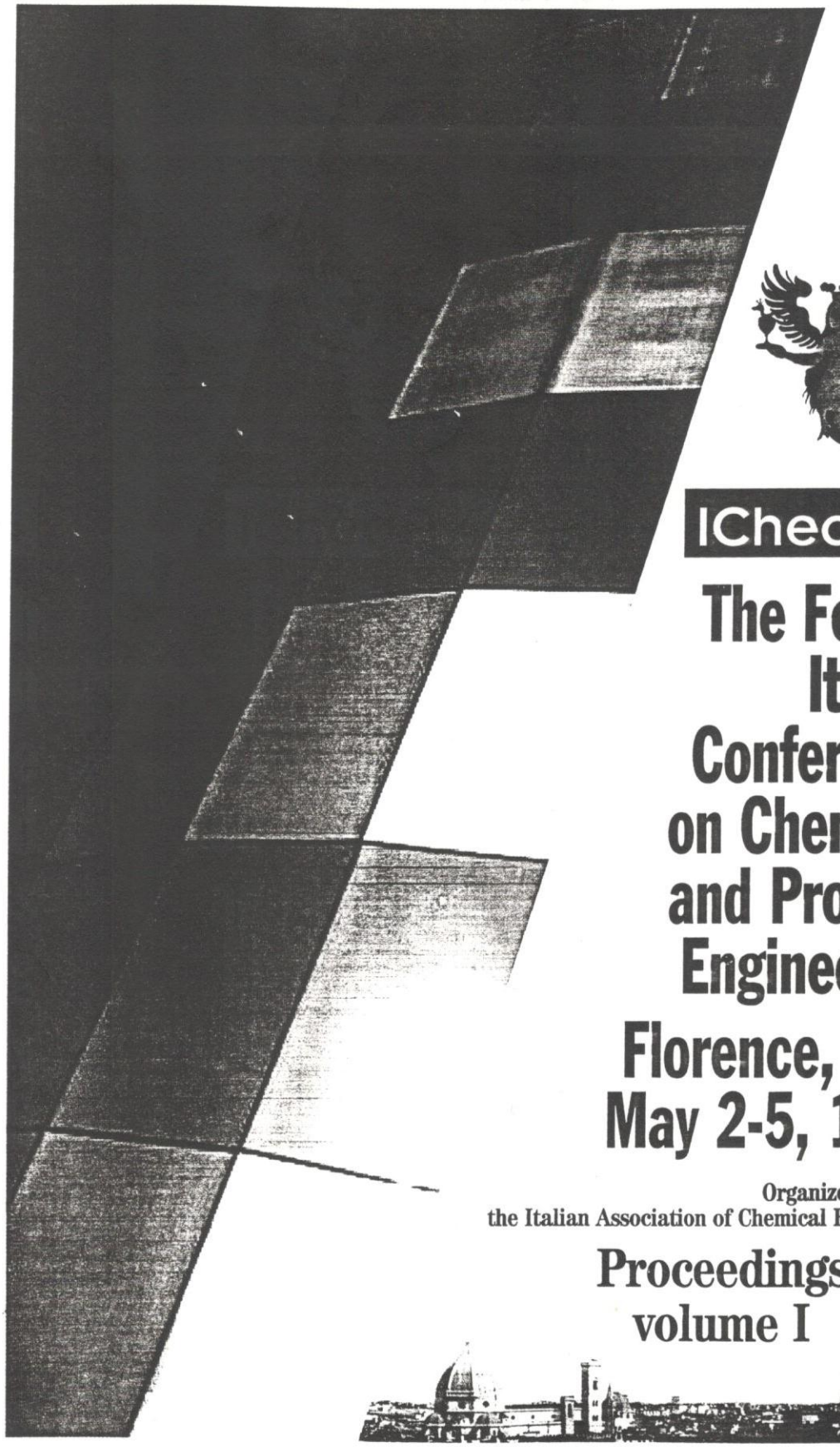

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EXTRACTION OF PIGMENTS AND OIL FROM TOMATO INDUSTRY WASTE

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ABSTRACT

Tomato skin and seeds from industrial waste were used to extract pigments and oil. The experimental results indicate that the yield of the operation depends on the feed size and their moisture content. By using several solvents was proved that the non-polar ones have a great selectivity. Vegetable oil was found to be an appropriate solvent, therefore by considering that the seed are quite reaches in oil and that commonly available food colorants are sold as pigments in oil solutions an attempt to obtain a mixture of seed oil and tomatoes peels pigments was made.

INTRODUCTION

Fresh tomatoes contain 2.5 - 4 % (w/w) of seeds and peels. During the manufacturing processes of tomato paste and peeled tomatoes a large amount of these waste is obtained and this represents a serious environmental problem. The waste contains 50 - 85 % moisture and is used in part as animal feed while in large quantity must be destroyed. However the tomato peels are quite reaches in lycopene (Shama and Le Marguer, 1996), the pigment E160d, and the seeds are a good source of vegetable oil reach of unsaturated acids. Therefore it is worthy to verify if it is possible by means of a simple technology to recovery these components whose economic value is increasing due to the actual policy of food industry which prefer to replace artificial colors with natural ones.

MATERIALS AND METHODS

Tomato waste from a local tomato industry was divided into lots and stored frozen until used. The initial moisture content of seeds and peels was lowered to 10 % (w/w) by drying them at 70 °C by means of a laboratory scale fluidized bed dryer (Sherwood Scientific, Cambridge England). The dried waste was grounded by means of mixer and the powder was divided into fractions of different average size with vibrating sieves. Leaching was performed in a batch system. Solvents of HPLC grade were used (Lab Scan, Dublin, Ireland). Visible spectra were measured by means of an UV-Spectrophotometer (Shimadzu Model 1030 A, Japan). Gas-chromatographic analysis was performed with an instrument (DANI 8610HT) equipped with a capillary column 50 m length and a cyanopropilmetylsilicon film having thickness equal to 0.25 μ (Quadrex Corporation). The chromatographic conditions were the following: flame ionization detector (FID) set at 280 °C; programmed temperature vaporizer (PTV), temperature program: 3 s at 50 °C, heating rate 200 °C/min., final temperature 240 °C and 3 min holding at 240 °C; He flow equal to 1.8 ml/min.; oven temperature program: 3 min. holding at 130 °C, heating rate 8 °C/min.; final temperature 250 °C; split rate 1:60.

RESULTS AND DISCUSSION

The pigment yield varies with varying the quality of the row material. If the amount of green and yellow tomato processed is too high the yield is low. From industrial wastes of bad quality using the fraction having an average size of 0.0795 only 3 % (w/w) of pigments were extracted by means of a Soxhlet. Figure 1 shows the spectrum of the dried tomato peel extract by using petroleum ether. The principal constituent of the extract is lycopene. In fact the spectrum presents three maxima located at 445, 471 and 500 nm, respectively, which compares well with literature data relative to lycopene: λ_{max} at 468-473, and secondary peaks at 440-445 and 500-506 nm (Tan Barrie, 1988).

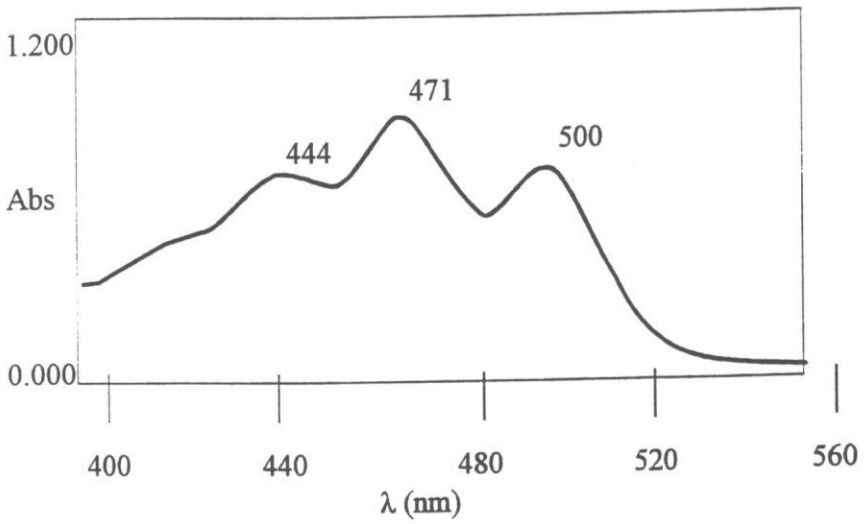

Figure 1 - UV Spectrum of extract by using petroleum ether.

The selectivity of petroleum ether is very good however it is not allowed by the European Community which indicates as food grade solvents acetone, ethylacetate, hexane, methylencloride, ethanol, isopropanol and methanol.

Table 1 -Spectral maxima of the extracts obtained by using various solvents

Solvent	**Maxima (nm)**		
Ethyl Acetate	506	474	448
Acetone	505	474	448
methylencloride	516	483	457
Hexane	503	471	445
Ethanol	448		425
Isopropanol	470	447	426
Methanol	445		422

Table 1 reports the location of the spectral maxima of the extracts obtained by using the allowed solvents. Among the solvents investigated only acetone, ethyl acetate, hexane and methylencloride were found to be selective with respect to carotenoids, while the polar solvents such as ethanol, isopropanol and methanol were poor solvents. Their selectivity was lower than the non-polar solvent and, moreover, the solubility of lycopene in them was very low. As non-polar solvents are more efficient it was not surprising that a vegetable oil, in particular corn oil, performed well as a solvent. In particular UV spectra of the relative extract showed three maxima, the main located at 475, and the secondary ones at 449 and 506 nm, respectively. When a feed containing tomatoes seeds is used the extract contains an oil whose composition is reported in table 2:

Table 2 - Composition of the tomato seeds oil.

MEFA	Percentage
palmitic	14.3 %
palmitoleic	0.4 %
stearic	4.2 %
oleic	24.0%
linoleic	48.9 %
linolenic	0.3 %
arachic	2.2 %
erucic	1.0 %

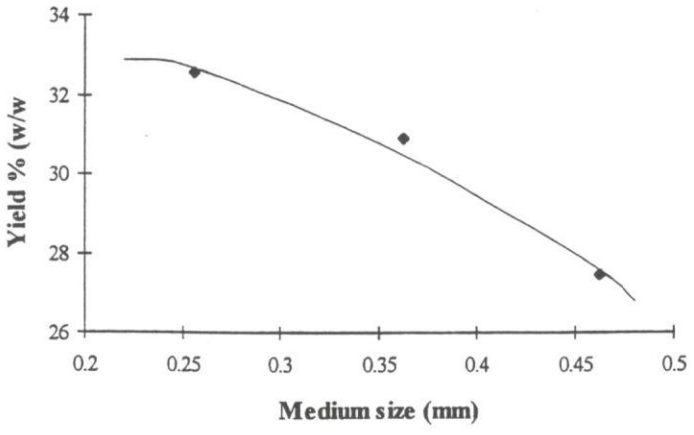

Figure 2 - Amount of oil obtained from different size ground tomato seeds

This oil is very reach of unsaturated acids (more than 75 %) and in particular of linoleic acid (more than 45 %) and therefore it can be used as food ingredients. If the oil extraction is carried out on the whole seeds the amount of oil which is extracted is about of 12 %, however the yield can be improved by grounding the seeds. Figure 2 shows the amount of oil which can be extracted from the seeds by using fractions of different average size. It can be noticed that the yield increases about three times when particles having an average diameter equal to 0.256 mm were used.

By considering that the seeds are the 50 % in weight of the tomato waste and that lycopene is selectively extracted by vegetable oil, it was worthy to explore the possibility to obtain a pigment in oil solution as a result of the extraction process. Preliminary results not shown indicate that the yield of pigment which were extracted is independent on the size of the grounded peels, while the amount of oil extracted from the seeds varies with varying the size of the grounded seeds. By using dried waste fractions of different size it was possible to obtain pigments in seeds oil solution with variable carotenoids concentration. Figure 3 shows the yield of pigment extracted as a function of the average diameter of the dried waste fraction.

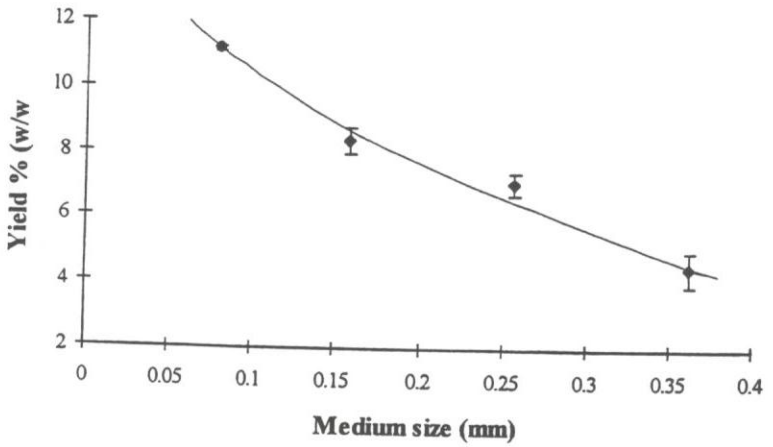

Figure 3 - Yield of the extraction as function of the average size of powder of tomato waste.

CONCLUSIONS

Tomato industry waste may be an important supply of natural pigments and vegetal oil. Since the wide diffusion of this industry, in particular in the Southern Italy, the potential supply of tomato waste is of many tons per year. Leaching can be a simple and useful operation to recovery the valuable components of the tomato industry waste. The preliminary results which have been shown suggest interesting prospective in the development of this technique.

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