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Preparation and Characterisation of Aqueous Solution Vs Methonolic Extract of Annona Muriciata.

Dr. N.S. Shree Abiraami [1], Devika S Pillai [2]

[1] Post graduate, Department of oral medicine and radiology, Saveetha dental college and hospital, Saveetha Institute of Medical and Technical science (SIMATS), Saveetha university, Chennai, India

[2] Senior Lecturer, Department of Oral Medicine, Radiology, and Special Care Dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS) Saveetha University, Chennai, IND

Abstract

Soursop (Annona muricata), a tropical plant known for its health-promoting properties, contains numerous bioactive compounds that contribute to its traditional use in anticancer, anti-inflammatory, and antibacterial treatments. Scientific efforts have focused on validating these traditional applications and understanding the bioactive compounds' mechanisms. This study compares aqueous and methanolic extraction methods to determine their effectiveness in isolating these compounds. Methanolic extraction, which often yields a wider variety of bioactive compounds, was found to be more efficient and eco-friendly than aqueous extraction. Using UV-Vis Spectroscopy and FTIR, various phytochemicals were identified in the extracts. The methanolic extract showed a richer profile with more functional groups such as polyphenols, amides, inorganic carbonate, SiO2, and aromatics, and higher concentrations of alkaloids, flavonoids, and phenolics. In contrast, the aqueous extract contained fewer functional groups but exhibited strong antioxidant properties. These findings suggest that while the methanolic extract may have more therapeutic potential due to its diverse bioactive content, the antioxidant properties of the aqueous extract also have valuable medicinal applications. Further investigation is needed to fully understand the health benefits of these extracts.

Categories: Dentistry, Oral Medicine, Therapeutics

Keywords: health, plants, biomedical applications, antioxidant, antimicrobial, Soursop, Annona Muricate

Introduction

Annona muricata, commonly known as soursop or graviola, is a tropical fruit-bearing tree belonging to the Annonaceae family. This plant has gained significant attention in the scientific community due to its rich content of bioactive compounds, which are associated with various health benefits [1]. Traditional medicine has utilized different parts of the Annona muricata plant, such as the leaves, fruit, seeds, and bark, for their purported therapeutic properties, including anticancer, anti-inflammatory, and antimicrobial effects [2]. The potential of Annona muricata in treating various ailments has prompted extensive research to validate these traditional claims and to understand the underlying mechanisms of its bioactivity.

The process of extracting bioactive compounds from plant materials is a crucial step in the development of herbal medicines. The choice of solvent for extraction plays a pivotal role in determining the efficiency of extraction and the types of compounds obtained. Aqueous extraction, which uses water as the solvent, is often preferred for its safety, environmental friendliness, and cost-effectiveness [3]. On the other hand, methanolic extraction, using methanol as the solvent, is known for its ability to extract a broader spectrum of bioactive compounds due to the solvent's polarity [4]. Understanding the differences in the phytochemical profiles and therapeutic potential of aqueous versus methanolic extracts of Annona muricata can provide valuable insights for their application in natural product-based drug development.

Studies have shown that Annona muricata extracts contain a variety of bioactive compounds, including alkaloids, flavonoids, phenolics, and acetogenins, which contribute to its medicinal properties [5]. These compounds have been reported to exhibit significant biological activities, such as antioxidant, anticancer, and antimicrobial effects [6]. The efficacy of these extracts can vary depending on the solvent used for extraction. For instance, methanolic extracts of Annona muricata have been found to contain higher concentrations of certain bioactive compounds compared to aqueous extracts, potentially enhancing their therapeutic efficacy [7].

The characterization of plant extracts involves identifying and quantifying the bioactive compounds present in the extracts. Techniques such as UV-Visual spectroscopy, High-Performance Liquid Chromatography (HPLC), and Gas Chromatography-Mass Spectrometry (GC-MS) are commonly used for this purpose [8]. UV-Visual spectroscopy is useful for determining the presence of specific phytochemicals by measuring their absorbance at different wavelengths [9]. HPLC and GC-MS provide more detailed information on the chemical composition of the extracts, enabling the identification of individual compounds and their concentrations [10].

The current study aims to compare the preparation and characterization of aqueous and methanolic extracts of Annona muricata. By employing standardized extraction methods and advanced analytical techniques, this research seeks to elucidate the differences in the phytochemical profiles and potential therapeutic applications of these extracts. The findings of this study will contribute to the growing body of knowledge on the medicinal potential of Annona muricata and guide future research in the development of natural product-based therapeutics.

Objective

The aim of this study is to assess and contrast the efficacy of various solvent extraction techniques, notably aqueous and methanolic extractions, in isolating bioactive components from Annona muricata (soursop). The study intends to establish the therapeutic potential and medicinal applications of the plant's extracts by analysing their phytochemical profiles and functional groups using UV-Vis Spectroscopy and FTIR. This study aims to investigate the impact of solvent selection on the extraction efficiency and the range of bioactive chemicals recovered, thereby contributing to the advancement of herbal medicine development.

Materials And Methods

Collection and Preparation of Annona muricata Extract

The leaves of Annona muricata, commonly known as soursop, were collected and prepared with meticulous care to ensure the purity and efficacy of the extracts. Initially, the leaves were extensively washed with distilled water to remove any external impurities such as dust, dirt, and potential pollutants. This thorough washing process is crucial to avoid any contamination that might interfere with the subsequent extraction and analysis of bioactive compounds.

After washing, the leaves were naturally dried at room temperature. This method of air drying was chosen to preserve the integrity of the bioactive compounds, as excessive heat can degrade these sensitive molecules. The drying process continued until the leaves were completely desiccated. Following this, the dried leaves were ground into a fine powder using a hybrid grinder. The grinding process increases the surface area of the plant material, thereby enhancing the efficiency of the extraction process.

To prepare the aqueous extract, 5 grams of the powdered leaves were mixed with 100 mL of distilled water. This mixture was then subjected to autoclaving. Autoclaving, which involves using high-pressure saturated steam at elevated temperatures, ensures the comprehensive extraction of bioactive components from the plant material. The high temperature and pressure facilitate the breakdown of plant cell walls, releasing the phytochemicals into the solution.

After autoclaving, the solution was filtered through Whatman No. 1 filter paper to remove any remaining solid particles. Filtration is a critical step to ensure that the extract is free from any particulate matter that could interfere with subsequent analyses. The clear filtrate was then stored at a temperature of 4°C to preserve its stability and prevent any microbial growth before further examination and characterization (Figure 1).

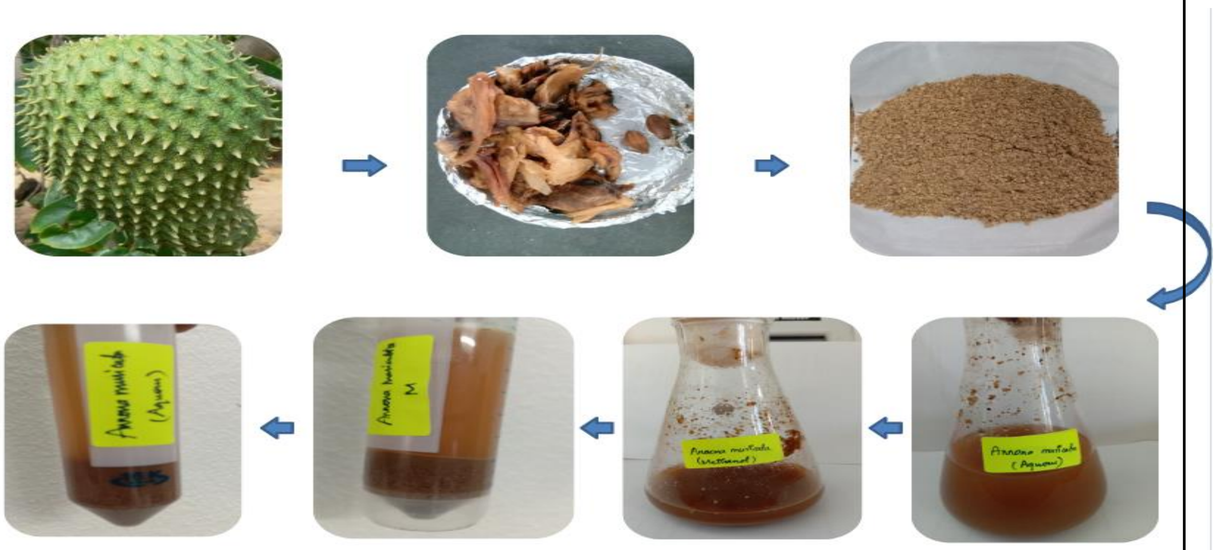
Methods for Characterisation

UV-Visible Spectroscopy

To analyze the optical properties of the aqueous and methanolic extracts of Annona muricata, UV-Visible spectroscopy was employed. This technique is highly effective in detecting and measuring different phytochemicals present in the extracts. The experiment was conducted using a Thermo Scientific Evolution 600 UV-Vis spectrophotometer, equipped with 1 cm quartz cuvettes. The absorbance spectra were recorded over a wavelength range of 200-800 nm. This range encompasses the absorption maxima of various phytochemicals, allowing for their identification and quantification based on their specific absorbance characteristics. UV-Visible spectroscopy provides a rapid and non-destructive means to analyze the phytochemical composition of plant extracts, making it an essential tool in the characterization process.

Fourier Transform Infrared (FTIR) Spectroscopy

Fourier Transform Infrared (FTIR) spectroscopy was used to identify the functional groups and biomolecules present in the Annona muricata extracts. These functional groups and biomolecules play crucial roles as capping, reducing, and stabilizing agents in various biochemical processes. The FTIR spectra were obtained using a Bruker FTIR spectrophotometer, covering a broad wavelength range of 4000-400 cm^{-1}. This range includes the characteristic absorption bands of numerous functional groups, such as hydroxyl, carbonyl, and amine groups. By analysing the FTIR spectra, the presence and nature of these functional groups in the extracts can be determined. FTIR spectroscopy provides detailed information about the molecular composition of the extracts, which is essential for understanding their bioactive properties.



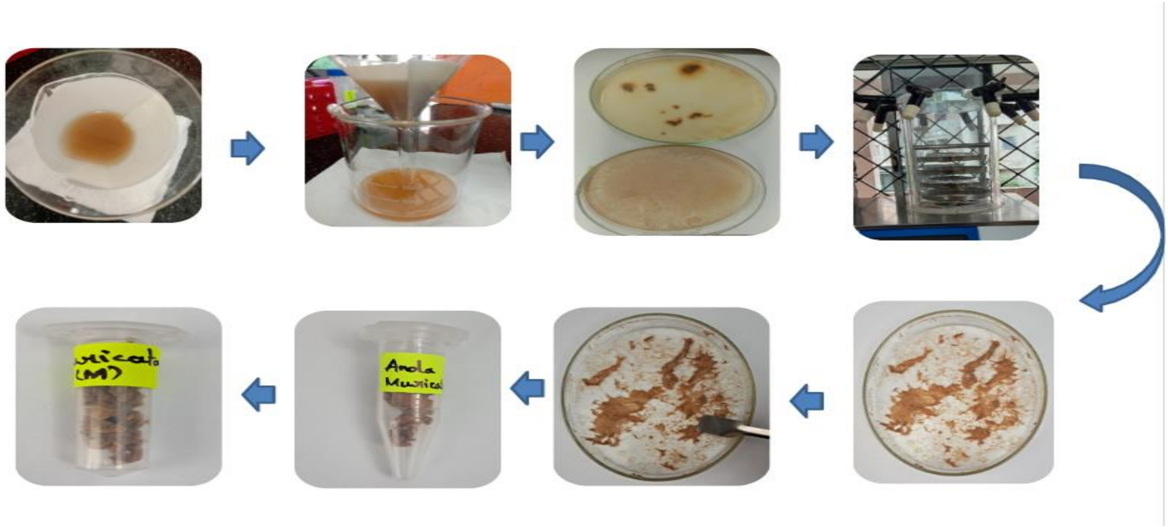


Figure 1 Shows extraction of Annona Muricata

Results

Ultraviolet-visible (UV-Vis) Spectroscopy

Aqueous Extract

The UV-Vis spectra of the aqueous extract of Annona muricata exhibit prominent absorbance peaks at approximately 320 nm and 350 nm. These peaks suggest the existence of phytochemicals. The conspicuous peak at a wavelength of 350 nm provides evidence of the existence of phytochemicals from the Annona muricata plant, which exhibit distinct absorbance properties within this specific range.

Methanolic Extract

The methanolic extract of Annona muricata has notable absorbance peaks at approximately 320 nm and 350 nm in its UV-Vis spectra, which are comparable to those observed in the aqueous extract. The presence of phytochemicals in the methanolic extract is confirmed by the prominent peak at 350 nm, which further supports the occurrence of Annona muricata phytochemicals. (Figure 2)

FT-IR Spectroscopy

FT-IR spectroscopy was employed to examine the functional groups found in the aqueous and methanolic extracts of Annona muricata.

Aqueous Extract

The FT-IR spectra of the aqueous extract exhibited two prominent peaks at 3330.21 cm^{-1} and 1636.37 cm^{-1}. The peaks observed in the spectrum correspond to the polyphenols group and amide groups, respectively, indicating the existence of these functional groups in the aqueous extract.

Methanolic Extract

The FT-IR spectra of the methanolic extract exhibited four distinct peaks at 3321.06 cm^{-1}, 1642.03 cm^{-1}, 1407.32 cm^{-1}, and 1015.24 cm^{-1}, as well as an extra peak at 643.22 cm^{-1}. These summits are representative of: 3321.06 cm^{-1} is Polyphenols group. 1642.03 cm^{-1} is Amide groups. 1407.32 cm^{-1} is Inorganic carbonate compound. 1015.24 cm^{-} is SiO_2 group .643.22 cm^{-1} is Aromatic group.

The methanolic extract exhibits a wider array of functional groups in comparison to the aqueous extract, emphasizing the heterogeneous phytochemical content of the methanolic extract.(Figure 3)

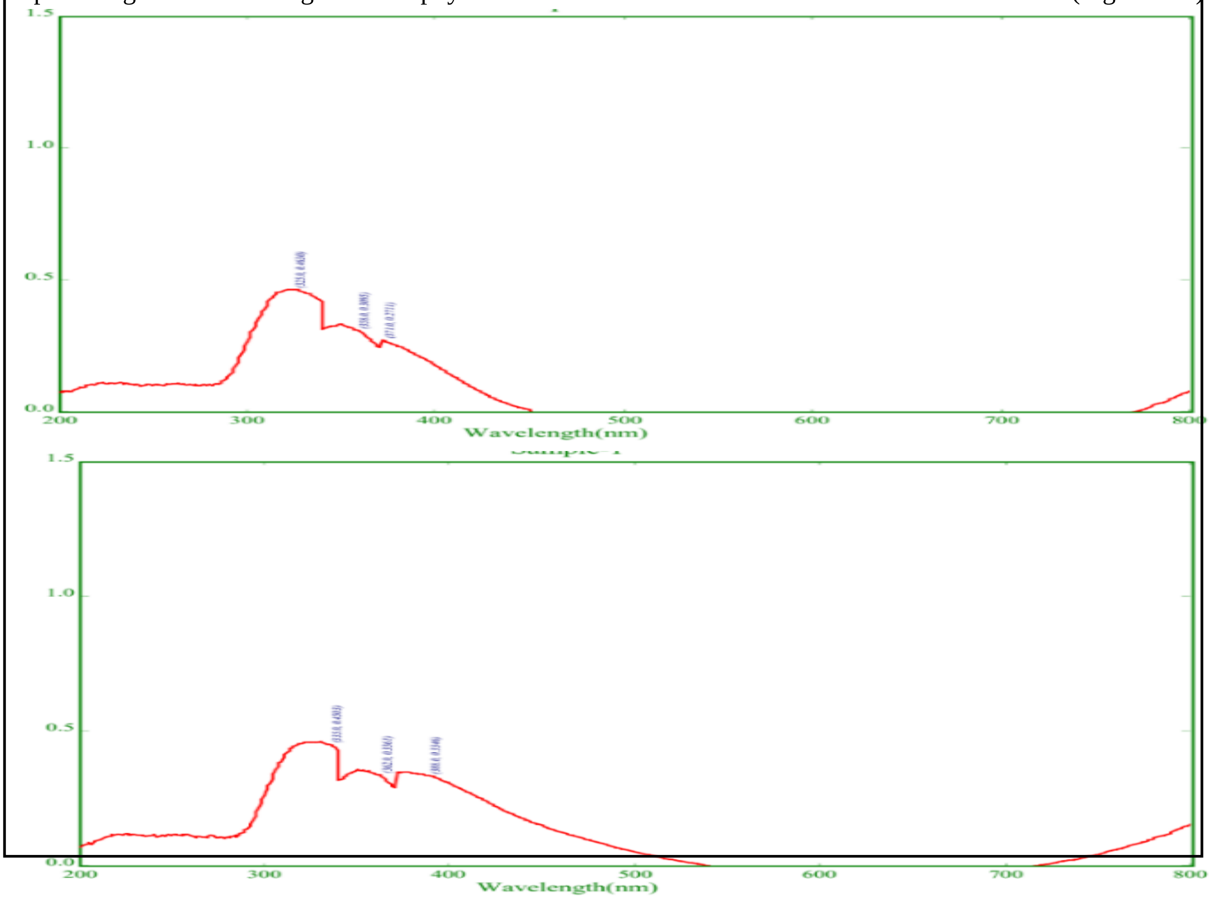


Figure 2: UV-Visible spectroscopy

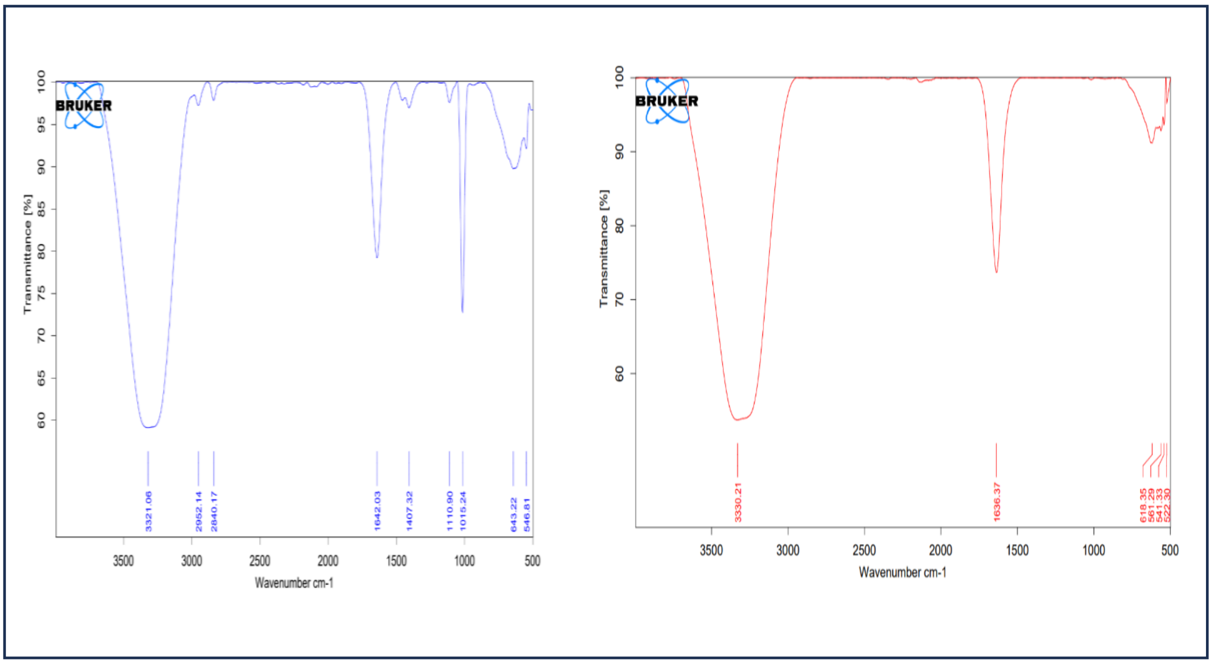


Figure 3: Fourier transform infrared spectroscopy examination

Discussion

The traditional medicinal plant Annona muricata, which is also known as Graviola or soursop, has attracted significant interest as an alternative medication due to its extensive therapeutic properties. Annona muricata has been utilised for the purpose of maintaining overall health in the past; however, recent research has concentrated on its potential for cancer treatment [11]. In the leaves of A. muricata, a variety of biologically active components have been identified, which have demonstrated efficacy against a variety of conditions, such as cancer, inflammatory arthritis, diabetes, hypertension, and parasitic infections [12].

Annona muricata has been discovered to inhibit the development of cancer cells and induce apoptosis, which is the process of programmed cell death. Chemotherapy is the primary treatment for cancer, which continues to be the most common cause of mortality in Western countries [13][14]. Although chemotherapy has the potential to be effective, it also carries substantial risks due to the destruction or damage of healthy cells. Consequently, there is an urgent requirement for novel therapeutic strategies that are not only effective but also non-toxic, targeted, and cost-effective for patients [15].

Annona muricata's potential as a cancer treatment is derived from its capacity to selectively target cancer cells while preserving healthy ones. This selectivity diminishes the probability of adverse effects that are frequently linked to conventional chemotherapy. The cytotoxic effects of the plant's bioactive compounds, including acetogenins, have been the subject of extensive research on a variety of cancer cell lines. These compounds function by impeding the production of energy in cancer cells, which in turn induces apoptosis and prevents the proliferation of cancer cells [16].

In addition to its anticancer properties, Annona muricata demonstrates anti-inflammatory, antidiabetic, antihypertensive, and antiparasitic properties [17]. The plant's anti-inflammatory properties render it a potential treatment for inflammatory arthritis, a condition that is defined by chronic inflammation of the joints. The plant's potential for managing diabetes and hypertension is underscored by its capacity to modulate blood sugar levels and blood pressure [18]. Additionally, the antiparasitic properties of Annona muricata render it an effective treatment for parasite-induced infections, which are prevalent in tropical and subtropical regions where the plant is prevalent.

Further research is required to gain a comprehensive understanding of the effects of Annona muricata, despite its promising therapeutic potential. Studies must be conducted to ascertain the appropriate dosage, long-term safety, and potential adverse effects of the plant's extracts and isolated compounds [20]. Although preliminary research has yielded favourable outcomes, it is imperative to conduct thorough clinical trials in order to verify these discoveries and establish consistent treatment protocols [21].

The variability in the concentration of bioactive compounds is one of the primary obstacles to the use of Annona muricata as a cancer treatment. The concentrations of these compounds can fluctuate as a result of a variety of factors, such as the plant's growing conditions, the portion of the plant that is utilised, and the extraction method. In order to guarantee consistent and dependable therapeutic results, it is essential to standardise the extraction and formulation processes [22].

Furthermore, it is essential to comprehend the mechanisms of action of Annona muricata's bioactive compounds in order to optimise its application in cancer treatment. Acetogenins have been demonstrated to inhibit the production of adenosine triphosphate (ATP) in cancer cells, a process that is crucial for their energy supply, according to research. This inhibition results in the depletion of energy in cancer cells, which in turn induces apoptosis. Nevertheless, additional research is required to elucidate the intricate molecular pathways and to identify any potential interactions with other treatments [23][24].

Another critical aspect that necessitates comprehensive investigation is the safety profile of Annona muricata. Although the plant has been traditionally employed to treat a variety of maladies, there is a lack of comprehensive research on its long-term safety in humans [25]. Some studies have reported potential neurotoxic effects associated with the consumption of Annona muricata, particularly with protracted use or high doses. Consequently, it is imperative to implement comprehensive safety evaluations to guarantee that the advantages of the facility outweigh any potential hazards.
Moreover, the therapeutic efficacy of Annona muricata could be improved by investigating its synergistic effects with other conventional and alternative treatments. The integration of the plant's bioactive compounds with current cancer therapies has the potential to enhance treatment outcomes and mitigate the adverse effects of chemotherapy. This integrative approach has the potential to result in the creation of more comprehensive and effective cancer treatment strategies [26].

In summary, Annona muricata's diverse therapeutic properties make it a promising alternative treatment for cancer and a variety of other conditions [27][28]. Nevertheless, it is imperative to conduct a comprehensive investigation to determine its safety, efficacy, and standardisation. The full potential of this traditional medicinal plant can be fully realised by identifying the appropriate dosage, comprehending the mechanisms of action, and ensuring long-term safety [29][30]. Annona muricata has the potential to become a valuable addition to the current arsenal of remedies for cancer and other chronic diseases as research advances. It provides patients with a targeted, non-toxic, and affordable therapeutic option.

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