Experimental report

25/09/2018

Proposal:	**9-13-725**	**Council:**	4/2017
Title:	The adsorption of different species of Moringa seed proteins to silica and alumina surfaces		
Research area:	Soft condensed matter		

This proposal is a new proposal

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Samples: Moringa seed proteins

Instrument	Requested days	Allocated days	From	To
D17	3	2	12/03/2018	14/03/2018
FIGARO	0	0		

Abstract:

The proteins extracted from the seeds of Moringa trees are known as the most effective and environmental friendly coagulating agents for use in water purification as they are non-toxic and can be grown in high yield in many areas. Seeds from different Moringa species show different adsorption and flocculation properties. Even material from the same species can behave differently depending on the purification procedure. In this study we aim to understand the differences in the adsorption behaviour of various proteins from different species extracted to high yield as would be used in practice. The information will allow optimisation of this valuable process with a broader range of seed sources. The results from this study will be used, with knowledge of the molecular composition, to modify growing condition of the trees in order to improve sustainable water treatment techniques.

The adsorption of different species of Moringa seed proteins to silica and alumina surfaces

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Introduction

The proteins extracted from the seeds of *Moringa* trees are known as the most effective and environmental friendly coagulating agents for use in water purification as they are non-toxic and can be grown in high yield in many areas. Seeds from different Moringa species show different adsorption and flocculation properties [1, 2]. Even material from the same species can behave differently depending on the growing conditions and purification procedure. The aim of this experiment was to understand the adsorption of proteins from different species of *Moringa* to silica and alumina surfaces and the effect of addition of cationic surfactant. The information will allow optimisation of this valuable process with a broader range of seed sources. The results from this study can be used, with knowledge of the molecular composition, to modify growing condition of the trees in order to improve sustainable water treatment techniques.

We had previously studied the adsorption of the protein extracted from the seeds of *Moringa oleifera* [3-8], *Moringa ovalifolia* and *Moringa stenopetala* to silica and alumina substrates. In this experiment, we studied the adsorption of *Moringa peregrina and oleifera* grown in Iran. A comparison between *Moringa oleifera* proteins measured in our previous experiments (grown in Botswana) and *Moringa oleifera* proteins measured in the present experiment (grown in Iran) provides information about how the growing condition can alter the properties of these proteinsA comparison between the adsorption of different species and materials grown in different areas will provide information that guides the use.

Experimental procedure

Moringa proteins from the seeds of different trees were extracted following the same procedure as described in reference 4, 5. The stock solution of each proteins was prepared in D_2O as it provides sufficient contrast on both silica and alumina/water interfaces. The sample holder was a reflection solid/liquid cell made with silicon/silicon oxide on one side and sapphire on the other side so that the adsorption of the same solution can be studied at both surfaces by rotation [10]. The adsorption of each protein was measured in 5 concentrations (between 0.001 and 0.2 % wt) followed with a rinsed which was measured in both H_2O and D_2O contrasts. After the rinse measurements, the possibility of displacing the adsorbed protein from interface was investigated with cationic surfactant, tetradecyltrimethylammonium bromide ($C_{14}TAB$).

Results

The data was modelled with previously used fitting program (*lprof*) which allows the adsorption of layers with different volume fractions of proteins and then an exponential decay towards the bulk solution [11]. An example scattering length density profile (SLD) calculated by the model is shown in Figure 1. Figure 2 shows the amount of protein adsorbed to alumina and silica surfaces at different concentrations. The results show that *Moringa oleifera* proteins adsorb more onto silica (similar to our previous observations from the African *Moringa oleifera* proteins) whereas *Moringa peregrina* shows higher adsorption to alumina. Comparison between the adsorption of *Moringa oleifera* proteins extracted from seeds of the trees grown in

Iran and Africa, showed higher adsorption for African species at the same concentrations (up to 5.3 mg m^{-2} [5, 7] for African and 3.2 mg m^{-2} for Iranian *Moringa oleifera*). This suggests that growing condition can significantly influence the properties of *Moringa* proteins.

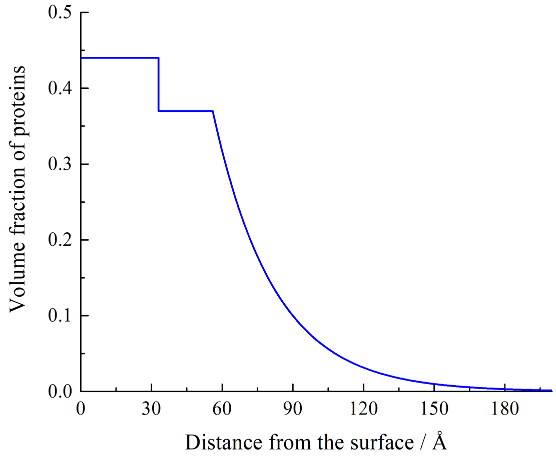

Figure 1. Scattering length density profile for the adsorbed protein layer to a silica/water interface.

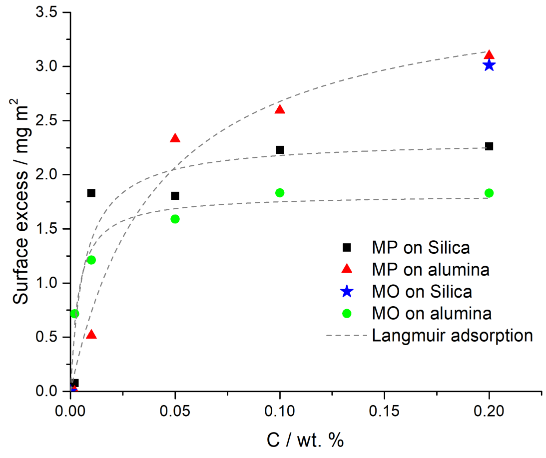

Figure 2. Surface excess of *Moringa oleifera* (MO) and *Moringa peregrina* (MP) proteins on silica and alumina surfaces at different protein concentration. Dashed lines show the Langmuir adsorption isotherm.

Zeta potential measurements did not show a significant difference between Moringa oleifera and Moringa peregrina, they both have zeta potential 20 ± 3 mv.
The amino acid analysis of the two-species measured in this experiment, show similar compositions within one or two percentages of understandingly except for glutamic acid, glycine and arginine where the percentage can vary slightly more (up to 6 percent).
Further discussions and analysis are underway to understand the physical reasoning behind observed adsorption behaviour. These can provide more detailed analytical information which will be correlated to the differences observed in adsorption behaviour of proteins.

References

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