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RESEARCH ARTICLE

Quality of bay leaf extract *(Syzygium polyanthum)* using various solvents as natural preservative in jerky

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ABSTRACT

Sustainable food preservation is essential in strengthening food security in the agro-complex sector. Bay leaves *(Syzygium polyanthum)* are a local spice from Indonesia that contains bioactive compounds, including flavonoids and eugenol, with potent antioxidant and antimicrobial activities. This study aims to evaluate the quality of bay leaf extract using different solvents to determine the most effective solvent for developing natural preservatives for beef jerky products. The experiment used a completely randomized design (CRD) with five solvent treatments: distilled water (T1), methanol (T2), ethanol (T3), petroleum ether (T4), and n-hexane (T5). The parameters tested in this study were Total Dissolved Solids (TDS), pH, color value (L*a*b*), and Fourier Transform Infrared Spectroscopy (FTIR). The results showed that the type of solvent had a significant effect ($p<0.01$) on all parameters. Ethanol produced extracts with the highest TDS value (942.75±35.2 mg/L), slightly acidic pH (6.40±0.42), and the lightest color intensity (L*=39.98 ±1.85). The yellowness value (b* = 4.14 ± 0.49) also indicated higher concentrations of flavonoids and other phenolic compounds. FTIR analysis confirmed the presence of hydroxyl (3231 cm^{-1}) and aromatic (1650 cm^{-1}) functional group peaks in the ethanol extract, indicating its superior ability to extract antioxidant-rich compounds. In addition, a more explicit spectral definition in the fingerprint region further indicates a richer bioactive molecular composition compared to other solvents. This study concludes that ethanol is the most efficient solvent for producing high-quality bay leaf extracts, with excellent potential as natural preservatives to improve oxidative stability and extend the shelf life of beef jerky. This study provides valuable insight into the development of preservation systems using natural ingredients, especially for meat products that require safer, more sustainable preservation methods. This innovation supports sustainable food processing and promotes safer preservation practices, contributing to achieving national food security by using local biological resources.

1. INTRODUCTION

Food safety is a fundamental aspect of public health because unsafe food systems can generate biological, chemical, and nutritional risks, while a food systems approach is needed to support safer, healthier, and more sustainable food supply chains (Alarcon et al., 2021). Meat products are considered high-risk foods due to their high nutrient content, which makes them highly susceptible to lipid oxidation and microbial contamination, leading to quality deterioration and potential food safety risks for consumers (Domínguez et al., 2019). The food industry often uses synthetic preservatives such as nitrites, sorbates, and benzoates to inhibit spoilage. However, the use of synthetic food preservatives has raised concerns due to potential adverse health effects associated with long-term consumption, including toxicological risks and possible associations with chronic diseases, leading to increased interest in natural alternatives for food preservation (Sambu et al., 2022; Shi et al., 2024). Therefore, it is necessary to develop safe, effective, and environmentally friendly natural preservation innovations as part of the implementation of green food processing in modern food production systems.

Dendeng is a dried meat product that has a longer shelf life due to its low water content. The grinding process during dendeng production allows for more even absorption of spices, resulting in better taste and texture. However, ground dendeng is susceptible to fat oxidation during processing. The drying and heating processes increase the formation of malondialdehyde (MDA), leading to rancidity, reduced nutritional value, and a decline in sensory quality. Fat oxidation is one of the leading causes of damage to dendeng, and the use of natural preservatives is necessary to inhibit oxidative reactions (Febriana et al., 2025).

Bay leaves *(Syzygium polyanthum)* are aromatic medicinal plants containing various bioactive compounds, particularly phenolic compounds, flavonoids, tannins, and essential oils such as eugenol. These phytochemical constituents have been reported to exhibit antioxidant and antimicrobial activities, indicating their potential as natural agents for food preservation applications (Hartanti et al., 2019; Uddin et al., 2022). These bioactive compounds exhibit antioxidant and antimicrobial properties that can inhibit the growth of foodborne pathogens such as Staphylococcus aureus and Escherichia coli, while also slowing lipid oxidation processes in meat-based products through radical scavenging mechanisms (Shahidi and Ambigaipalan, 2015). Ethanolic extracts of *Syzygium polyanthum l*eaves have been reported to contain high levels of bioactive compounds such as flavonoids and phenolics, which contribute to strong antioxidant activity and potential inhibition of lipid oxidation in food systems (Hidayati et al., 2017).

Research on the effectiveness of solvents for extracting bioactive compounds from bay leaves for use in food products remains minimal. Previous studies have mainly focused on phytochemical screening and general antioxidant activity of plant extracts, while limited attention has been given to how solvent polarity influences the extraction yield, phytochemical composition, and bioactivity of plant extracts, which are important parameters in food safety applications (Alara et al., 2021; Tourabi et al., 2023). Solvent polarity plays a crucial role in determining the efficiency of phytochemical extraction, influencing the yield and composition of bioactive compounds such as phenolics and flavonoids, which in turn affect the antioxidant and antimicrobial potential of plant extracts (Alara et al., 2021).

The bioactivity of bay leaves has been extensively studied to date, but research comparing the effectiveness of various solvents in extracting functional compounds from bay leaves for application in bay leaves is very limited. Previous studies have reported general antioxidant capabilities but have not examined the effect of polarity on the physicochemical quality of extracts or their effects in food products (Nawaz et al., 2020). There has been no research that details TDS, pH, color characteristics, and FTIR, even though these parameters determine the stability of the extract, its suitability in the meat matrix, and its antioxidant capacity. This study is necessary to evaluate the types of solvents used and identify the optimal solvent for beef jerky applications. This research is important because the proper solvent will improve extraction efficiency, maximize the recovery of phenolic compounds, and produce stable extracts that are safe for use as natural preservatives in meat products, thereby reducing the use of synthetic substances in the meat industry.

This study aims to evaluate the quality of bay leaf extract produced with various types of solvents in determining the most effective solvent in producing extracts that have the most potential as natural preservatives in dendeng products based on the parameters of Total Dissolved Solids (TDS), pH, color values (L* = lightness, a* = redness-greenness, b* = yellowness-blueness), and Fourier Transform Infrared Spectroscopy (FTIR) parameters. This research will also provide a scientific basis for the development of safe, sustainable, and efficient natural preservative technology in the food industry. Overall, this research provides new insights by integrating phytochemical analysis and FTIR to determine the optimal solvent for extracting high quality compounds from bay leaves. This topic has not been studied in depth and comprehensively in previous research.

2. MATERIALS AND METHODS

2.1. Materials

This study used bay leaf powder *(Syzygium polyanthum)* as the main ingredient in the extraction process, purchased from an e-commerce site under the brand Naturlife (Indonesia). The solvents used were distilled water, methanol, 70% ethanol, petroleum ether, and n-hexane (analytical grade, Merck®). Other materials needed included Whatman No. 1 filter paper, which was obtained from the Krida Tama Persada Laboratory Store in Malang.

2.2. Methods

The study used laboratory experiments with a completely randomized design (CRD) and five solvents: distilled water (T1), methanol (T2), 70% ethanol (T3), petroleum ether (T4), and n-hexane (T5), with four replicates per treatment. The selection of solvents with different polarities used the latest extraction method for bioactive compounds found in herbal materials (Lee et al., 2024).

2.3. Extraction Procedure

Bay leaf powder was sieved using a 100-mesh sieve to obtain a uniform particle size, then weighed at 20 g for each repetition. The weighed bay leaf powder was then mixed with the solvent at a 1:10 (w/v) ratio and macerated for 24 hours at room temperature in the dark to prevent degradation of phenolic compounds. Extraction was performed using Ultrasound-Assisted Extraction (UAE) for 10 minutes with an ultrasonic cleaner. Next, the mixture was centrifuged at 4000 rpm for 15 minutes. The supernatant was filtered through Whatman No. 1 paper and concentrated using a RE-52 A rotary evaporator at 60°C under low pressure until a thick extract was obtained. The extract was stored in an Ambel vial at 4°C until further analysis.

2.4. Parameter Measurement

Total Dissolved Solids (TDS)

Previous studies have reported that high concentrations of total dissolved solids (TDS), especially above 500 mg/L, can cause gastrointestinal disturbances and reduce solution palatability (Pandey et al., 2020). In this study, the TDS content of the extract samples was measured using a digital TDS meter. Before measurement, the device was calibrated using a standard solution according to the procedure instructions to produce accurate results. The bay leaf extract samples were first diluted with distilled water at a specific ratio to prevent readings exceeding the device's detection limit. The TDS meter electrode was immersed in the sample until the displayed value stabilized. The resulting value was recorded as the TDS. TDS measurements were carried out at room temperature to prevent changes in conductivity that could affect the TDS readings.

pH Measurements

The pH value of the bay leaf extract solution was measured using a digital pH meter. Before use, the pH meter was calibrated with distilled water and pH standards at 4 and 7 to ensure accurate and stable measurements. The calibration process continued until the value displayed on the device stabilized. The electrode on the pH meter was rinsed with distilled water before and after each test to prevent contamination between samples. A total of 10 ± mL of extract solution was placed in a clean glass beaker, and the electrode was dipped until the pH reading was stable and did not change. All pH tests were conducted at room temperature to minimize temperature changes affecting pH measurements (Chua et al., 2024).

Color Measurements (L*, a*, b*)

Color testing was performed with a color reader using a CIE Lab color system-based color reader. This tool provides three main parameters, namely L*, a*, and b*. For the L* parameter, a higher value indicates a higher level of brightness, while a lower value indicates a darker color. In this study, testing focused on the L* and a* parameters. The a* value indicates the red-green color spectrum, where an increase in the a* value indicates a higher intensity of redness. Meanwhile, a decrease in the a* value indicates a tendency towards greenish colors (Ardiansyah et al., 2022).

Fourier Transform Infrared Spectroscopy (FTIR)

Functional groups were identified using FTIR spectroscopy. The extract was scanned in absorbance mode over 4000-400 cm^{-1}, at a resolution of 4 cm^{-1} using ATR (Attenuated Total Reflectance). FTIR analysis can be employed to identify functional groups in plant extracts, where characteristic absorption bands such as hydroxyl (O–H), carbonyl (C=O), and aromatic (C=C) are commonly associated with bioactive secondary metabolites including phenolics and flavonoids (Fadlelmoula et al., 2022; Pasieczna-Patkowska et al., 2025).

2.5. Data Analysis

The data obtained are analyzed using Analysis of Variance (ANOVA) to determine the effect of solvent type on bay leaf extract and the observed parameters. If significant differences among treatments are found, Duncan's Multiple Range Test (DMRT) is used to distinguish among them.

3. RESULT AND DISCUSSION

3.1 Total Dissolved Solids (TDS)

The results showed that the use of various solvents had a very significant effect on the Total Dissolved Solids (TDS) results ($p<0.01$). The average TDS is presented in Table 1.

Table 1: The average total dissolved solids (TDS) of bay leaf extracts using various solvents

Treatments	TDS (mg/L)
T1	1024.50^{c}± 16.4
T2	342.75^{a}± 10.4
T3	942.75^{c}± 35.2
T4	446.75^{b}± 32.9
T5	463.25^{b}± 24.1

Note: superscripts within the column (^{a,b,c}) represent highly significant differences ($p<0.01$).
TDS: Total Dissolved Solids

The results of the Total Dissolved Solids (TDS) parameter test indicate that the concentration of extractable phytochemicals reflects the solvent's ability to break down plant cell walls and release dissolved compounds. Ethanol produced the highest TDS value of 942.75 ± 35.2 mg/L, indicating that ethanol is a solvent with a superior polarity balance for extracting phenolic and aromatic compounds compared to water or nonpolar solvents. The intermediate polarity of ethanol enables it to solubilize a wide range of phytochemicals, including both polar and semi-polar compounds such as phenolics, flavonoids, and certain terpenoids, resulting in improved extraction efficiency and higher recovery of bioactive compounds relevant for antioxidant and preservative activity (Alara et al., 2021). This finding is supported by Dewijanti et al. (2019), who reported that ethanol extraction of *Syzygium polyanthum* leaves, particularly 70% ethanol, produced high total phenolic and flavonoid contents, with stronger antioxidant activity than 96% ethanol extract. Similarly, Aditya, (2023) found that 96% ethanol extraction of *S. polyanthum* leaves yielded measurable phenolic and flavonoid compounds, and ultrasound-assisted extraction improved total phenolic recovery and antioxidant activity. This high TDS value corresponds to a better antioxidant concentration. It can enhance the oxidative stability of meat products, which is essential for maintaining product quality and supporting sustainable food preservation systems that contribute to food security, particularly in developing and tropical regions (Lorenzo et al., 2019). Extracts obtained with ethanol solvents also exhibit the most efficient interactions with other solvents, facilitating the development of natural preservatives that can strengthen resilience in agro-food systems.

Research by Varady et al. (2022) indicates that higher TDS values are positively correlated with free radical scavenging capacity, especially in aromatic plant extracts. High TDS values in ethanol extracts indicate the solvent's ability to extract semipolar compounds, such as eugenol, conjugated flavonoids, and other phenolic derivatives, which play an important role in inhibiting the formation of malondialdehyde (MDA) in beef jerky products. This, with high TDS values, not only indicates extraction efficiency but also suggests greater potential when applied in functional foods, such as the development of natural preservatives. Lee *et al.* (2024) also stated that ethanol is a polar solvent that can dissolve various bioactive compounds, both polar and semi-nonpolar, including flavonoids, phenols, terpenoids, and several other fatty acids. The good solubility of ethanol makes it more efficient in extracting soluble compounds compared to other solvents that are too polar or nonpolar.

3.2 pH Value

The results of the study indicate that the use of various solvents has a highly significant effect on the pH results ($p<0.01$). The average pH values are presented in Table 2.

Table 2: The average pH values of bay leaf extracts using various solvents

Treatments	pH values
T1	$5.55^{a} \pm 0.45$
T2	$5.11^{a} \pm 0.53$
T3	$6.40^{b} \pm 0.42$
T4	$6.30^{b} \pm 0.37$
T5	$6.20^{ab} \pm 0.48$

Note: Superscripts within the column (^{a,b,ab}) represent highly significant differences ($p<0.01$).

The pH difference in bay leaf leaf extracts can be explained by the polarity of the solvents, which can affect the solubility of compounds in acids and bases. Polar solvents such as methanol and water tend to extract more acidic components, thereby lowering the pH. Conversely, semipolar ethanol selectively extracts phenolic compounds with minimal acid contribution, allowing the high pH to be maintained. This is in line with the opinion of Lee *et al.* (2022), who stated that methanol's higher polarity compared to ethanol, allows it to form stronger hydrogen bonds, as both a donor and an acceptor, thereby increasing the extraction of polar compounds. In addition, methanol has greater solvent power and broader solubility than water, enabling rapid, efficient, and effective extraction of bioactive compounds such as flavonoids, terpenoids, and phenolics. However, methanol must be used with caution due to its volatility and flammability. Considering the polarity of each solvent and the type of compound to be extracted, the selection of ethanol as a semipolar solvent can provide an optimal balance between pH stability and the extraction of phenolic compounds that act as antioxidants.

The study found that the pH of the ethanol extract was 6.40, compared with 5.11 for the methanol extract, a difference of 25%, indicating a significant difference in pH between the two extracts. This optimal pH helps maintain the extract's stability, increases preservation efficiency, reduces the risk of spoilage, and enables the safer application of natural extracts in food systems, thereby helping reduce dependence on synthetic preservatives.

3.3 Lightness, Redness, Yellowness (L*a*b*) color

The use of various solvents significantly affects the color of bay leaf extracts ($p<0.01$). The average L*, a*, and b* values for bay leaf extracts using various solvents are shown in Table 3.

Table 3: The average L*a*b* values of bay leaf extracts using various solvents

Treatments	Lightness (L*)	Redness (a*)	Yellowness (b*)
T1	$34.94^{c} \pm 1.64$	$-1.45^{c} \pm 0.27$	$8.09^{c} \pm 0.31$
T2	$28.10^{a} \pm 0.73$	$-1.98^{c} \pm 1.33$	$1.68^{a} \pm 0.72$
T3	$39.98^{e} \pm 1.85$	$-1.18^{c} \pm 0.44$	$4.14^{b} \pm 0.49$
T4	$32.30^{b} \pm 0.45$	$-6.59^{b} \pm 1.30$	$10.45^{d} \pm 1.45$
T5	$38.29^{d} \pm 1.37$	$-8.23^{a} \pm 0.19$	$21.76^{e} \pm 1.85$

Note: Superscripts in the column (^{a,b,c,d,e}) indicate highly significant differences ($p<0.01$).

L*, lightness; a*, redness-greenness; b*, yellowness-blueness

Lightness (L*)

The lightness value (L*) indicates that the lightness intensity in bay leaf extract is directly related to the concentration of phenolic and aromatic compounds, which greatly affect color intensity. This study found that the highest L* value was 39.98, indicating that the extract was more precise and more stable than methanol or other nonpolar solvents. Ethanol, as a semi-polar solvent, enhances the extraction of a wide range of phytochemicals, including flavonoids and chlorophyll-related derivatives, due to its ability to dissolve both polar and moderately non-polar compounds, resulting in improved extract clarity and pigment recovery (Lee et al., 2024). Improved color brightness in plant-based extracts is associated with better pigment stability and

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reduced oxidation, which can enhance visual quality and consumer acceptance in meat products such as beef jerky (Domínguez et al., 2019). These pigments contribute to maintaining color stability in food systems by reducing oxidative reactions and improving product quality, which is important for minimizing food losses during storage and processing (Domínguez et al., 2019). Extraction with ethanol solvent not only improves physicochemical quality but also supports green preservation strategies that are essential to a safe and sufficiently efficient food system.

The results also show a significant difference in L* across solvents, due to ethanol's ability to selectively extract phenolic compounds, flavonoids, and chlorophyll, thereby reducing dark pigment content and non-pigment substances such as wax (Borges *et al.,* 2020). Polar solvents such as methanol and water tend to extract more dark pigments and tannin compounds, resulting in extracts with lower lightness values and a cloudier appearance. Higher L* values obtained with the ethanol extraction indicate better color stability, as phenolic compounds are more resistant to fat oxidation (Radzali *et al.,* 2020). This shows a positive correlation between extract brightness and antioxidant activity, with brighter extracts containing more stable and effective bioactive compounds that help prevent color degradation.

Extracts with high L* values are more visually appealing to consumers and have great potential to extend shelf life, thereby supporting product waste reduction and improving efficiency in the food system. Selecting ethanol as a semipolar solvent can increase the brightness of the extract and maintain the stability of bioactive compounds, which is particularly important for its application as a natural preservative.

Redness (a*)

The redness value (a*) in this study shows that the red-green intensity is negative (-1.19), indicating that extracts obtained with ethanol have a distinctive light green hue characteristic of plant extracts rich in phenolic compounds. This low redness value indicates that the structures of chlorophyll and eugenol are stable without extensive oxidation, consistent with the view of Qasim *et al.* (2024), who stated that ethanol maintains the balance of natural pigments in *Syzygium* species through controlled interactions between the solvent and solute. Antioxidant compounds extracted from plant materials can inhibit lipid oxidation, which is closely associated with the formation of brown discoloration in meat products, thereby helping to maintain color stability and improve the quality of dried meat products such as jerky (Domínguez et al., 2019). Maintaining redness stability in meat products is associated with reduced oxidative degradation of pigments, which helps preserve visual quality, improve consumer perception, and support product acceptance while minimizing the need for synthetic color additives (Domínguez et al., 2019). These characteristics are in line with the principles of sustainable agro-processing, which introduces natural additives into meat product preservation.

The difference in redness values when using different solvents is due to ethanol's ability to selectively extract phenolic compounds and chlorophyll, thereby minimizing the red color produced and preventing brown discoloration from oxidation, while maintaining the stability of green pigments. Polar solvents such as methanol tend to extract more dark or oxidized pigment compounds, resulting in extracts with a more negative and less stable green color. This is in line with previous research, which indicates that natural pigments are sensitive to oxygen, metals, light, temperature, and pH, making extraction and fragmentation from complex plant matrices containing fiber, carbohydrates, and proteins a challenging process (Bocker and Silva, 2022). The negative value produced in the ethanol extract indicates a natural balance between chlorophyll and aromatic compounds, neither of which undergoes excessive oxidation. This also indicates vigorous antioxidant activity, as these bioactive compounds prevent degradation and browning, thereby preserving the extract's natural color and making it visually appealing (Dias *et al.,* 2020).

Stability in the a* value is also essential to ensuring that bay leaf extract can be used as a food additive ingredient without synthetic additives and to maintain color quality, thereby increasing consumer confidence in the product. The choice of ethanol as the solvent in this salam leaf extract not only functions as a preservative for bioactive compounds but also supports the stability of the red-green color in natural plant extracts.

Yellowness (b*)

The yellowness value b* in this study was 4.14 using ethanol as a solvent, indicating that the presence of flavonoids and tannins is responsible for the golden color of the extract. These bioactive compounds in Syzygium polyanthum have been reported to exhibit strong antioxidant activity, which can contribute to the inhibition of lipid oxidation and rancidity formation in meat systems through free radical scavenging mechanisms (Hidayati et al., 2017). Ethanol extraction enhances the recovery of phenolic compounds in *Syzygium polyanthum* leaves, which are associated with conjugated structures contributing to absorbance characteristics in the visible region and influencing the color properties of the extract (Rohaeti et al., 2021). This property not only improves quality but also indicates the presence of natural protective molecules that function as preservatives (extending shelf life). The stability of the b* value ethanol-treated samples indicates a more durable color system and contributes to product consistency during storage. The yellowish color imparted by the ethanol solvent is a functional indicator and is directly linked to sustainability and durability in food systems.

The difference in b* values across different solvents is due to ethanol's ability to selectively extract flavonoids and tannins, yielding extracts with a more golden-yellow hue. Conversely, polar solvents such as methanol and water tend to extract more complex and oxidized phenolic compounds, resulting in a duller b* color intensity. This is in line with previous studies showing that flavonoids are generally polar and more soluble in polar solvents such as methanol and ethanol, which significantly affects the quality of the extract (Li *et al.,* 2024).

The high and stable b* value of this ethanol extract indicates that the pigment's resistance to oxidation and degradation during storage is positively correlated with the antioxidant activity of the bioactive compounds. This suggests that the extract will maintain the integrity of natural protective molecules, which are important for determining visual quality and food safety. Bay leaf extract, when used with ethanol as a solvent, not only enhances visual appeal but also serves as a functional indicator of product reliability in the food system, supporting food sustainability and security through preservation with natural ingredients rather than harmful/synthetic chemicals.

3.4 Fourier Transform Infrared Spectroscopy (FTIR)

The FTIR spectrum of bay leaf extract (Figure 1 to 5) shows characteristic absorption peaks corresponding to hydroxyl (O-H) stretching at 3231-3240 cm⁻¹, aromatic C–H stretching around 2926 cm⁻¹, aromatic C=C ring vibrations at 1603–1650 cm⁻¹, and strong C–O and C–O–C stretching between 1028–1199 cm⁻¹. FTIR spectroscopy is widely used to identify functional groups in plant extracts, where absorption bands corresponding to hydroxyl, carbonyl, and aromatic vibrations are associated with phytochemical constituents such as phenolics and flavonoids that contribute to antioxidant and antimicrobial activities (Pasieczna-Patkowska et al., 2025). The ethanol extract (Figure 3), exhibited more intense FTIR absorption bands in the hydroxyl (3200–3400 cm⁻¹) and carbonyl (around 1650 cm⁻¹) regions, indicating the presence of polar bioactive compounds such as phenolics and flavonoids, which are more efficiently extracted due to the semi-polar nature of ethanol as a solvent (Thummajitsakul et al., 2022). The strong absorbance intensity in FTIR regions associated with hydroxyl and aromatic groups indicates a higher presence of phenolic compounds, which contribute to free radical scavenging activity and inhibit lipid oxidation in meat systems through hydrogen donation mechanisms and stabilization of reactive oxygen species (Domínguez et al., 2019).

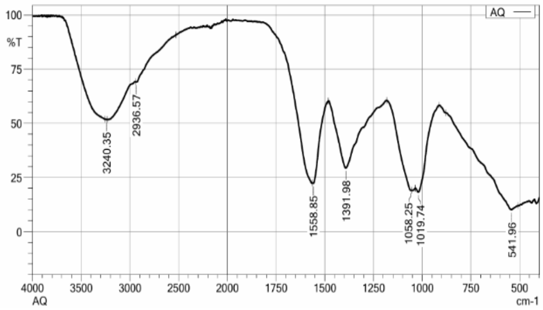

Figure 1: FTIR spectra of bay leaf extract (Aquades)

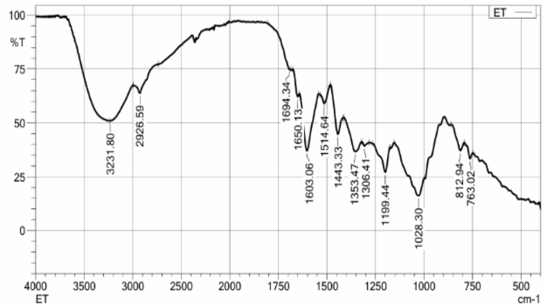

Figure 2: FTIR spectra of bay leaf extract (Methanol)

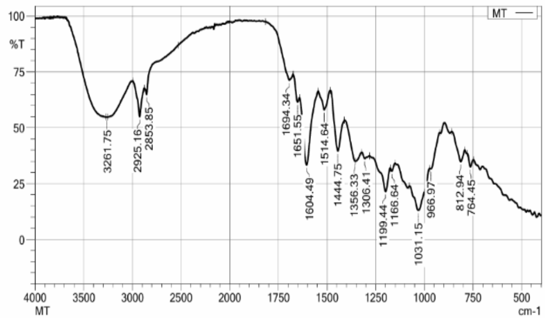

Figure 3: FTIR spectra of bay leaf extract (Ethanol)

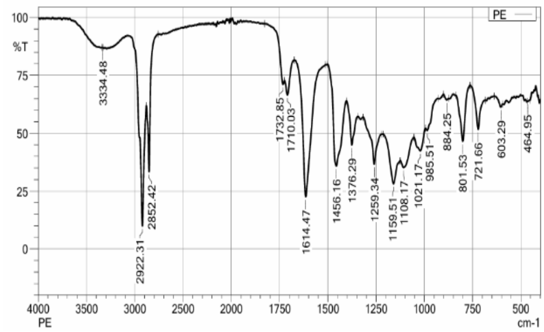

Figure 4: FTIR spectra of bay leaf extract (Petroleum Ether)

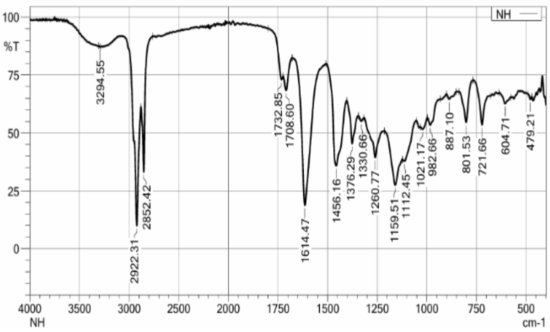

Figure 5: FTIR spectra of bay leaf extract (N-Hexane)

The absorption band in the region of approximately 800–900 cm^{-1} is associated with out-of-plane C–H bending vibrations in aromatic compounds. In eugenol and other phenolic constituents of essential oils, this region reflects the presence of substituted aromatic ring structures, confirming the existence of aromatic functional groups in plant extracts (Rodríguez et al., 2018; Taraj et al., 2020). Ethanol is widely used as an environmentally friendly solvent in plant extraction because of its efficiency in dissolving phenolic and flavonoid compounds, which enhances the recovery of bioactive constituents responsible for antioxidant activity in food systems (Alara et al., 2021). The intense peaks in ethanol-extracted bay leaf extracts are better at preserving the structures of phenolic compounds and essential oils. They are relevant to their application in meat preservation products such as jerky. FTIR detected these phenolic compounds and eugenol, which play an important role in inhibiting lipid oxidation and suppressing microbial growth during storage, thereby improving the quality and shelf life of beef jerky.

The FTIR spectrum of bay leaf extract using ethanol solvent shows sharper results (Figure 3), reflecting that ethanol solvent extracts bioactive compounds in greater quantities compared to highly polar or nonpolar solvents. Efficiency in this extraction is critical for its formulation as a natural preservative, because high phenolic concentrations correlate strongly with the antioxidant and antimicrobial properties required in processed meat products. This study highlights the role of ethanol as an efficient and environmentally friendly extraction solvent that enhances the recovery of bioactive compounds, particularly phenolics, thereby supporting the development of natural preservatives for improving the stability and quality of protein-based food products (Lee et al., 2024).

4. CONCLUSION

The use of various solvents in bay leaf extract significantly affects the quality of bay leaf extract *(Syzygium polyanthum),* including TDS, pH, color, and FTIR profile parameters. Ethanol produces the best extract, with the highest TDS, a stable pH, a bright color, and a distinct peak in phenolic compound content, indicating good antioxidant and antimicrobial activity. This study also confirms the potential of ethanol as a natural, sustainable preservative to improve the quality of beef jerky products and support food security through environmentally friendly processing innovations. The effectiveness of ethanol extraction also demonstrates its ability to selectively concentrate key bioactive compounds, such as flavonoids, tannins, and eugenol, which are important in preventing lipid oxidation and microbial growth in meat products, especially dendeng. Therefore, bay leaf extract using ethanol solvent can be used as a good alternative to synthetic additives and contribute to food products with cleaner labels, longer shelf life, and better consumer safety.

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