Soap production from the oils of locally grown seeds and their antimicrobial effect

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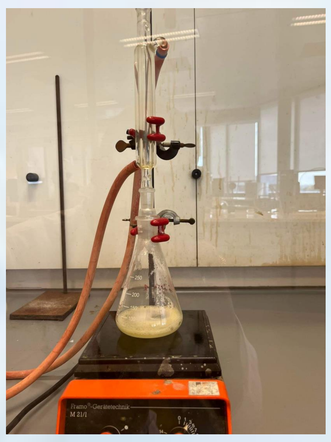
Introduction

The goal of our project was to produce soap starting from oils cold pressed from locally grown seeds. The oils and the soap we both created were also tested on their antimicrobial effect. This project was created as part of the RESOAP project in collaboration with the centre of expertise Sustainable Resources. The locally grown seeds and their oils were given to us by 'praktijkpunt landbouw Vlaams-Brabant'.

Materials and methods

Some of the seeds that were provided were cold pressed into oil using a hand press by PITEBA.



The saponification of the oils trusts on the basic hydrolysis of the triglycerides together with NaOH. The saponification value is determined by a back titration, this determines how much NaOH is needed to saponify the oils. Liquid soap and soap bars were made by using a hot process.

For the production of solid soap, 100g of oil was mixed with an amount of a NaOH solution calculated from the SAP value with a 1:3 ($NaOH:H_2O/EtOH$) ratio. Both solutions were mixed and heated for 30 min and poured into the RESOAP molds.

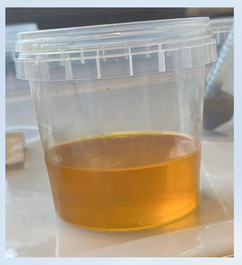
Liquid soap was made the same way as solid soap but with a KOH-solution. The soaps were tested to see if they were ready by dissolving it into hot water and measuring the pH. Afterwards a glycerin-water (0,2:0,8) solution was added.

In the antibacterial tests, three main methods were used. A diffusion assay with diffusion discs, an assay where the analyte was in contact with the bacteria and an assay where growth was tracked in time intervals. *S. aureus* and *E. coli* were used on freshly prepared TSA plates. Because of the insolubility of oil in water-based growth medium, different experiments were done. Physiological water was mixed with the oil by shaking, mixed with the oil and placed in an ultrasonic bath with the objective of making micelles and mixing the oil with physiological water and some Tween 20 to make an emulsion.

The antimicrobial activity of the different oils and solid rapeseed soap were also determined experimentally by tracking the microbial growth of *E. coli* in TSB enriched with different oils/soap at set time intervals. In addition, the growth-inhibiting properties of safflower oil were studied by performing the same experiment on a dilution series of Safflower oil in DMSO to increase the solubility of the oil.

Results and discussion

For the cold pressing of the different seeds, the tightness of the adjustment bolt/stop was most important to adjust the pressure for each of the different seeds.

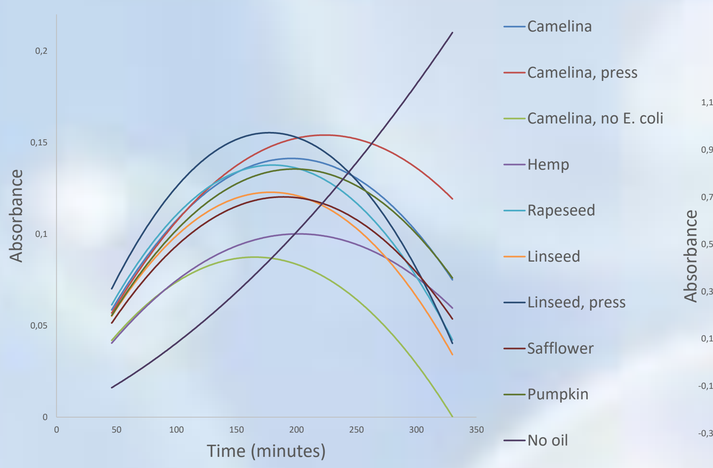


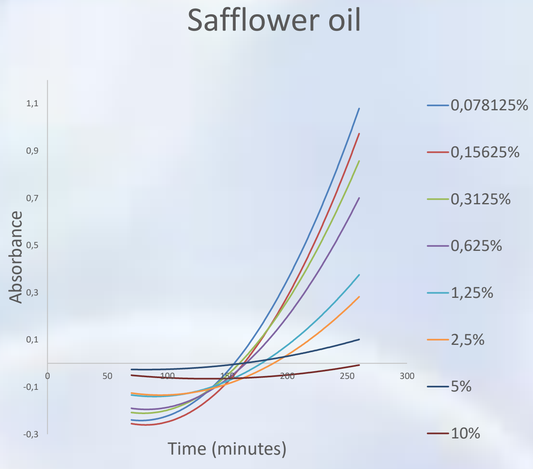
Oil	Saponification value (mg NaOH/g oil)
Oil pumpkin	153,92
Hemp	143,48
Camelina	121,54
Mustard	130,27
Linseed	159,69
Rapeseed	160,02
Safflower	158,83
Blue moonseed	154,68

For the saponification value, it is important that ethanolic NaOH is used. Only then, the determination of the saponification numbers went smoothly. The saponification numbers are still a bit higher than the theoretical values.

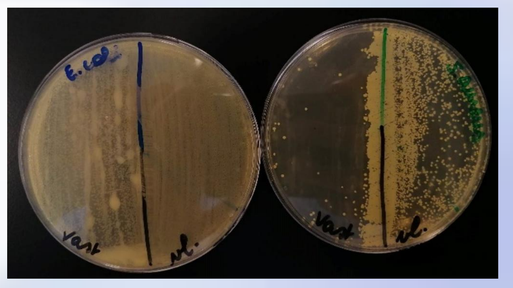
$$N = \frac{[(c_{NaOH} * 25{,}00\ mL) - (c_{HCl} * V_{avg})] * MM_{NaOH}}{exact\ mass\ oil}$$

Solid soap observations		
Oil	pH after one week of maturation	pH after two week of maturation
Hemp	10	9
Rapeseed	11	9
Camelina	13	11
Linseed	10	8
Safflower	9	8
Oil pumpkin	10	8
Blue moonseed	9	8





Rapeseed soap				
Time (minutes) →	149	206	250	1545
Mass soap (g) ↓				
0	0.010	0.004	0.013	0.143
0.1	0.005	0.004	0.005	0.004
0.25	0.008	0.007	0.002	0.002
0.5	0.005	0.003	0.001	0
1	0.002	0.002	0.001	0



To determine the antimicrobial action of oil, it is important to sterilize the oil beforehand to remove the micro-organisms present. The experiments were performed with E. coli and S. aureus. Fresh camelina, old linseed and safflower scored best for the classical diffusion tests.

Dissolving oil in physiological water, with Tween 20 or in the ultrasonic bath to promote the diffusion of oil in the polar TSA, gave no different results. Direct contact of oil or soap with the bacteria resulted in fewer and smaller bacterial colonies. The soaps showed stronger antimicrobial activity against *S. aureus* compared to *E. coli*

Conclusion

Camelina is the only seed that was easily pressed.

Solid soap was produced by heating and stirring a mixture of oil and NaOH/water. Fluid soap was made the same way but instead of NaOH, KOH solution was used.

Camelina-, linseed- and safflower oil showed the strongest antibacterial properties in solution over time for *E. coli* and *S. aureus*.

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