

Enzyme-aided production of lipid emulsifiers from side-streams of the food industry: rapeseed press cake and oat oil

During the manufacture of food, by-products are produced. These side-streams are not the focus of the production and are therefore often considered a waste. However, the streams frequently contain valuable components, which if utilized can increase the value of the crop while decreasing waste. Two by-products with potential for added value were investigated in this thesis, namely rapeseed press cake and oat oil.

Rapeseed press cake is the main side-stream of rapeseed oil production. In the year 2011/2012 the worldwide production of rapeseed oil was approximately 24 million ton and as a by-product 33.6 million ton of rapeseed press cake was produced. The cake still contains some oil, including useful phospholipids. These lipids are often used in the food industry to stabilize emulsions, like mayonnaise. The rapeseed press cake also contains valuable proteins, with a composition favourable for human consumption. The food department of Lund University has developed a method to extract these proteins. The first objective of this thesis project was to increase the yield of this procedure and to extract the remaining oil. To do this, a step was added to the method in which an enzyme cut the rapeseed cell-wall material into small pieces so to release entrapped protein and oil. This worked partly. More proteins were released, approximately 10%, but no oil-layer was seen. It turned out that the lipids were also cut into pieces during the procedure, which made them disappear into the water. This discovery had an upside though, as the pieces of the lipids turned out to be responsible for the bitter taste of the protein extract. Knowing this, the taste can be improved by slightly adjusting the method.

Oat oil is the main side-stream of the production of oat fibres by the Swedish company SweOat. The fibres in oat, especially beta glucans, have recently gotten much attention for their health promoting abilities and the production is growing steadily. Oat oil contains many polar lipids, like the previously mentioned phospholipids and galactolipids. Polar lipids are molecules that like both water and oil and therefore prefer to be at the boundary between water and oil. In an emulsion oil is dispersed as small droplets in water, or the reverse, and much of this water-oil interface exists. As oil and water do not like each other, the droplets will normally quickly come together to minimize contact with the other liquid. But when polar lipids are present the oil and water are shielded from each other and the droplets can remain dispersed. The second objective of this thesis project was to investigate oat oil's ability to stabilize an emulsion and how this ability changes when an enzyme cuts off a piece of the lipids. It turned out that adding oat oil to an emulsion does indeed increase the stability. This was especially the case for oat oil enriched in polar lipids, as you would expect. Surprisingly, stability was also increased when the oat oil was soaked in water for more than an hour before making the emulsion. During this time the oil changes from a yellow liquid to a white gel-like structure. This structure is called a liquid crystal; lipids are partly flexible, like a liquid, and partly well-regulated, like a crystal. These structures form a protective layer around the emulsion droplets, increasing stability. For the second part of the objective, pieces of the lipids were cut off by an enzyme. After fine-tuning the way to extract the lipids from the reaction mixture, it could be seen that the lipid's ability to stabilize emulsions was indeed affected by the enzyme. The longer the enzyme was in contact with the lipids, the better the lipids could stabilize the emulsion.

In conclusion it can be said that both rapeseed press cake and oat oil can be utilized to a greater extent. The insights in this report can help to produce in the future protein extract with a higher yield as well as without a bitter taste, increasing the feasibility to produce for human consumption. Oat oil can be used as emulsifier of which the properties can be changed by enzymes. Using the methods of this research as a starting point, eventually commercialized production of a range of lipid emulsifiers might be possible, in this way increasing the utilization and value of this side-stream from the food industry.