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The effect of the degree of modification on the emulsifying capacity of small granular starches

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BACKGROUND: Many food, pharmaceutical and cosmetic products are emulsions. Emulsions are mixtures of two immiscible phases where one is dispersed in another as fine droplets. These systems are thermodynamically unstable and in order to maintain their stability, stabilizers are needed. Traditional emulsions are stabilized by amphiphilic emulsifiers which act by lowering the interfacial tension, increase the steric hindrances and/or electrostatic repulsion between the droplets. Solid particles with partial dual wettability can also be used to produce stable emulsions known as Pickering emulsions. The irreversible adsorption and larger size of particles compared to conventional emulsifiers, decreases the risk of coalescence, giving Pickering emulsions higher stability as well as other merits including more robust formulation, reduced foaming problems and lower toxicity. Recently, hydrophobically modified small granular starches have shown to have superior properties when used as emulsifying agents producing Pickering emulsions. Starch is an attractive source since it is natural and abundant and modified starch an accepted ingredient and pharmaceutical excipient.

OBJECTIVE: To systematically characterize the effect of the degree of modification and physicochemical properties of 3 types of starch granules on their performance as Pickering emulsion stabilizers.

METHODS: Small granular starches from quinoa, amaranth and rice were hydrophobically modified with octenyl succinic anhydride (OSA) in alkaline slurry to different degrees i.e. 0.6, 1.2, 1.8, 2.4, and 3.0%. The native and modified starch granules were used to stabilize emulsions. The physico-chemical properties of these Pickering emulsifiers were characterized by light scattering, light microscopy, scanning electron microscopy, proximate analysis and differential scanning calorimetry. The emulsification capacity was investigated by particle size analysis and the stability was investigated by application of accelerated environmental stress on emulsions using centrifugation and the stability was assessed by multiple light scattering.

RESULTS: The results showed that it is feasible to formulate emulsions by small granular starches, particularly in surface hydrophobized form, with a great potential for application in food, cosmetic and pharmaceutical industries. With respect to emulsification properties, the results showed that both initial stability and stability towards accelerated stress is directly related to modification degree, granule size, and starch amount in the formulation. Furthermore, it appears that a certain degree of trace protein does not interfere with the OSA modification and has a better emulsification result at lower degrees of modification.