

EFFECT OF SUPERCRITICAL CO₂ EXTRACTION ON TRANS/CIS LYCOPENE GEOMETRICAL ISOMERISATION

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The SC-CO₂ extraction process can be used to obtain targeted food components from natural products such as lycopene from tomatoes. Lycopene is a powerful antioxidant and potential high-value compound for the nutraceutical and pharmaceutical sectors. In nature, lycopene commonly occurs in the all-*trans* configuration, but the more biologically active and More bioavailable are *cis*-lycopene geometrical isomers. Therefore there is interest in the isomerisation of *trans*-lycopene into its *cis*-form when lycopene is obtained for subsequent incorporation into functional foods and nutraceuticals.

The objective of this study was to evaluate the influence of SC-CO₂ extraction on *trans/cis* lycopene isomerisation. The effects on lycopene geometrical isomerisation at various pressures and temperatures were studied for experimental analysis and modelling. The temperature range of 40-60 °C and pressure range of 35-55 MPa were used to measure the isomerisation of lycopeneNE from Lyophilized tomato during SC-CO₂ extraction.

Table 1. Selected factors and their levels for the CCD factorial design

Analytical factors	Coded symbols	Factors levels ^a				
		-2	-1	0	+1	+2
Extraction temperature (°C)	T	30	40	60	80	90
Extraction time (min)	t	80	120	180	240	280
Extraction pressure (psi)	P	1300	3000	5000	8000	9700

^a Factors levels: +2, -2 are values given from the software Design-Expert. Levels: -1, +1 are chosen factors values

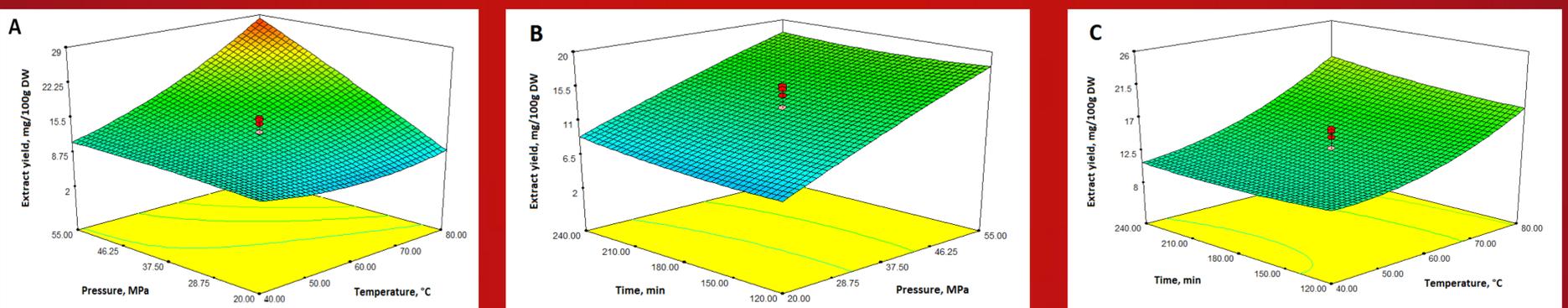


Fig. 1. 3D response surface plot showing effects of temperature and pressure at constant time (180 min) (A); effects of time and temperature at constant pressure (37.5 MPa) (B); effects of time and pressure at constant temperature (60 °C) (C)

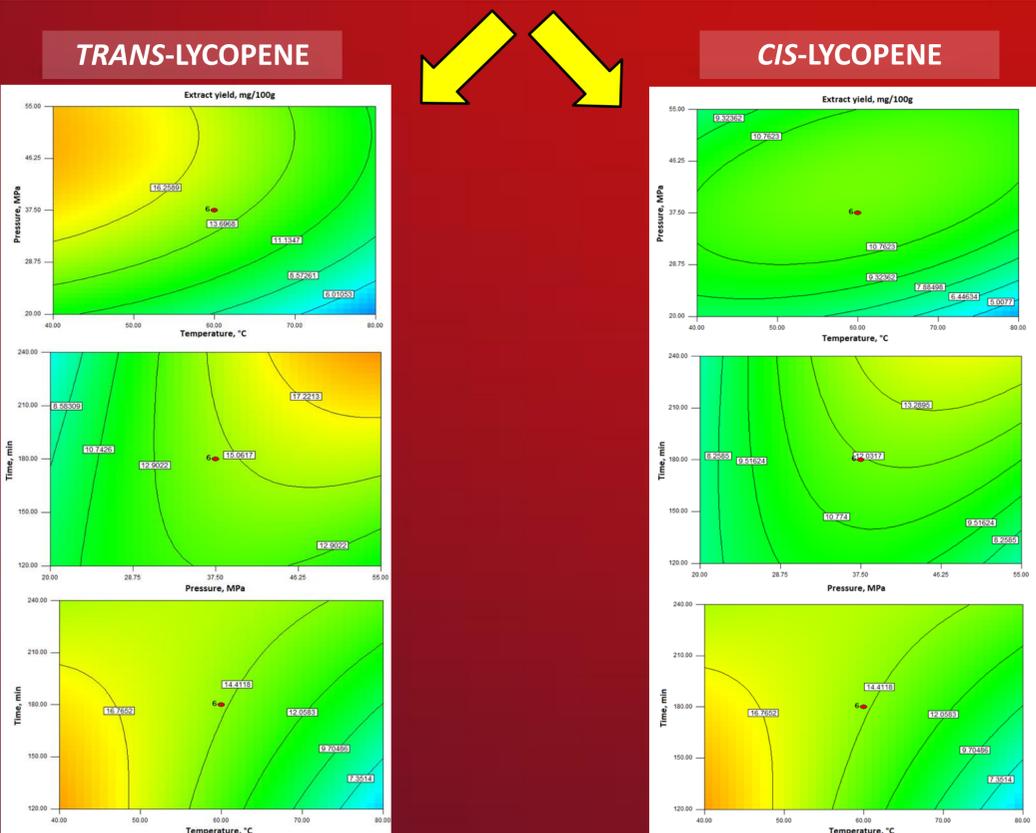


Fig. 2. The effect of temperature, pressure and time on SC-Co₂ Extraction of all *trans*- and *cis*-lycopene is shown by a contour plot

CONCLUSIONS

The predicted models were highly significant ($p < 0.05$). SCE-CO₂ and the predicted values of extraction method well fitted the experimental values. total *cis*-lycopene isomers content in the SCE-CO₂ extract at optimal parameters was 58 %. The predicted optimal extraction process parameters were 40 °C temperature, 55 MPa pressure and 240 min extraction time.

Lyophilized tomato (CV 'Admiro' F1, harvested in 2014) samples were obtained from Biochemistry and Technology laboratory (LRCAF Institute of Horticulture (Babtai, Lithuania).

The SC-CO₂ experiments were carried out using supercritical fluid extractor SFT-150 (Supercritical Fluid Technologies, USA). Each extraction was performed using 25 g of freeze-dried red tomato. The factors used were temperature, pressure and extraction time. The flow rate (3 L/min) and CO₂ concentration of the feed gas were constant during the test.

HPLC analysis. The content of total lycopene (all-*trans* and *cis*-isomers) in the SC-CO₂ extracts was analysed by the rP-HPLC using a C₃₀ column, with UV-Vis and PAD detectors. To quantify lycopene in the extract samples, a calibration curve was generated using an authentic all-*trans*-lycopene standard. Levels of *cis*-lycopene isomers are given in all-*trans*-lycopene equivalents.

Experimental design. Response surface methodology (RSM) using central composite design (CCD) was employed to determine the effect of three variables on the extract yield and to identify optimum conditions for lycopene extraction. For data analysis and model establishing the software Design-Expert trial version 8.0.6.1 (Stat-Ease Inc., Minneapolis, MN) was used. Extraction pressure (P), temperature (T) and time (t) were chosen as independent variables with five levels for each of them (Table 1.)

The CCD model was adequate in optimizing SC-CO₂ extraction of lycopene from tomato. Fig. 1 shows the three-dimension (3D) response surface plot under different testing conditions of extract yield. The best results in terms of extraction yield were obtained working at the highest temperature (80 °C) and relatively high pressure (55 MPa) (29.20 mg/100g in lyophilized tomato).

The highest ratio of *cis*-lycopene isomers of SC-CO₂ fluid extract obtained at low temperature (40 °C) and high pressure (55 MPa) indicated higher lycopene bioavailability due to the *cis*-isomers generation (55-58 % of total lycopene) (Fig. 2.)



ACKNOWLEDGEMENT

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