Analysis of the potential of lycopene and dietary fiber from a by-product of organic tomato processing as ingredients in functional food formulations

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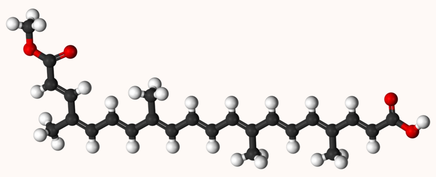
INTRODUCTION

- **Production of tomato:** 117 million tons (global production) (Ninčević Grassino et al., 2020), 527 thousands tons (Colombia) (FAO, 2021).

- **Nutritional importance:** Presence of lycopene, vitamin C, potassium, folate and vitamin K (Bjarnadottir, 2019).



- **Percentage of waste of tomato-based products:** 5% composed mainly of peel and seed (Ninčević Grassino et al., 2020).

- **Functional composition:**
  - Lycopene: reduction of cardiovascular diseases and the improvement of skin health (6 mg/day) (Rahimi & Mikani, 2019) (Alam et al., 2019) (Shi & Le Maguer, 2000).
  - β-carotene: Precursor of vitamin A, improve normal collagen formation and helps with physiological inmune resposes of skin in relation to UV radiation (Ninčević Grassino et al., 2020).
  - Dietary fiber: preventing colon cancer, lowering the risk of cardiovascular disease and reducing blood sugar (Gu et al., 2020)

- **Objective:** To characterize the amount of TDF in an organic tomato peel sample obtained by a local processing industry, as well as evaluate the optimal recovery percentage of total carotenoids content.

EXPERIMENTAL DESIGN

Table 1. Independent variable of the experimental design using 40 °C and 45 minutes of UAE.

Assay	Biomass – solvent ratio (w/v)	Solvent ratio (AE:ET)
1	0,025	80:20
2	0,025	20:80
3	0,05	80:20
4	0,05	20:80

Equation 1. Total carotenoid content (µg b-carotene equivalent/g). Response variable.

$$\%Recovery = \frac{TCC\left(\frac{mg}{100\ g}\right) of\ UAE}{TCC\left(\frac{mg}{100\ g}\right) of\ CE} * 100$$

RESULTS

Table 2. Approximate composition of total dietary fiber, protein and ashes of tomato peel.

Tomato peel (DB)[a]	Approximate composition[b]
TDF (g/100g)	49,46 (0,057)
Protein (g/100g)	0,75 (0,14)
Ash (g/100g)	0,0019 (0,0008)

[a]All results are reported on a dry weigth basis. [b]Values in parentheses are the standards deviations

A value of reference of 57,4 g/100g (Gu *et al,* 2020) was found on literature. Therefore, this is a good estimation of total dietary fiber.

Table 3. Average color parameters of tomato peel before and after hot – water blancher process.

Parameter	No treated sample[a]	Treated sample[a]
L	22,6	12,4
a*	15,8	18,3
b*	22,3	14,8

[a]The values reported are average of 6 measurements per sample.

Carotenes (mainly lycopene) suffers isomerization reactions at high temperatures. Therefore, the compound tends to degrade its red color (Eh & Teoh, 2012). Parameter L (difference in lightness and darkness) is de most affected by blancher process

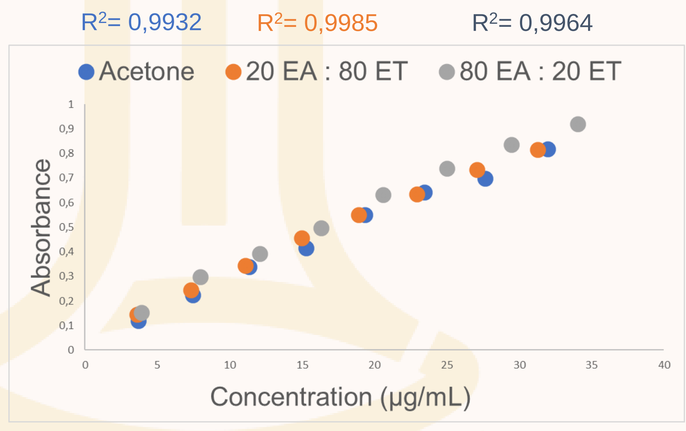


Figure 1. Calibration curve for acetone and ethyl acetate : ethanol at (20:80) and (80:20) respectively

Table 4. Total carotenoid content (TCC)[a] using UAE and EC methods and statistical analysis using Tukey's and Dunnet's comparison test[c]

Assay	Extraction Method	TCC (mg/100g) DB[b]	% of recovery	Tukey's test group	Dunnet's test group
Control	EC	305,61 (33,19)	100%	A	A
1	UAE	253,89 (19,39)	83%	A B	A
2	UAE	125,07 (10,66)	41%	C	-
3	UAE	205,81 (11,21)	67%	B	-
4	UAE	190,22 (6,44)	62%	B C	-

[a]mg b-carotene equivalent/100g. [b]Values in parentheses are the standards deviations. [c]p-value=0.001

- Assay 1 (80:20 AE:ET, 0,025 w/v) has the major recovery percentage and from statistical test it can be stated that it has no significative difference with control.
- UAE is considering a green emerging extraction technique.
- Solvents used in UAE (EA:ET) have a lower environmental impact and better safety in foods than solvent in EC (acetone)

MATERIALS AND METHODS

ABSTRACT

- Peel is one of the most untapped products. it is a source of a significant variety of carotenoids and total dietary fiber (TDF).
- For the characterization of TDF, the AOAC method (991.43) was followed.
- The content of TDF was 49,46 ± 3,91 (g/100g) on dry basis.
- Optimization of UAE had been performed using a solvent ratio of 80 EA : 20 ET and 2.5% w/v of biomass – solvent ratio at 40 °C for 45 minutes.
- Recovery percentage of total carotenoid content in terms of β-carotene equivalent per g of sample was established as response variable.
- The optimal recovery percentage of total carotenoid content was 90%. That means, a total carotenoid content of 253.89 ± 19.39 mg β–carotene equivalent/100 g on dry basis.

CONCLUSIONS

- Tomato peel is a good source of carotenes and dietary fiber which are known to improve health issues
- The study shows a potential solution for unused tomato industry by-products such as peel
- UAE extraction with 80:20 solvent ratio and a biomass – solvent ratio of 0.025 (w/v) is not significantly different from the acetone extraction
- UAE extraction can be used as a replace for conventional extraction
- The study promote the development of potential functional food products
- The study shows a way out for applying concepts of sustainability (following SDG's) and circular economy

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ACKNOWLEDGEDMENTS

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MORE INFORMATION

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