Extraction of flavored coriander vegetable oil through extrusion technology

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EXTRACTION OF FLAVORED CORIANDER VEGETABLE OIL THROUGH EXTRUSION TECHNOLOGY

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In an age where fossil resources are steadily depleting and environmental concerns have become an established subject of public and political discussions, the pursuit of sustainability is deeply entrenched in society. With regard to this and considering the consistently growing demand, the implementation of renewable resources in industrial processes could be a decisive solution. An interesting novel bioresource could be presented by *Coriandrum sativum* L., an annual herb from the family of Apiaceae and native to the eastern Mediterranean region. The coriander fruits are of particular interest, as they contain two distinct oil fractions. These comprise an essential oil with about 70% linalool and a vegetable oil, characterized by the presence of petroselinic acid, which constitutes over 70% of all fatty acids. Petroselinic acid, or *cis*-6-octadecenoic acid, presents a rare fatty acid common amongst the vegetable oils from Apiaceae crops. As a positional isomer of the more ubiquitous oleic acid, it may give rise to the synthesis of a series of novel, biobased compounds that could be of great interest to several industries. This renders the vegetable oil from coriander fruits particularly promising and as a consequence, the establishment of an efficient and economically favorable extraction process will constitute a major challenge for future research. Extrusion technology could present an attractive alternative to solvent extraction as it produces high quality vegetable oil that has not come into contact with any chemical substances. Further, the press cakes may find various profitable applications due to their essential oil content and antioxidant activity. Next to this, the extrusion cakes constitute natural biocomposites and could be transformed to value-added agromaterials through thermopressing. These biodegradable polymers could possibly replace less sustainable materials in automobile, building and furniture industries. The major disadvantage of mechanical pressing is considered its relatively low extraction yields and consequently a high residual oil content within the press cakes. A possible solution may lie within the application of seed pre-treatments prior to the extrusion process. Therefore, the moisture content of coriander fruits was varied and the effect on the crushing behavior and extraction efficiency through single-screw, as well as twin-screw extrusion was assessed.

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INTRODUCTION

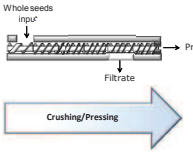
- Vegetable oil → 73% Petroselinic acid (28%)
- Essential oil → 70% Linalool (0.70%)
- Press cake → Potential for agromaterials

- Single- and twin-screw extrusion as sustainable processes for high quality oil extraction
- Improvement of extraction yields through seed pre-treatments
- Economical considerations & oil quality analysis

Coriandrum sativum L.

MATERIAL & METHODS

Single-screw extrusion



- Traditional oil pressing technique
- Low capital cost
- High energy consumption
- Low flexibility

➢ OMEGA 20 type single-screw extruder

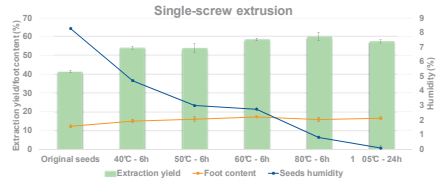
Twin-screw extrusion

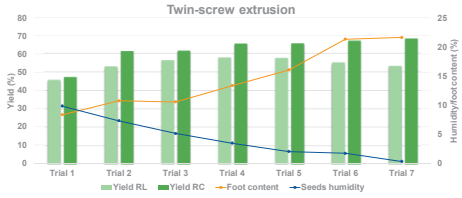
- Innovative technique for oil extraction
- T-regulated modules
- High capital cost
- Reduced energy consumption
- High flexibility & versatility

➢ Clextral BC21 co-rotating twin-screw extruder

RESULTS & DISCUSSION

Extrusion yields





R_L: Extraction yield based on the amount of oil obtained
R_C: Extraction yield based on the residual oil content of the press cake

Quality parameters

Single-screw extrusion

Drying profile	none	60° C – 6h	80° C – 4h	80° C – 6h	105° C – 24h
Seeds humidity (%)	8.2 ± 0.1	2.7 ± 0.1	1.4 ± 0.1	0.8 ± 0.1	0.0
% FFA	1.37 ± 0.03	1.37 ± 0.03	1.42 ± 0.12	1.37 ± 0.06	1.37 ± 0.01
% PA	73.4 ± 0.2	74.2 ± 0.5	74.7 ± 0.1	74.8 ± 0.1	74.9 ± 0.2

Twin-screw extrusion

	Trial 1	Trial 4	Trial 6	Trial 7
Seeds humidity (%)	9.8 ± 0.2	3.4 ± 0.2	1.7 ± 0.1	0.3 ± 0.1
% FFA	1.66 ± 0.01	1.51 ± 0.03	1.58 ± 0.02	1.50 ± 0.01
% PA	72.7 ± 0.3	73.6 ± 0.1	73.8 ± 0.2	73.7 ± 0.2

FFA: Free fatty acids; PA: Petroselinic acid

- Drying of seeds significantly improves oil extraction through enhanced crushing ability during extrusion
- Intensive drying results in a 45% increase of extraction yield for both single- and twin-screw extrusion
- Foot contents of the filtrate show an important increase with decreasing seed humidity
- Oil from seeds with reduced humidity show increased PA content
- Good oil quality even for intensively dried seeds

CONCLUSION

- Drying of the seeds was shown highly effective as a pre-treatment prior to extrusion
- Best oil yields for TSE result from moderate drying due to reduced foot contents
- Good quality oil with high petroselinic acid content was obtained