

Comparative Analysis of Watermelon (*Citrullus lanatus*) Seed Oil from Arid and Industrial Regions of Rajasthan.

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Abstract.

Watermelon (*Citrullus lanatus*) is a member of the family Cucurbitaceae that produces seeds with edible oil containing nutritionally important unsaturated fatty acids, phytosterols, tocopherols and natural antioxidants. Environmental conditions have a strong influence on the quantity and quality of seed oil. The objective of this study was to compare seed oils obtained from watermelon grown in arid and industrial regions by laboratory extraction and qualitative spectroscopic characterisation. Mature seeds were collected from representative locations and cleaned, dried and powdered before oil extraction by soxhlet extraction using petroleum ether as solvent. The oil obtained was purified by solvent recovery and liquid-liquid separation in a separating funnel. The obtained oil was preliminarily characterised by UV–Visible spectroscopy for absorption spectra in the ultraviolet region.

The laboratory procedure indicated an efficient extraction and purification of watermelon seed oil. The UV–Visible spectrum showed strong absorption in the low ultraviolet region, followed by gradual decrease in the absorbance at higher wavelengths with broad shoulder near 285–295 nm. This indicated the presence of conjugated molecular systems and naturally occurring unsaturated lipid constituents. UV spectroscopy cannot determine the specific fatty acid composition but gives useful preliminary information on the oxidation status and chromophoric substances of vegetable oils. Spectroscopic comparison is a useful initial analytical approach for plant growth because environmental pollution, particularly industrial emissions, can affect oxidative degradation of unsaturated lipids. This work provides a reliable laboratory protocol for future quantitative characterisation by gas chromatography with flame ionisation detection (GC-FID) or gas chromatography-mass spectrometry (GC-MS). This study adds to the knowledge of environmental factors influencing watermelon seed oil quality and serves as a basis for a complete fatty acid profile.

Keywords: Watermelon seed oil, *Citrullus lanatus*, Cucurbitaceae, Soxhlet extraction, UV–Visible spectroscopy, vegetable oil, arid zone, industrial zone.

1.Introduction

Watermelon (*Citrullus lanatus*) is one of the most economically important fruit crops in tropical and subtropical regions. Although the fruit is widely consumed for its edible pulp, seeds are a valuable agricultural resource with high protein and oil content. The watermelon seed oil is a rich source of essential fatty acids such as linoleic, oleic, palmitic and stearic acids and these are useful in nutritional, pharmaceutical and industrial uses. Climatic conditions, soil characteristics, irrigation practices and environmental pollution are the major factors affecting seed oil quality. Plants in arid environments are often subjected to drought stress, high temperature and increased solar radiation while those in the vicinity of industrial areas may be exposed to airborne pollutants, heavy metals and other contaminants. These environmental factors are able to alter lipid metabolism and induce modifications in fatty acid biosynthesis and oxidative stability.

Vegetable oils have attracted considerable scientific attention due to their importance as renewable sources of edible oils, bioactive compounds and industrial raw materials. The increasing demand for healthy edible oils has motivated researchers to explore non-conventional oilseed crops. The watermelon seed contains about 25–45 % oil, depending on the cultivar and the environmental conditions.

Soxhlet extraction is generally used for extraction of vegetable oils due to its simplicity, reproducibility and high efficiency of extraction. Solvent removal and purification are required after extraction before analytical characterisation. UV-Vis spectroscopy is a fast and non-destructive technique for the initial evaluation of oil quality by detection of conjugated dienes, trienes and oxidation products that are formed during storage or environmental stress.

The present work describes the laboratory extraction of watermelon seed oil followed by purification and qualitative UV-Visible characterisation as an initial step toward comparative evaluation of oils obtained from arid and industrial regions.

2. Methods and Materials

2.1 Collection of Samples

Matured watermelon fruits were collected from cultivated fields in two contrasting environmental conditions, an arid agricultural region, and an industrially influenced region. Healthy, disease free and physically sound fruits were selected. Seeds were separated from fruits by hand, washed thoroughly with distilled water and air dried at room temperature. The dried seeds were oven dried to constant weight at about 50 °C to minimise the moisture content. Dry seeds were cleaned and powdered finely in laboratory grinder and stored in air tight polyethylene containers till extraction.

2.2 Soxhlet Extraction

Accurately weighted about 25-50 g powdered watermelon seed sample and it was transferred into a cellulose extraction thimble. The thimble was placed in a Soxhlet extractor coupled to a round bottom flask holding petroleum ether (boiling range 40-60°C). The extraction assembly was equipped with a water-cooled condenser and heated with an electric heating mantle.

Continuous extraction was done for about 6–8 h until the solvent circulating through the extractor became colourless indicating complete extraction of oil. The non-polar lipid components were extracted from the powdered seed material by dissolution in petroleum ether and repeated solvent cycles were used to ensure efficient recovery of oil.

2.3 Recovery of Solvent

After extraction the seed oil dissolved in the solvent was passed to a distillation arrangement. Petroleum ether was recovered by controlled heating at atmospheric pressure. The distilled solvent was collected for reuse and crude watermelon seed oil remained in the distillation flask. The extracted oil was cooled at room temperature and further purified.

2.4 Separation of Liquid–Liquid

The crude oil obtained after solvent recovery sometimes contained traces of moisture and suspended impurities. The purification was carried out in a glass separating funnel. Appropriate washing procedures were used to remove polar impurities without disturbing the integrity of the oil phase. After complete phase separation, the lower aqueous layer was removed and the purified oil was collected in clean amber glass bottles and stored under refrigeration until spectroscopic analysis

2.5 UV Visible Spectroscopy

Qualitative spectroscopic analysis was carried out using UV-Visible spectrophotometer. The purified watermelon seed oil was prepared at appropriate dilutions in spectroscopic grade solvent. Spectral measurements were carried out in quartz cuvettes of 1 cm path length.

The absorption spectrum was recorded in the wavelength region 200-350 nm. The instrument was calibrated with solvent blank before sample analysis. The absorbance was measured over the wavelength range to identify the characteristic ultraviolet absorption behaviour of naturally occurring chromophoric compounds.

3. Qualitative Analysis of the UV Spectrum

The UV-Visible spectrum of watermelon seed oil exhibited strong absorption in the lower ultraviolet region (about 205–260 nm). Outside this region the absorbance decreased quickly around 265–270 nm, and then there was a broad absorption feature around 285–295 nm before the absorbance slowly decreased toward 335 nm. The strong absorption below 260 nm may be due to electronic transitions of unsaturated molecular frameworks and naturally occurring minor constituents of vegetable oils. The broad shoulder at 285–295 nm suggests the possible presence of conjugated oxidation products, tocopherols or other naturally occurring chromophoric compounds.

The lack of several sharp peaks indicates that the extracted oil consists mainly of lipid molecules with broad electronic absorption instead of discrete aromatic compounds. The gradual decrease of absorbance beyond 300 nm is consistent with the behaviour expected for edible vegetable oils. Although UV spectroscopy cannot differentiate individual fatty acids, the spectral profile obtained is useful in providing qualitative information regarding molecular unsaturation and oxidative state.

4. Possible trends of oxidation and unsaturation

Environmental factors on lipid biosynthesis and oxidative stability of oilseed crops Plants grown under dry conditions typically have higher levels of unsaturated fatty acids in an effort to preserve membrane fluidity under drought stress. In contrast, industrial pollution may raise oxidative stress due to exposure to air pollutants and heavy metals.

Oxidative degradation of unsaturated fatty acids produces conjugated dienes and secondary oxidation products absorbing ultraviolet radiation. Therefore, UV spectroscopy has been widely used as a rapid screening technique to evaluate oxidative changes in edible oils.

The broad absorption feature around 290 nm may be a marker of oxidation associated chromophores generated during natural metabolism or storage. However, confirmation necessitates complementary analytical techniques, such as determination of peroxide value, Fourier Transform Infrared spectroscopy (FTIR), gas chromatography-mass spectrometry (GC-MS), gas chromatography-flame ionisation detection (GC-FID) or high performance liquid chromatography (HPLC).

The laboratory methodology presented in this study provides a reproducible protocol for the extraction and purification of watermelon seed oil for future quantitative analysis of fatty acids.

5. CONCLUDING

In the present investigation, an efficient laboratory protocol for extraction, purification and preliminary characterisation of watermelon seed oil was developed using Soxhlet extraction, solvent recovery, liquid–liquid separation and UV–Visible spectroscopy. The qualitative picture of the ultraviolet absorption is indicative of unsaturated components of lipids and naturally occurring chromophoric compounds typical of vegetable oils. UV spectroscopy is a rapid screening technique for assessing oil quality and potential oxidation behaviour. However, determination of the fatty acid composition requires chromatographic techniques such as GC–FID or GC–MS. Further investigations should combine chromatographic analysis with physicochemical parameters and statistical evaluation to establish all the differences between oils obtained from arid and industrial environments. Such studies will provide information on the influence of environmental factors on the nutritional quality and stability of watermelon seed oil.

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