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REVIEWER'S REPORT

Manuscript No.: IJAR-56299

Title: COMPARISON OF DIFFERENT DRYING METHODS ON THE PHYSICAL PROPERTIES AND ANTIOXIDANT ACTIVITY OF Rosmarinus officinalis L

Recommendation:
Accept as it is

Rating	Excel.	Good	Fair	
Originality		√		
Techn. Quality			√	
Clarity			√	
Significance			√	

Reviewer Name: Dr. Manju M

Detailed Reviewer's Report

1. Overall Study Objective and Scope

The manuscript aims to determine how different drying techniques influence the physicochemical, antioxidant, and microbiological quality of rosemary leaves under tropical conditions. This objective is clearly stated and addresses a practical gap in postharvest processing science. The comparison among sun drying, solar dryer drying, and microwave-vacuum drying is relevant for both academic and industrial applications. The study successfully links drying technology with product quality outcomes. However, the objective could be strengthened by explicitly stating a hypothesis. Including a predictive statement would improve scientific framing. Overall, the study's aim is meaningful and well justified.

2. Scientific Relevance and Novelty

The research addresses an underexplored topic—performance of advanced drying technologies in tropical environments. Most previous studies focus on temperate conditions, making this work regionally significant. The inclusion of microwave-vacuum drying provides technological novelty. The study also integrates microbiological, nutritional, and physical quality metrics, which enhances its multidisciplinary value. This comprehensive evaluation distinguishes it from single-parameter studies. Nevertheless, authors should more explicitly compare novelty against recent literature. A short paragraph highlighting the innovation gap would strengthen impact.

3. Background Context and Literature Review

The introduction provides a thorough explanation of drying principles, moisture removal phases, and preservation mechanisms. Literature citations are relevant and generally up-to-date. The discussion of microwave-vacuum drying principles is particularly strong and informative. However, some references are listed without critical interpretation. Synthesizing prior findings instead of listing them would improve scholarly depth. Additionally, a short subsection summarizing limitations of past rosemary drying studies would help contextualize the research gap. Overall, the background is informative but could be more analytical.

4. Significance for Tropical Agriculture

The manuscript effectively emphasizes the need for improved herb processing technologies in tropical climates. High humidity, microbial growth, and environmental contamination are correctly identified as major constraints. This contextualization strengthens the applied relevance of the work. The study's focus on the Dominican Republic adds geographic specificity. Such regional targeting enhances practical

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usefulness for local producers. However, quantitative climate data would make the argument stronger. Including average seasonal humidity or temperature values would add credibility.

5. Botanical and Functional Importance of Rosemary

The authors correctly describe rosemary as an antioxidant-rich aromatic herb with medicinal and culinary value. Its essential oil properties and pharmacological relevance are well introduced. This establishes justification for studying preservation methods. The description of bioactive compounds aligns with known phytochemical profiles. However, the manuscript could briefly list key phenolics responsible for antioxidant activity. Mentioning compounds such as rosmarinic acid or carnosic acid would enhance scientific detail. Still, the botanical background is adequate.

6. Experimental Design Structure

The comparative design involving three drying methods is logical and appropriate. Using equal sample mass and identical tray configurations ensures methodological fairness. The inclusion of fresh rosemary as a control strengthens comparative interpretation. Replication levels are generally acceptable for food science experiments. However, the rationale for selecting specific drying durations is not fully explained. Providing preliminary optimization data would clarify parameter selection. Overall, the experimental structure is well organized.

7. Sampling and Plant Material Handling

Collection of leaves from a defined plantation with coordinates ensures traceability. Harvesting during morning hours is appropriate because metabolite levels are stable at that time. Refrigerated transport and processing within 24 hours minimize degradation. Such handling demonstrates methodological rigor. Still, the manuscript should specify whether leaves were washed before drying. Cleaning procedures affect microbial counts. Clarifying this step would improve reproducibility.

8. Description of Sun Drying Treatment

The sun drying protocol is detailed and realistic, reflecting traditional processing conditions. Recording solar intensity, humidity, and tray temperature strengthens reliability. The inclusion of overnight exposure simulates actual farmer practices. Such realism improves applicability of results. However, exposure to environmental contaminants is mentioned later but not experimentally monitored. Measuring dust deposition or contamination would provide stronger evidence. Nevertheless, the method description is thorough.

9. Solar Dryer Methodology

The solar dryer design is well described, including dimensions and UV-filtering cover. Temperature control below 50°C is appropriate for preserving phytochemicals. Periodic moisture monitoring ensures accurate endpoint determination. These methodological strengths support reproducibility. However, airflow rate inside the dryer is not specified. Air circulation strongly affects drying kinetics. Providing ventilation parameters would improve technical clarity.

10. Microwave-Vacuum Drying Parameters

The microwave-vacuum drying system is described with detailed technical specifications. Reporting vacuum range, frequency, temperature, and power consumption demonstrates transparency. Short interval drying tests (2–6 min) are suitable for optimization. Verification of final moisture content confirms endpoint accuracy. Still, justification for chosen vacuum pressure is absent. Including references or pilot tests supporting parameter selection would strengthen validity. Overall, the methodology is well presented.

11. Analytical Method Selection

The analytical methods chosen cover all key quality attributes. Moisture, water activity, color, antioxidant capacity, vitamin C, and microbiological counts together provide comprehensive evaluation. The combination of physical, chemical, and microbiological analyses is a major strength. Standardized methods increase credibility. However, essential oil composition was not analyzed. Since rosemary is valued for volatile compounds, including this parameter would enhance completeness.

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12. Moisture Content Determination

The gravimetric infrared method at 105°C is appropriate for plant materials. Performing analyses in quintuplicate improves statistical reliability. Reporting results on wet basis is suitable for comparison with standards. The method is clearly described and replicable. Yet, moisture distribution within leaves is not discussed. Internal gradients can affect drying kinetics. A brief explanation of possible variability would strengthen interpretation.

13. Water Activity Measurement

Water activity determination using a calibrated instrument at controlled temperature is methodologically sound. Triplicate measurements ensure reliability. The chosen particle size improves uniformity. Results are interpreted correctly relative to microbial growth thresholds. The discussion linking aw values with shelf stability is scientifically accurate. Including sorption isotherm data would further enhance predictive value. Nonetheless, the analysis is adequate.

14. Color Evaluation Technique

Color measurement using the CIE L*a*b* system is standard practice for food products. Calibration with a white plate ensures accuracy. Ten replicates per treatment provide strong statistical power. The explanation of parameter meaning improves clarity. The comparison with fresh leaves strengthens interpretation. However, total color difference (ΔE) was not calculated. Including ΔE values would provide a single comparative indicator.

15. Antioxidant Activity Determination

The DPPH radical scavenging assay is widely accepted for antioxidant evaluation. The extraction procedure is clearly described and reproducible. Serial dilutions and IC_{50} calculation allow quantitative comparison. Incubation conditions and wavelength selection are appropriate. The methodology demonstrates good laboratory practice. Still, relying on a single antioxidant assay limits interpretation. Adding FRAP or ABTS assays would validate findings.

16. Vitamin C Quantification

HPLC analysis with external calibration ensures accurate quantification of ascorbic acid. Column type, mobile phase, flow rate, and detection wavelength are properly reported. Triplicate analysis strengthens reliability. The method is scientifically sound and sensitive. Detection limits should be specified to justify "not detected" results. Without this, interpretation of vitamin C loss remains uncertain. Including validation parameters would improve rigor.

17. Microbiological Assessment

Use of ISO standard methods for microbial enumeration demonstrates strong methodological quality. Appropriate media and incubation conditions were selected. Reporting both bacteria and fungi provides comprehensive safety evaluation. Duplicate plating enhances reliability. The discussion correctly relates results to international standards. However, initial surface sterilization steps should be clarified. This information is essential for interpreting microbial reductions.

18. Statistical Analysis

Application of ANOVA followed by Tukey's HSD test is appropriate for comparing treatments. Reporting mean ± standard deviation is standard practice. The significance level ($p < 0.05$) is acceptable. Statistical software is clearly identified. However, assumptions of normality and homogeneity are not discussed. Confirming these assumptions would strengthen statistical validity. Inclusion of effect size values would also be beneficial.

19. Drying Kinetics Interpretation

The results clearly demonstrate dramatic reduction in drying time using microwave-vacuum technology. The explanation based on pressure gradients and volumetric heating is scientifically sound. Quantifying time reduction percentages strengthens interpretation. Comparisons with literature confirm consistency. Graphical representation of drying curves would enhance visualization. Such plots would help readers understand moisture removal dynamics.

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20. Moisture Content Findings

All methods successfully reduced moisture below the safe storage threshold. Reporting exact percentages allows clear comparison. Microwave-vacuum drying achieved the lowest final moisture level. Although statistically significant, differences among methods are relatively small. This suggests that time efficiency rather than final moisture is the main advantage. The discussion appropriately acknowledges this point. Additional replication across seasons would confirm stability.

21. Water Activity Results Interpretation

The study correctly highlights water activity as a predictor of microbial stability. The extremely low aw achieved with microwave-vacuum drying is noteworthy. Values below 0.40 indicate excellent shelf stability. The comparison with published data supports credibility. Interpretation of microbial risk is accurate. Including storage stability tests would strengthen conclusions. Long-term monitoring is recommended.

22. Color Preservation Discussion

Color results convincingly show that microwave-vacuum drying best preserves natural green pigmentation. The explanation involving reduced oxidation and shorter heating time is logical. Sun drying's degradation effect is convincingly linked to UV exposure. These interpretations are consistent with plant pigment chemistry. Sensory evaluation could complement instrumental data. Consumer acceptance testing would increase applied relevance.

23. Antioxidant Retention Analysis

The antioxidant results are one of the strongest aspects of the study. Quantitative comparisons clearly demonstrate superiority of microwave-vacuum drying. Reporting percentage retention aids interpretation. The explanation of oxidative degradation mechanisms is scientifically sound. Literature comparisons strengthen validity. However, identification of specific phenolic compounds would deepen understanding. Future studies should include chromatographic profiling.

24. Vitamin C Stability Discussion

Vitamin C degradation patterns align with known thermal sensitivity of ascorbic acid. The complete loss during sun drying is plausible given prolonged exposure. Microwave-vacuum drying's retention is convincingly explained by reduced temperature and oxygen levels. Statistical significance is properly reported. Still, confidence intervals should be added. These would help evaluate precision of estimates.

25. Microbial Reduction Interpretation

The microbiological results demonstrate clear differences among drying methods. Microwave-vacuum drying produced the lowest microbial counts, suggesting an additional sterilization effect. The discussion of electroporation and cellular disruption is scientifically credible. Linking results to international limits strengthens practical relevance. However, identification of microbial species would provide deeper insight. Future studies should include microbial profiling.

26. Overall Conclusion, Significance, and Recommendations

The manuscript presents strong evidence that microwave-vacuum drying is the most efficient and quality-preserving method for rosemary dehydration under tropical conditions. The work is scientifically sound, methodologically detailed, and practically relevant. Its findings have direct implications for food processing industries and small-scale producers. The conclusions are supported by data and logical reasoning. Minor methodological clarifications and additional analyses would further strengthen the study.