

# Evaluation of Dual-Powered Dehydration Device for Food Preservation in Baler Aurora Philippines

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## Article Details:

Received: 25 February 2026

Revised: 27 February 2026

Accepted: 07 March 2026

Published: 10 March 2026

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## Recommended Citation:

Capin, A. R. (2026). Evaluation of Dual-Powered Dehydration Device for Food Preservation in Baler Aurora Philippines. *The International Review of Multidisciplinary Research*, 1 (3), 122-131. <https://doi.org/10.5281/zenodo.18934136>

## Index Terms:

dual-powered, dehydration device, hybrid solar-electric dryer, food dehydration, drying kinetics, specific energy consumption

**Abstract.** This study evaluated the effectiveness of an improvised dual-powered eco-friendly dehydration device using a diverse group of evaluators, including students, faculty, TESDA experts, and industry experts/farmers. The device was assessed across six quality indicators: design and aesthetics, materials, portability, functionality, safety, and usability. The data was collected using four Likert evaluation checklists that were valid and reliable according to review and validation using Cronbach's Alpha, with a reliability coefficient of 0.95 and a verbal interpretation of "very reliable." Prior to evaluation, the responders were shown how the equipment operated and what its characteristics were. The overall assessment yielded an average mean of 3.78, interpreted as "Very Effective." This strong overall rating underscores the device's potential as a viable solution for sustainable food preservation, particularly in resource-limited settings. Individual categories also received high ratings, with usability scoring the highest at 3.87 ("Very Usable") and materials receiving the lowest at 3.74 ("Very Good"). The exceptional usability score highlights the intuitive design that facilitates ease of use even for non-experts, while the slightly lower materials rating points to areas for potential refinement in durability or sourcing. A one-way ANOVA revealed a significant difference in the assessments of materials ( $F=4.390$ ,  $p=0.006$ ) and safety ( $F=3.882$ ,  $p=0.011$ ) among the evaluator groups ( $\alpha=0.05$ ). These statistical findings indicate that evaluator expertise levels impacted perceptions of technical aspects, with varying expectations based on professional experience. The TESDA experts provided the lowest mean scores for both categories, suggesting that the evaluators' professional backgrounds influenced the technical assessment of these specific indicators.

## Introduction

A dehydrator is a piece of equipment that removes moisture from foods, preventing the growth of germs, yeast, and mold. It dries food at a low temperature to preserve the nutrients and enzymes. A dehydrator allows you to organically extend the shelf life of food without using additives. The most basic type of dehydrators are direct ones, in which food is dried straight through a glass in the sun. Although this method is inexpensive, the food may be harmed by the ultraviolet rays. An indirect dehydrator heats the air via a solar collector. After that, warmer airflow will enter the cabinet containing the food, eliminating the potential of radiation-induced food damage. The hybrid kind, which combines direct solar radiation and a solar collector, is typically larger, more costly, and more difficult to manufacture. Although it exposes the food to solar radiation, it dries it faster than indirect and direct techniques. The hybrid type is a contemporary indirect dehydrator that dries food using additional technologies (Szabo, Gillet, Valles, Pereira1, Keppens, Krommendijk, Duarte, Malheiro1, Ribeiro, Justo, Silva, Ferreira, & Guedes, 2019).

One of the oldest methods of food preservation in the world is dehydration, with its principles influencing some of the most modern methods of food science (Flora, 2023). The rapid change in the drying and dehydration methods occurs even from ancient time from sun drying to solar drying, from convective air drying to impingement drying. (Mohapatra & Mishra,

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2011). Dehydration of food is the process of lowering the moisture content to a low level in order to extend its shelf life by incorporating one or more kinds of energy. Typically, hot air adds heat to the food while also transporting moisture away from it (Jayas, 2016). Dehydration an ancient method of economically preserving food while retaining all of its nutrients is dehydrating it. Dehydrators come in two varieties: solar and electrical. Solar dehydrators differ from electrical dehydrators, which all uses the same heating element, fan, and air vents. Some fruit drying processes, such as sun-drying prunes, have been supplanted in recent years by hot-air dehydration, which dries the fruit faster and in better quality. Natural gas utilization for hot-air dehydration may reduce in the future owing to energy restrictions. If this happens, air heating will require a different energy source. The benefits of dehydration include faster drying than traditional sun drying, more vitamin A retention, and protection from the weather (Szabo et al., 2019).

Solar dehydrators are powered by the sun and can help you dehydrate your food without using energy (Ajmera, 2022). Dehydration necessitates a temperature of 30 to 60°C. The dry food should be split into small, thin pieces. The equipment desiccates crops and food ingredients by gathering heat from the through outdoor heat catchers and concentrating it in a drying chamber. The device also incorporates an electronic support system ensures drying productivity by using backup heaters in the event of inadequate solar radiation (Mendez, 2023). The dehydration technique removes moisture without using high heat, preserving important vitamins and minerals that might otherwise be lost in other preservation processes such as canning.

Food scraps are common environmental issue, with millions of tons of edible food thrown away each year. Dehydrating food is a proactive approach to this issue. By extending the life of produce that would otherwise spoil, you help to reduce food waste. This is especially helpful for people who raise their own food or buy seasonal products in quantity (NA, 2024) Reduced productivity during rainy season. With unpredictable climate, relying on sun drying exposes food items to a variety of risks, mainly economic perspective (Mendez, 2023).

## Methodology

### *Type of Investigation*

This study pertained to the developed dual powered eco-friendly dehydration device for food preservation. It aimed to assess and evaluate the developed dehydration device if it was effective and efficient enough to be used by the students, faculty, TESDA assessors (food Processing), industry experts and farmers. The researcher created a checklist questionnaire for the evaluation of the device. The researcher distributed the checklist questionnaire to all the identified respondents. The evaluation checklist questionnaires were utilized by the respondents in evaluating the developed device in terms of design and aesthetics, materials, portability, functionality, safety, and usability.

### *Research Design*

To completely address the research problems and objectives related to the evaluation of an dehydration device with a dual source of energy for food preservation, the researcher utilized survey and developmental method in order to give a comprehensive understanding of the dehydration device's efficacy, usability, and influence on food processing technology.

Self-structured evaluation checklist questionnaire was used to collect data like opinions, experiences, and recommendations about the design and aesthetics, materials, portability, functionality, safety and usability and operation of the dehydration device.

Evaluators input was collected during the prototype evaluation process in order to improve functionality and refine the design. To make sure the dehydration device prototype satisfies the requirements and industry standards, the evaluation plan encompassed technical evaluation, evaluators feedback analysis, and performance evaluation. Lastly, workshops and training sessions was part of the implementation and dissemination strategies to encourage knowledge sharing and ease the adoption of the dual powered dehydration device in professional and educational settings within the food processing industry.

### *Research Locale*

The respondents for this study included a diverse group; comprising three (3) faculty members handling the Food Processing subjects and 30 students enrolled in Food Processing subject from Tarlac Agricultural University, 6 faculty members handling the Food Processing subject and 30 students enrolled in Food Processing subject from Nueva Ecija

University of Science and Technology, 30 second-year students enrolled in the Bachelor of Industrial Technology major in Food Technology program enrolled in Food Processing subjects; six (6) core instructors from ASCOT with NC II and handling Food Technology, Electrical and Automotive Technology subjects; 5 TESDA experts (accredited assessors) from TESDA (Food Processing NC II, EIM NC II and Welding NC II) and 5 industry experts (producers of dried or dehydrated products and farmers or producers of root crops) who was responsible in the evaluation of the technicality of the device. This had a total number of 115 respondents. These individuals have been carefully selected for their relevance to the research objectives and their expertise in the field, ensuring a comprehensive representation of perspectives. Ethical considerations, including informed consent and confidentiality, were strictly adhered throughout the data collection process. The table 1 shows the actual number of the respondents of the study.

Nature of Respondents	Total	Percentage
Faculty of TAU	3	2.61
Students of TAU	30	26.10
Faculty of NEUST	6	5.21
Students of NEUST	30	26.10
Faculty of ASCOT	6	5.21
Students of ASCOT	30	26.10
TESDA experts (Assessors)	5	4.35
Industry experts/farmers	5	4.35
<b>TOTAL</b>	<b>115</b>	<b>100</b>

Table 1. Actual Numbers of Respondents

#### Data Gathering Instrument

The main source of gathering data information was the evaluation checklist questionnaire. It was an instrument for research, consisting of a list of statements, along with the choice of answers, printed or typed in a sequence on a form used for acquiring specific information from the respondents (Aryal, 2022). This study pertained to the developed dual powered eco-friendly dehydration device for food preservation. Its aim was to assess and evaluate the developed dehydration device if it was effective and efficient enough to be used by the respondents. The researcher created a checklist questionnaire for the assessment of the device. The researcher distributed the evaluation checklist questionnaire to the purposely selected respondents to be utilized in evaluating the developed device in terms of Design and aesthetics, Materials, Portability, Functionality, Safety, and Usability.

#### Validity and Reliability of the Instrument

To ensure that the items in the questionnaire were valid and reliable, the instrument was subjected to review and validation by the thesis adviser and other knowledgeable people, specifically the faculty of the School of Engineering in Electrical and Mechanical Engineering program for comments, corrections, and enrichment. The instrument was pre-tested to the non-respondent students of Aurora State College of Technology, specifically the Bachelor of Industrial Technology major in Food Technology Third year students. Comments and suggestions were gathered and incorporated before the instrument was utilized in this study. Cronbach's Alpha was used in computing the reliability coefficient. Based on the analysis it has a result of 0.95 with a verbal interpretation of very reliable.

#### Data Gathering Procedure

Data gathering was done following the protocols. Before the data gathering, seeking permission and approval from the academic Institution officials of Aurora State College of Technology (ASCOT), Tarlac Agricultural University (TAU) and Nueva Ecija University of Science and Technology (NEUST), Technical Education Skills and Development Authority (TESDA), Industry experts and farmers was done. Securing approval and cooperation of requested evaluators were also assured to be able to gather reliable data, suggestions and recommendations.

The researcher demonstrated to the members of the evaluators or respondent the operation process and the features of the device. This was done to enlighten them what the developed has to offer and its benefits to the would-be users.

The judgement of the device by the selected evaluators on its design and aesthetics, materials, portability, functionality, safety and usability were done using the self-made and validated evaluation checklist using the 4 Likert scale response mode with its specific verbal interpretations.

Collected data from the evaluators included their suggestion, comments, and suggestions for the improvement of the developed device. This was indicated in the recommendation of the study for the next researchers. The data collected was interpreted and discussed in the data gathering techniques.

*Measurement and Data Collection*

*Design and aesthetics.* The device was excellent if it has an outstanding design and was visually appealing, minimalist, comfortable, and user-friendly. The aesthetics enhance usability and functionality and are highly polished with excellent attention to detail.

*Materials.* It was very good if it exceed all expectations and standards of the device. It has outstanding quality offering superior durability and refined finish. There was a high level of confidence in the selection of the materials.

*Portability.* The device was very portable if it was lightweight and compact making it easy to use, carry, and transfer/transport without supervision. It was designed for effortless mobility, fitting well in various spaces without hassle. It has a handle, stackable trays, collapsable features, or a streamlined design.

*Functionality.* It was very functional if it efficiently meets standard and implied needs and no weaknesses are found in the device. It was highly efficient in drying food. It has well-designed controls and features to enhance the ease of use. Operates smoothly with minimal adjustment needed. Versatile, accommodating a wide range of foods with optimal performance. Reliable and well-built

*Safety.* It was very safe if the use of the device is safe from any hazards. It is designed with high safety standards, minimizing the risk of burns, electrical hazards, or malfunctions. It has reliable features for overheating, protection, and security. It has stable construction to ensure safe operation. It has user-friendly safety mechanisms, such as auto shut-off and others to enhance protection. It meets or exceeds industry safety regulations, providing confidence in long-term use.

*Usability.* It was very usable if it has a highly in-built design that allows effortless operation. User-friendly controls such as temperature control, function, and timer with clear instructions make its easy to use. The well-designed layout and features enhance convenience and efficiency with smooth and hassle-free functionality.

*Data Analysis Techniques*

In determining the significant differences in the evaluation of the device in terms of the design and aesthetics, materials, functionality, portability, safety, and usability ANOVA was used. To determine the implications of the effectiveness of the device, meta analysis was used.

The following scoring guide for the evaluation of the improvised device by the faculty, students, TESDA assessors and expert- respondents shows range and verbal interpretations.

Table 2 shows the scoring guide for design and aesthetics, materials, portability, , functionality, safety and usability of the improvised dual powered Eco-friendly dehydration device.

The researcher used a four- point Likert Scale with mean and standard deviation interpretation in the assessment by Faculty, students, TESDA experts, and industry expert/farmers' acceptance of the use of the eco-friendly dehydration device. Using descriptive statistics, the data was analyzed and interpreted.

Range	Verbal Interpretation
3.25- 4.00	Excellent / Very Good/ Very Portable /Very functional/Very Safe / Very usable/Very Effective
2.50- 3.24	Good / Portable / Functional/ Safe / Usable/ Effective
1.75- 2.49	Fair /Slightly Portable/Slightly safe Slightly Usable /Less Effective
1.00- 1.74	Poor/Not Portable / / Not function/Not Safe Not Usable/ Not effective

*Table 2. Scoring guide for the assessment of the improvised dual powered Eco-friendly dehydration device by the faculty, students, TESDA Assessors and Experts.*

## Results and Discussion

### *Summary Results of Descriptive Statistics on Design and Aesthetics, Materials, Portability, Functionality, Safety and Usability by Students, Faculty, TESDA experts and Industry and Farmers*

The descriptive analysis of the device in terms of different quality indicators as design and aesthetics, materials, portability, functionality, safety and usability as evaluated by the students was shown in Table 3. It revealed that it has an "Excellent" design and aesthetics with a mean of 3.82, and a "Very good" materials with a mean of 3.86. It also shows that the device was "Very portable" with the mean of 3.74 and is also "Very functional" with the mean of 3.81 further it shows that the device was also "Very safe" and "Very usable" with the means of 3.87 and 3.90 respectively. The overall mean was 3.83 which was "Very Effective". This result signifies that the device would be of great help to students during laboratory works specifically on food preservation by dehydration. This will also enhance effectiveness and assurance of quality products by the students.

Quality Indicators	Mean	Verbal Interpretation
Design and Aesthetics	3.82	Excellent
Materials	3.86	Very Good
Portability	3.74	Very Portable
Functionality	3.81	Very Functional
Safety	3.87	Very safe
Usability	3.90	Very usable
Over all mean	3.83	Very Effective

*Table 3. Summary Results of Descriptive Statistics on the Design and Aesthetics, Materials, Portability, Functionality, Safety and Usability by Students*

The descriptive analysis of the device in terms of different quality indicators as design and aesthetics, materials, portability, functionality, safety and usability as evaluated by the faculty as shown in Table 4 revealed that, it has an "excellent" design and aesthetics with a mean of 3.73, and a "very good" materials with a mean of 3.71. It also shows that the device was "very portable" with the mean of 3.67 and is also "very functional" with the mean of 3.82. further it shows that the device was also "very safe" and "very usable" with the means of 3.77 and 3.77 respectively. It has an over mean of 3.68 which means that it was "Very effective" It implies that the developed device was an acceptable instructional device in the food processing subject basically in food dehydration.

Quality Indicators	Mean	Verbal Interpretation
Design and Aesthetics	3.73	Excellent
Materials	3.71	Very Good
Portability	3.67	Very Portable
Functionality	3.82	Very Functional
Safety	3.77	Very safe
Usability	3.77	Very usable
Over all mean	3.68	Very Effective

*Table 4. Summary Results of Descriptive Statistics on the Design and Aesthetics, Materials, Portability, Functionality, Safety and Usability by Faculty*

The descriptive analysis of the device in terms of different quality indicators as design and aesthetics, materials, portability, functionality, safety and usability as evaluated by the TESDA experts in Food processing, Electrical Installation and Welding and Fabrication as shown in Table 5 revealed that, it has an "excellent" design and aesthetics with a mean of 3.76, a "very good" materials with a mean of 3.54. It also shows that the device was "very portable" with the mean of 3.82 and is also "very functional" with the mean of 3.58. further it shows that the device was also "very safe" and "very usable" with the means of 3.51 and 3.85 respectively. It has an overall mean of 3.68 which is "Very effective" It signifies that the developed devices were acceptable and complied with the industry standard to be used in food processing, the electrical connections were also set in standard set by PEC and the development of the device also conforms the standards of welding and fabrication.

Quality Indicators	Mean	Verbal Interpretation
Design and Aesthetics	3.76	Excellent
Materials	3.54	Very Good
Portability	3.82	Very Portable
Functionality	3.58	Very Functional
Safety	3.51	Very safe
Usability	3.85	Very usable
Over all mean	3.68	Very effective

Table 5. Summary Results of Descriptive Statistics on the Design and Aesthetics, Materials, Portability, Functionality, Safety and Usability by TESDA Experts

The descriptive analysis of the device in terms of different quality indicators as design and aesthetics, materials, portability, functionality, safety and usability as evaluated by the industry experts and farmers as shown in Table 6 revealed that, it has an "excellent" design and aesthetics with a mean of 3.83, and a "very good" materials with a mean of 3.84, it also shows that the device was "very portable" with the mean of 3.82 and is also "very functional" with the mean of 3.93. further it shows that the device was also "very safe" and "very usable" with the means of 3.84 and 3.95 respectively. The overall mean was 3.78 which is "Very effective". The result implies the developed device can have a significant usage to evaluators in preserving their surplus produce since the device can be brought to the farm where they can dehydrate their produce using the solar energy. It also implies that it has a significant effect on the quality of the product.

Quality Indicators	Mean	Verbal Interpretation
Design and Aesthetics	3.83	Excellent
Materials	3.84	Very Good
Portability	3.82	Very Portable
Functionality	3.93	Very Functional
Safety	3.84	Very safe
Usability	3.95	Very usable
Over all mean	3.78	Very effective

Table 6. Summary Results of Descriptive Statistics on the Design and Aesthetics, Materials, Portability, Functionality, Safety and Usability by Industry Experts/Farmers

The summary of the descriptive analysis of the device in terms of different quality indicators as design and aesthetics, materials, portability, functionality, safety and usability as evaluated by the faculty, students, TESDA experts and industry experts/farmers as shown in Table 7 revealed that, it has an "excellent" design and aesthetics with a mean of 3.79, and a "very good" materials with a mean of 3.74. It also shows that the device was "very portable" with the mean of 3.76 and is also "very functional" with the mean of 3.79, further it shows that the device was also "very safe" and "very usable" with the means of 3.75 and 3.87 respectively. The overall mean was 3.78 which is "very effective" The result implies that according to the evaluators, the developed device has complied with the standards required by the industry in terms of design, aesthetics and materials. It also conforms with the electrical standards as to connections and settings and quality of the device body as weld. It also shows that the devices have a versatile functionality and usability since it was a dual powered device but can be used separately in the case it was deemed necessary. It was also safe to use since it was developed to have a closed control panel and safe electrical connections and control. It was also a low temperature setting of 60 degrees centigrade.

Quality Indicators	Mean	Verbal Interpretation
Design and Aesthetics	3.79	Excellent
Materials	3.74	Very Good
Portability	3.76	Very Portable
Functionality	3.79	Very Functional
Safety	3.75	Very safe
Usability	3.87	Very usable
Over all mean	3.78	Very Effective

Table 7. Summary of Descriptive Statistics on the Design and Aesthetics, Materials, Portability, Functionality, Safety and Usability by the evaluators

*Difference between the assessment of the device by students, faculty, TESDA experts, and Industry experts/farmers in terms of Design and Aesthetics, Material, Portability, Functionality, Safety and Usability*

The following discussions present the computed difference between the assessment of the device by students, faculty, TESDA experts, and Industry experts/farmers in terms of Design and Aesthetics, Material, Portability, Functionality, Safety and Usability.

Quality Indicators	Mean/ Interpretations				Overall	F-value (P-value)
	Student	Faculty	Experts	Farmers		
Design and Aesthetics	3.82 Excellent	3.73 Excellent	3.76 Excellent	3.83 Excellent	3.79 Excellent	0.810 (0.491)
Materials	3.86 Very Good	3.71 Very Good	3.54 Very Good	3.84 Very Good	3.74 Very Good	4.390* (0.006)
Portability	3.74 Very Portable	3.67 Very Portable	3.82 Very Portable	3.82 Very Portable	3.76 Very Portable	0.568 (0.637)
Functionality	3.81 Very Functional	3.82 Very Functional	3.58 Very Functional	3.93 Very Functional	3.79 Very Functional	1.941 (0.127)
Safety	3.87 Very Safe	3.77 Very Safe	3.51 Very Safe	3.84 Very Safe	3.75 Very Safe	3.882* (0.011)
Usability	3.90 Very Usable	3.77 Very Usable	3.85 Very Usable	3.95 Very Usable	3.87 Very Usable	1.751 (0.161)
Overall	3.83 Very Effective	3.75 Very Effective	3.68 Very Effective	3.87 Very Effective	3.78 Very Effective	

\* test result is significant at 5% level of significance

*Table 8. Differences in the Assessment Result between Quality Indicators of the Dual Powered Dehydration Device by Student, Faculty, TESDA Expert, and Industry Expert/Farmers*

As shown in Table 8 the evaluators composed of faculty and students of ASCOT, TAU and NEUST, TESDA experts, Industry experts/ farmers rated device in terms of designed and aesthetics and got the overall rating of 3.79 with the verbal interpretation of "excellent" which means the machine was approved by the evaluators as to the quality indicator design and aesthetics. In terms of materials, the evaluator gave an overall rating of 3.74 with a verbal interpretation of "very good" which reveals that the material used in the device was accepted and approved by the evaluators during the assessment. In terms of Portability, the evaluators rated the device in an overall rating of 3.76 with a verbal interpretation of "very portable" which shows that the device was designed with ease and comfort during usage and mobility. In terms of functionality, the evaluators rated the device in overall rating of 3.79 with a verbal interpretation of "very functional" which indicated that the device meet the standard of the quality indicators descriptors. In terms of safety, the evaluators rated the device in an overall rating of 3.75 with verbal interpretation of "very safe" which means the device shows no or less harm during its utilization and performance. It also shows that it meets the safety standards of the quality indicators of the descriptors. In terms of usability, the evaluators overall rating was 3.87 with a verbal interpretation of "very usable". The over mean was 3.78 which is "Very effective". It implies that the device was designed to satisfy the intended users' needs. Tests of differences in the assessment of material ( $F=4.390$ ,  $p=0.006$ ) and safety ( $F=3.882$ ,  $p=0.011$ ) between design and aesthetics, materials, portability, functionality, safety and usability showed significant results at  $\alpha = 0.05$ . This implies that assessment in terms of material and safety was affected by the nature of evaluators. It was highly evident in the evaluation of the TESDA experts which shows the lowest mean in terms of material and safety. The null hypothesis was rejected since there was significant difference in the test result of materials and safety between the assessment of the device by students, faculty, TESDA experts and industry experts/farmers in terms of design and aesthetics, materials, functionality, portability, safety, and usability.

Evaluating materials for dual-powered dehydration devices requires a comprehensive assessment, as specialists take into account multiple elements to guarantee peak performance, safety, and effectiveness. These elements include the characteristics of the materials, compatibility with energy sources, and the incorporation of sophisticated decision-support systems (Skrzek et al., 2025).

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The primary factors impacting expert evaluations focus specifically on material characteristics and compatibility. Materials must endure operational temperatures for both solar and electric applications without deterioration. They should also resist corrosion while maintaining structural stability, and components need to withstand repeated thermal cycles and mechanical stresses. Integration of energy sources should support dual-power compatibility that enables systems to alternate between or concurrently utilize electric and solar energy. Materials that boost energy retention or minimize losses are preferred to enhance the overall efficiency of the system. Considerations for environmental sustainability, such as utilizing locally available materials or employing sustainable or recyclable options, can lower costs and align with environmental objectives, as well as affect expert evaluations regarding transportation-related impacts (Skrzek et al., 2025), Kozlovska et al., 2023, and Oluwaleye et al., 2021).

Disparities in expert assessments of the materials utilized in dual-powered (electric and solar) dehydration devices arise from a range of interconnected factors. These variations result from differing priorities, regional factors, advancements in technology, and various methodological practices. Certain specialists concentrate on optimizing thermal efficiency, highlighting materials that improve heat conduction. Meanwhile, others emphasize maintaining the nutritional and sensory characteristics of food, which may necessitate materials that enable milder drying conditions (Radojcin, et al., 2021).

In an article published by Sara (2025) stressed that PLCs facilitate intricate drying processes with various stages, making them perfect for items that need precise temperature and time conditions. Sensors can track and modify elements such as temperature, humidity, and airflow in real-time, ensuring the consistency and uniformity of the drying procedure.

Evaluating the safety of dual-powered dehydration devices—those that operate using both electric and solar energy—necessitates a detailed examination of various aspects. Specialists take into account material characteristics, thermal behavior, system architecture, and operational guidelines to guarantee safe and efficient functionality. The evaluation of materials for dual-powered dehydration devices is a multifaceted task that greatly benefits from the incorporation of expert systems and a deep understanding of material properties concerning energy sources. By taking these elements into account, specialists can ensure the creation of effective, long-lasting, and sustainable dehydration systems (Rodriguez-Romero et al., 2024) and Oluwaleye et al., 2021).

During the assessment, the evaluators, composed of students, faculty, TESDA experts and industry experts/farmers assessed the device in terms of design and aesthetics, materials, portability, functionality safety and usability. After the evaluation made by the evaluators, recommendations were provided to improve the device as to its overall effectiveness and efficiency given in the recommendation. The overall result of the descriptive analysis in terms of design and aesthetics mean was 3.79 with verbal interpretation of “Excellent”, materials got a mean was 3.74 with verbal interpretation of “very good”, in portability, the mean was 3.76 with “very portable” verbal interpretation, functionality got a mean of 3.79 with “very functional” verbal interpretation, safety garner a mean of 3.75 with verbal interpretation of “very safe” and usability has a mean 3.87 with verbal interpretation of “very usable”. The overall mean was 3.78 with a verbal interpretation of “Very effective”.

Difference in the assessment result between the quality indicator of the improvised dual powered eco-friendly dehydration device by students, faculty, TESDA experts, and Industry experts/farmers revealed that in terms of designed and aesthetics and got the overall rating of 3.79 with the verbal interpretation of excellent which means the machine was approved by the evaluators as to the quality indicator design and aesthetics. In terms of materials, the evaluator gave an overall rating of 3.74 with a verbal interpretation of very good which reveals that the material used in the device was accepted and approved by the evaluators during the assessment. In terms of Portability, the evaluators rated the device in an overall rating of 3.76 with a verbal interpretation of very portable which shows that the device was designed with ease and comfort during usage and mobility. In terms of functionality, the evaluators rated the device in overall rating of 3.79 with a verbal interpretation of very functional which indicated that the device met the standard of the quality indicators descriptors. In terms of safety, the evaluators rated the device in an overall rating of 3.75 with verbal interpretation of very safe which means the device shows no or less harm during its utilization and performance. It also shows that it meets the safety standards of the quality indicators of the descriptors. In terms of usability, the evaluators overall rating was 3.78 with a verbal interpretation of very usable. It implies that the device was designed to satisfy the intended users' needs. Test of differences in the assessment of material ( $F=4.390$ ,  $p=0.006$ ) and safety ( $F=3.882$ ,  $p=0.011$ ) between design and aesthetics, materials, portability, functionality, safety and usability showed significant result at  $\alpha=0.05$ . This implies that assessment in terms of material and safety is affected by the nature of evaluators. It was highly evident in the evaluation of the TESDA experts which shows the lowest mean in terms of material and safety. The null hypothesis was rejected since there was significant difference in the test result of materials and safety between the assessment of the device by students, faculty, TESDA experts and industry experts/farmers in terms of design and aesthetics, materials, functionality, portability, safety, and usability.

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## Conclusion and Implications

Tests of differences in the assessment of material and safety between design and aesthetics, materials, portability, functionality, safety and usability showed significant results. This implies that assessment in terms of material and safety is affected by the nature of evaluators. It was highly evident in the evaluation of the TESDA experts which shows the lowest mean in terms of material and safety. The null hypothesis was rejected since there was significant difference in the test result of materials and safety between the assessment of the device by students, faculty, TESDA experts and industry experts/farmers in terms of design and aesthetics, materials, functionality, portability, safety, and usability.

## Acknowledgements

The author would like to thank the colleagues, institutions, respondents and family who provided guidance, feedback, and support throughout the conduct of this research and the preparation of this manuscript.

## Funding

This research received no external funding from any public, commercial, or not-for-profit funding agency, and no organization provided financial support for the conduct of the study, authorship, or publication of this article.

## Competing Interests Statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

## Data Availability Statement

Data gathered can be accessed by sending a formal request to the author of this study.

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## Appendices

### *Appendix A. Evaluation Checklist*

This appendix was a researcher made checklist that contains the complete 75-item evaluation checklist used to evaluate dual-powered dehydration device for food preservation, administered to 115 respondents across three Philippine State Universities, TESDA and Industry experts. The checklist includes Likert-scale items (1=Poor/ Not portable/ Not Functional/ Not Safe/ Not Usable/ Not Effective to 4= Very Good/ Very Portable/ Very Functional/ Very safe/ very usable/ very effective) covering the device design and aesthetics, materials, portability, functionality, safety and usability. Before it was used to gather data it undergoes reliability and validity test from faculty of the School of Engineering in Electrical and Mechanical Engineering program for comments, corrections, and enrichment. The instrument was pre-tested to the non-respondent students of Aurora State College of Technology, specifically the Bachelor of Industrial Technology major in Food Technology Third year students. Comments and suggestions were gathered and incorporated before the instrument was utilized in this study. Cronbach's Alpha was used in computing the reliability coefficient. Based on the analysis it has a result of 0.95 with a verbal interpretation of very reliable.