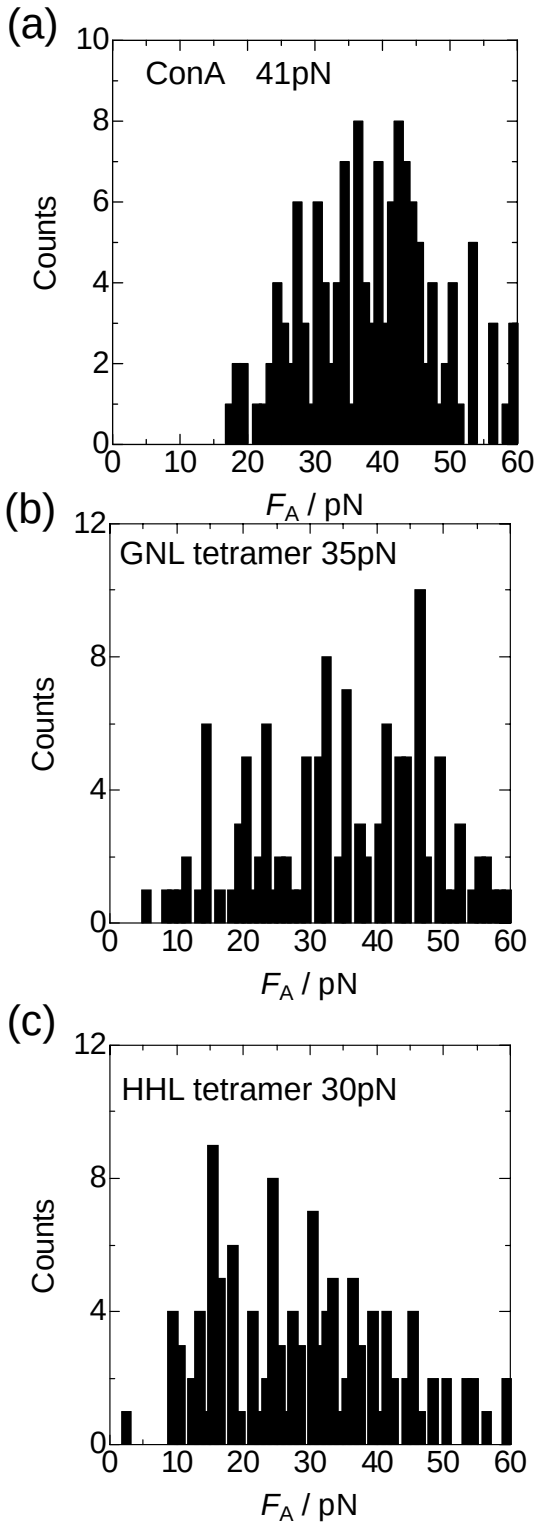

Fig. S1 Y. Iiguni and H. Watarai

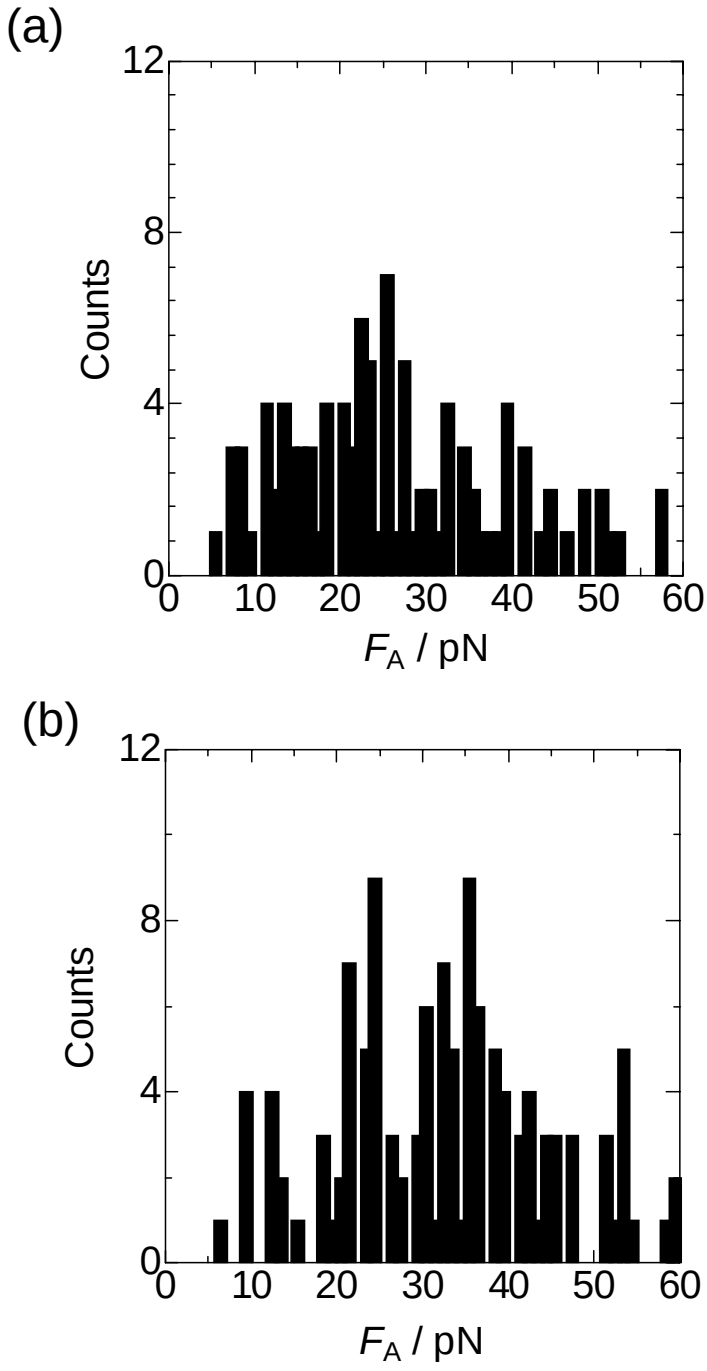

Fig. S2 Y. Iiguni and H. Watarai

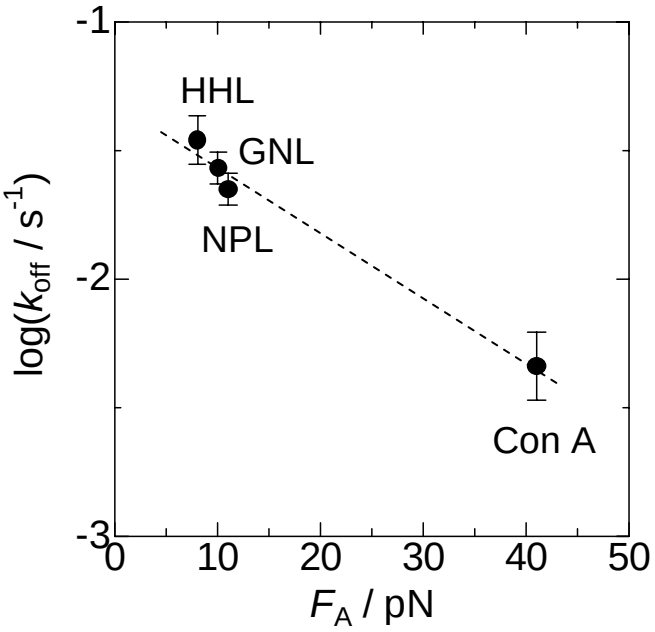

Fig. S3 Y. Iiguni and H. Watarai