

Conventional and Non-Conventional Methods for Extraction of Bioactive Compounds for Antioxidant Evaluation from Small Molecules in Plants, Food and Chemical Samples

Preeti Kaushik

Research Scholar

University Institute of Engineering and Technology

MDU Rohtak, India

Abstract: The objective of this paper is to state different extraction methods for extraction of bioactive compounds to assess their antioxidant properties. Conventional methods such as Maceration, Soxhlet extraction, Solvent extraction and Non-Conventional methods such as Ultrasound, Microwave assisted and Super critical fluid extraction methods and their advantages and disadvantages have been discussed.

1. INTRODUCTION

A lot of research has been done in the area of determination of Antioxidant and their effectiveness related to Reactive Oxygen species, because reactive species are involved in various number of biochemical processes. Antioxidant which are effective against scavenging activity of OH, playing very important role for human body. Therefore, it ignites the zeal to search for the new methods to give a reliable determination of Antioxidants. Nonconventional method involves different techniques for the determination of antioxidant activity. Among these methods are chemical method which are based on scavenging activity of antioxidants against free radicals like 1,1-DPPH[1] or 2,2'-Azinobis cation radical (ABTS)[2] and electrochemical assay which determine the total antioxidant power includes method such as insitu electrochemically generated superoxide anion radical[3] or Bromide[4]. However, because results in the measurement of antioxidant capacity depend on the method used, a single method cannot give an accurate prediction of antioxidant capacity of antioxidant compounds[5,6]. It is advised to make use of more than one method to estimate the invitro antioxidant capacity of substance materials extracts because of the complex nature of reactive chemical species[7].

2. CONVENTIONAL METHODS OF EXTRACTION

2.1 SOLVENT EXTRACTION

A widely accepted method by most researcher to extract phenolic and antioxidant. Soluble compounds are separated by this process by diffusion from a single matrix using a liquid matrix aiming to concentrate antioxidant from raw material [8].

2.2 MACERATION

A widely adopted used in medicinal research for antioxidant extraction from medicinal plant. Plant material is soaked (coarse or powdered) in a stoppered container with a solvent and let it stand at room temperature for a period of minimum 3 days with

continual agitation [9]. The process includes softening and breaking the plant's cell wall to release the soluble phytochemicals. In this conventional method, transfer of heat through convection and conduction and the choice of solvents will determine the type of compound extrication from the samples [10].

3. NON-CONVENTIONAL METHODS

3.1 Microwave –assisted extraction method

Microwave assisted extraction has the advantage over other extraction method and has been proved to be an efficient technique. Extension of MAE method was done to extract a variety of volatile and non-volatile compounds from different samples.

3.1.1 OPERATING PRINCIPLE

Basic principle of MAE is the use of microwave energy. Frequency from 300 to 3000 MHz is used for the operation to cause molecular motion by ionic conduction and dipole rotation. Resistance offered by the solution to the flow of ion causes friction and results in the heating up of solution.

Penetration of Microwave energy through a sample, led to absorption of energy by the sample at a rate dependent upon its dissipation factor. [11]

3.1.2 INSTRUMENTATION AND DIFFERENT PARAMETERS OF OPERATION

Microwave extraction device equipped with a temperature monitor and microprocessor programmer software to control operation parameter is used for MAE Extraction. Six major components make up a microwave instrument: -Microwave generator, wave guide, Microwave cavity, Mode stirrer, circulator and turntables. Magnetron produces the microwave energy and directs the wave guide into micro wave cavity.

Microwave extraction is done in two ways:-

- Extraction in closed vessel (under controlled pressure and temperature) of antioxidants in open vessel under atmospheric pressure. Nature of both solvent and solid matrix strongly determines the efficiency of extraction.
- Temperature and microwave power are important parameter, which ensures the efficiency and selectivity of extraction ,viscosity and surface tension of solvent reduce at high temperature which improves the diffusivity into sample matrix.100-200°C extraction temperature is maintained for the extraction of bioactive organic compounds from plant and food material in closed vessels.
- To avoid degradation of thermo labile compound, Microwave power is critical.

3.1.3 ADVANTAGES

- Efficient extraction of antioxidants.
- Extraction time is reduced from more than an hour (in conventional method) to time of 10 or 20 min for optimal recovery of analytes from plant and food sample matrices.
- Chances of degradation of bioactive compounds reduces significantly.
- It uses less solvent than conventional method such as soxhlet extraction.

3.2 ULTRASOUND ASSISTED EXTRACTION

3.2.1 OPERATING PRINCIPLE

UV extraction works on a principle to increase the mechanical effect to increase the mechanical effect which ultimately leads to increase the mass transfer and penetration of solvent into sample matrix [11].

3.2.2 INSTRUMENTATION AND DIFFERENT PARAMETERS OF OPERATION

UV bath or ultrasonic cleaner coupled with rolled heating using a cooling coil which is connected with a cooling chiller system and a water pump is used for the extraction, to maintain the temperature across the ultrasonic water bath.

- Extraction parameter such as solvent concentration, solvent/material ratio, temperature, extraction time and ultrasound power, significantly effect UAE extraction efficiency.
- Response surface methodology is a commonly used tool for parameter extraction optimization. RSM is an effectual mathematical and statistical tool which is based on fit of polynomial equation to experimental data [12]. RSM analyses effect of independent parameter as well as interaction of several parameter.

3.2.3 ADVANTAGES

- It is an effectual and nature friendly extraction method.
- It is an economic effortless process with a large scale application to industrial application to industrial production.[12]

3.3 SUPER CRITICAL FLUID EXTRACTION METHOD

SUPER FLUID is a substance that allocates the physical properties of both gas and liquid at its critical point. CO₂ is an excellent example of super fluid and behave like gas but also has solvating characteristics of liquid. CO₂ is used in extraction owing to excellent solvent for non-polar analytes and has low cost toxicity.

4. CONCLUSION

Conventional methods have major applicability in extraction of antioxidants from medicinal plants and foods from many years and also dominate in present of scenario for the extraction but owing to more advantages offered by Non –Conventional techniques in reduction of time in extraction and increase in quantity of extraction, pointing towards the replacement of old conventional methods by non-conventional method.

5. REFERENCES

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