Extraction and characterization of cashew nutshell liquid

Melvin Vermeeren
Project/Research Group: BRE
Contact information: mabj.vermeeren@student.avans.nl
Date: January 16
Supervisors: Qian Zhou, Rima Mahmoud

Introduction

The goal of the research is to extract cashew nutshell liquid from cashew nutshell rest stream by hot pressing and characterize the main components in extracted cashew nutshell liquid.

The three main components in cashew nutshell liquid are anarcardic acid, cardanol and cardol. Each substance contains both saturated and unsaturated compounds. For each main component, four different subcomponents can be distinguished, as shown in Figure 1.

The aromatic rings, polar functional groups, and double bonds in the side chains make them suitable for making coatings, primers, rubber compounds, and drug development [1-2].

During the research, HPLC has been used as the main analytic method to qualify and quantify the components in CNSL.

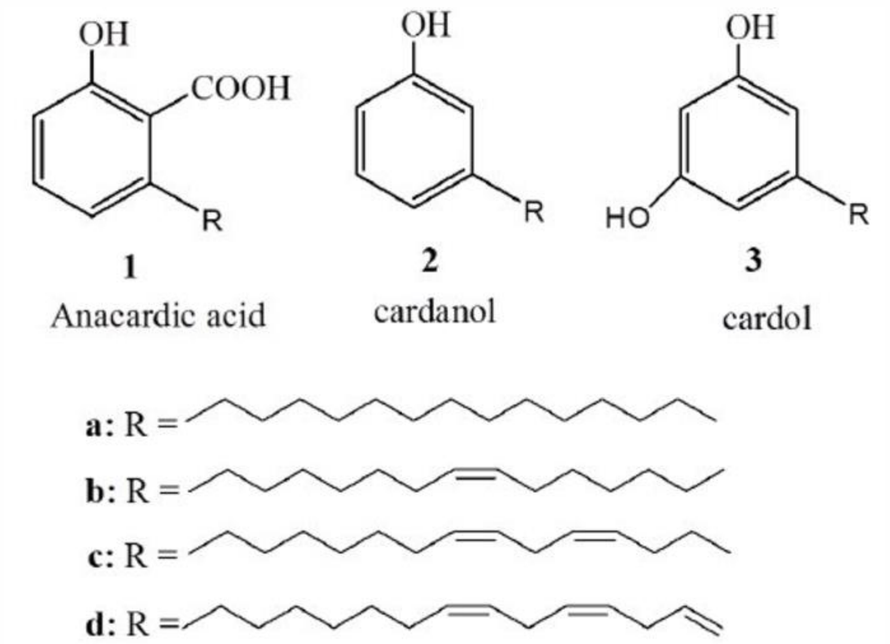


Figure 1: The chemical structures of anacardic acid, cardanol and cardol present in cashew nutshell liquid.[3]

Method

First, the oil is extracted from the cashew nut shells with the use of hot-pressing. Then, the oil gets purified using vacuum distilled. The obtained distillate gets identified and quantified using HPLC. The steps are represented in the flowchart shown in Figure 2 and in figure 3 are pictures of the equipment shown.

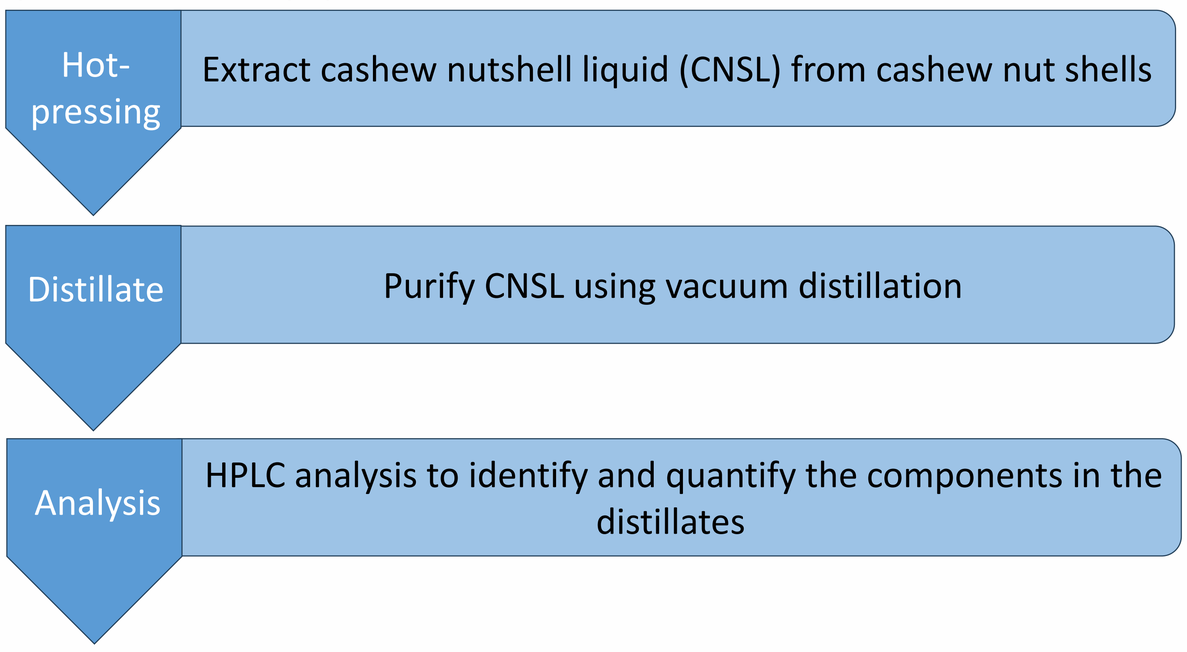


Figure 2: Flowchart of approach of research.

Figure 3: Cashew nut shells, hot-press with CNSL and CNS cake, vacuum distillation and HPLC Agilent 1200 series

Results

From hot pressing the results show that 23.95% of the total mass of cashew nut shells that is used, is converted into cashew nutshell liquid (CNSL). Figure 3 shows a pie chart of the different end products.

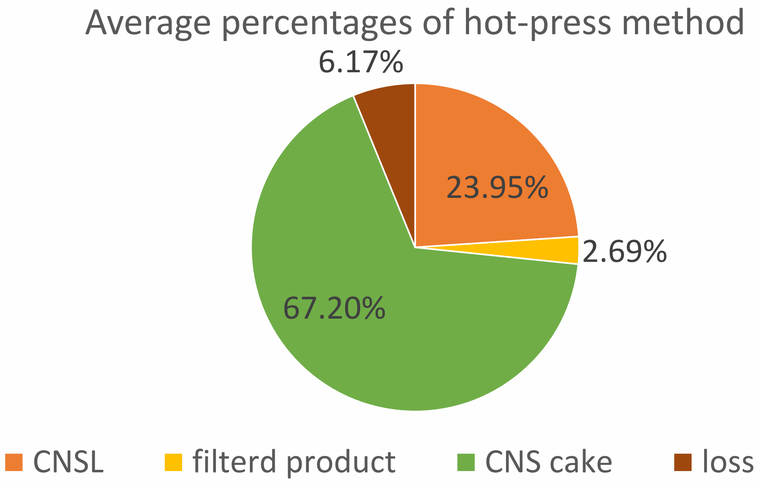
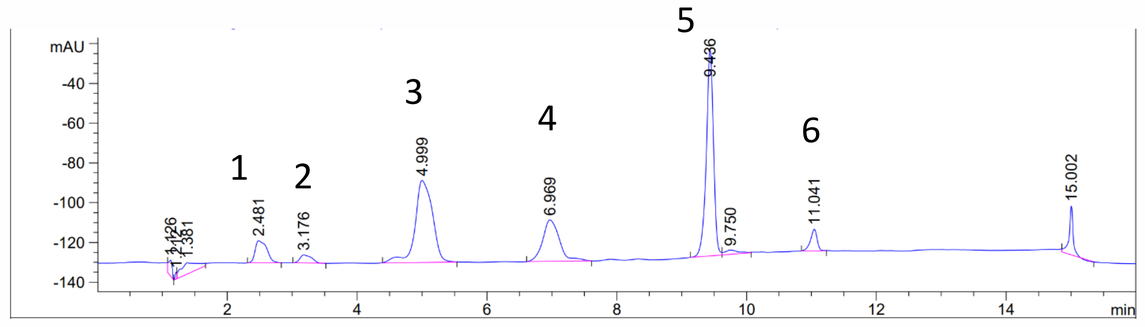


Figure 4: Pie chart with average percentages of the different end products obtained, by performing hot-press method.

The HPLC analysis of distillate from vacuum distillation is shown in Figure 4. Peak 1 and 2 are the components of cardol 15:3 and 15:2. Peak 4, 5 and 6 are the components cardanol 15:2, 15:1 and 15:0. The table shows the yield percentages of the quantified components. Peak 3 is identified as cardanol 15:3.



Peak number	Retention time	Component	Concentration (%)
1	2.481	Cardol 15:3	11.74
2	3.176	Cardol 15:2	2.29
4	6.969	Cardanol 15:2	35.94
5	9.436	Cardanol 15:1	33.69
6	11.041	Cardanol 15:0	3.37

Figure 5: HPLC chromatogram of distillate product from N-CNSL. Peak 1 is cardol 15:3, peak 2 is cardol 15:2, peak 3 is cardanol 15:2, peak 4 is cardanol 15:1 and peak 5 is cardanol 15:0.

Conclusion

It can be concluded that with the hot-press method, 23.95% cashew nutshell liquid can be extracted from cashew nut shells.

By using vacuum distillation, the obtained cashew nutshell liquid can be purified that contains 11.74% cardol 15:3, 2.29% cardol 15:2, 35.94% cardanol 15:2, 33.69% cardanol 15:1 and 3.37% cardanol 15:0.

In the further course of the research, it is recommended to establish a calibration curve of cardanol 15:3 to be able to quantify the component.

It is also recommended to investigate the possibilities of obtaining each component using flash column chromatography.

References

1. Lubi, M.C. et al. Designed monomers and polymers. pp. 123-153. 2000.
2.Uliassi, E. et al. Cashew nutshell liquid (CNSL) as a source of drugs for Alzheimer's disease. 2021
3. Hamad, F.B. et al. Potential biological applications of bio-based anacardic acid and their derivatives. 2015.