



Compost production from areca palm leaf sheath residues using a non-turning composting method: A case study of the Ban Tha Di Mee community enterprise in Loei province

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Abstract

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This study aimed to evaluate the physicochemical properties of compost produced from areca palm (*Areca catechu* L.) leaf sheath residues using a non-turning composting method with different agricultural residues. The study was conducted at the Ban Tha Di Mee Community Enterprise in Loei Province. Areca palm leaf sheath residues from plate production were used as the main raw material and combined with sugarcane leaves, rubber tree leaves, or rice straw, together with cow manure at a ratio of 4:1:1. The experiment was arranged in a Completely Randomized Design (CRD) with three treatments and three replicates ($n = 3$). T1 consisted of areca palm leaf sheaths, sugarcane leaves, and cow manure; T2 consisted of areca palm leaf sheaths, rubber tree leaves, and cow manure; and T3 consisted of areca palm leaf sheaths, rice straw, and cow manure. Composting was conducted for 60 days using the Maejo Engineering Maejo 1 non-turning composting method. Data were analyzed using one-way analysis of variance (ANOVA) at a significance level of 0.05. All treatments produced compost with a dark color, earthy odor, and crumbly texture. The pH ranged from 6.23 to 6.72, and electrical conductivity (EC) ranged from 0.14 to 0.29 dS/m. Significant differences among treatments were found in pH, EC, organic matter (OM), total nitrogen (TN), and total potassium (TK) ($p < 0.05$), whereas total phosphorus (TP) did not differ significantly ($p = 0.143$). OM, TN, and TP (P_2O_5) ranged from 10.56–13.48%, 0.38–0.48%, and 0.053–0.093%, respectively, below the cited Department of Agriculture criteria. In contrast, TK (K_2O) ranged from 1.30–1.66%, exceeding the cited criterion of $\geq 0.5\%$. The non-turning method is practical for community-level residue management, but further improvement of OM, TN, and TP is needed to meet organic fertilizer criteria.

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1. Introduction

The Ban Tha Di Mee community enterprise in Pak Tom subdistrict, Chiang Khan district, Loei province is a community group that produces food containers, such as plates, bowls, and other items, by processing areca leaf sheaths. The areca leaf sheaths are purchased from Chaiyaphum Province, where many areca palms are grown. On average, 800 kg of areca leaf sheaths are purchased per month for production. Nevertheless, the plate production process generates areca leaf sheath residues from trimming, mold pressing, and products that fail quality control, accounting for approximately 10% of the total areca leaf sheaths used. In addition, some areca leaf sheaths are damaged during transportation and due to improper storage. Currently, the community enterprise lacks a systematic and

efficient approach to managing these residues. Most of the biomass waste is openly burned or dumped in piles around the production shed, including in rubber plantations and vacant land. These practices cause environmental problems, such as particulate matter, trace gases, and toxic pollutants that degrade air quality and promote visual pollution [1–3]. This issue is particularly concerning because the area is located along a route to major tourist attractions in Loei Province. However, if these residues are used to produce compost, this could reduce the accumulation of organic waste in the community and contribute to mitigating global warming [4, 5]. In addition, compost can improve soil quality and support crop production for local farmers, while the utilization of agricultural residues can contribute to more sustainable agricultural practices [6–9]. During composting,

microbial communities play an important role in the decomposition of organic materials. In particular, thermophilic microorganisms and their extracellular enzymes contribute to the degradation of lignocellulosic materials, including cellulose, hemicellulose, and lignin, during the composting process [10]. In Northeastern Thailand, organic farming practices have emphasized the use of organic fertilizers to improve soil fertility and support the long-term sustainability of agricultural systems [11]. Therefore, converting locally available agricultural residues into compost may provide a practical approach for reducing organic waste while supporting more sustainable nutrient management at the community level.

Maejo Engineering Maejo 1 composting method is a non-turning composting method that allows farmers to produce high-quality organic fertilizer in large quantities without turning the compost pile. The process takes only 60 days and requires only animal manure and plant residues, without adding any special substances [12]. The resulting fertilizer meets the nutrient standards of the Department of Agriculture (DOA), with nitrogen (N) above 1.0%, phosphorus (P) above 0.5%, and potassium (K) above 0.5% [13]. High-quality organic fertilizer refers to a solid organic fertilizer containing total primary nutrients of at least 9% but not exceeding 20% by weight. It is produced through composting organic materials and natural agricultural inorganic materials with high nutrient content until they are fully decomposed. It may also be obtained by mixing fully decomposed organic fertilizer with organic materials and/or natural agricultural inorganic materials that meet the specified nutrient standards [14]. Therefore, this method was used as a model in the present study, and the compost mixtures were adjusted to match the local context and potential of the study area in order to maximize its practical benefits for the community.

Therefore, this study aimed to investigate the compost production process using areca leaf sheath residues through a non-turning composting method (Passive Composting) and to analyze the quality of the compost produced. The key plant nutrient contents were compared using Atomic Absorption Spectroscopy (AAS) to measure the levels of nitrogen (N) phosphorus (P) and potassium (K) in the composts produced with different mixtures. The agricultural residues mixed with areca leaf sheaths included sugarcane leaves, rubber tree leaves, and rice straw, which were also combined with cow manure at a ratio of 4:1:1. These agricultural residues are commonly found within the community and surrounding areas. The results of this study were expected not only to produce compost but also to help reduce the accumulation of organic waste and open burning practices. In addition, it can add value to agricultural residues by converting them into compost for household use and supporting future income generation for the community.

2. Materials and Methods

Tools and Equipment

Tools and equipment for composting cage Construction of the following

- 1) ½ inch PVC plastic pipes, 60 cm in length, 36 pieces
- 2) ½ inch PVC 3-way connectors, 24 pieces
- 3) Black plastic mesh, size 60 × 240 cm, 3 rolls
- 4) Cable ties, 15 cm in length, 120 pieces
- 5) Scissors
- 6) Marker pen
- 7) Measuring tape

Materials, Equipment, and Ingredients for Compost Production of the following

- 1) 10-kg weighing scale
- 2) Shovel (for mixing materials)
- 3) Rubber gloves
- 4) 10-litter watering cans
- 5) Areca leaf sheath residues
- 6) Sugarcane leaves
- 7) Rubber tree leaves
- 8) Rice straw
- 9) Cow manure

Laboratory instruments, equipment, and chemicals (AAS) of the following

- 1) Atomic Absorption Spectroscopy (AAS)
- 2) Analytical balance (Mettler Toledo, model AG204)
- 3) Burette
- 4) Pipettes (2, 5, 10, and 25 mL)
- 5) Sampling bottles
- 6) Beakers
- 7) Volumetric flask (100 mL)
- 8) Spatulas (for scooping chemicals)
- 9) Erlenmeyer flasks (125 and 250 mL)
- 10) Droppers
- 11) Wash bottles
- 12) Stirring rods
- 13) Filter paper
- 14) Funnel
- 15) Sample mortar (stone mortar)
- 16) Strainer (2 mm mesh size)
- 17) Rubber stoppers
- 18) Extraction solution
- 19) Boric acid (H₃BO₃), AR grade
- 20) Murphy's reagent
- 21) Ascorbic acid solution

Experimental Methods

Assembly of the Composting Cage: A composting cage measuring 60 × 60 × 60 cm was constructed using ½-inch PVC pipes, 3-way PVC connectors, and plastic mesh netting. The assembly process consisted of three steps. (A) First, ½-inch PVC pipes were cut into 60-cm lengths according to the required cage dimensions. (B) Next, the PVC pipes were connected using ½-inch 3-way PVC connectors to assemble a cubic frame measuring 60 × 60 × 60 cm. (C) Finally, a plastic mesh net (60 × 240 cm) was securely attached to all four sides of the frame using cable ties, while the top and bottom were left open to facilitate material loading, aeration, drainage, and compost sampling during the composting process, as shown in Fig. 1.

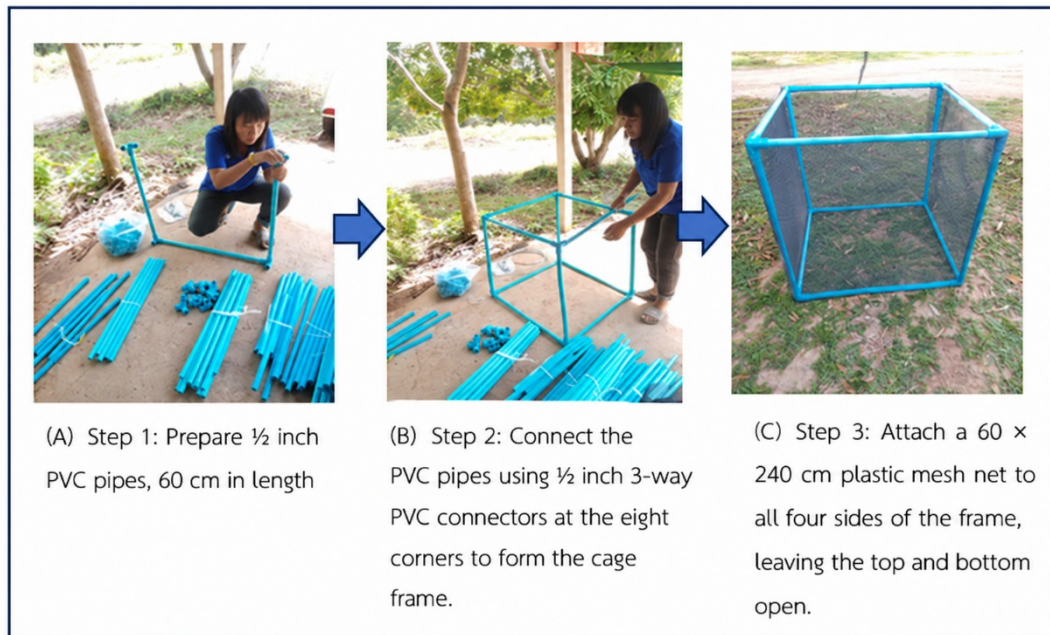


Fig. 1 Steps for assembling the composting cage: (A) preparation of 1/2-inch PVC pipes, each 60 cm in length; (B) connection of the PVC pipes using 1/2-inch three-way PVC connectors at the eight corners to form a 60 × 60 × 60 cm cage frame; and (C) attachment of a 60 × 240 cm plastic mesh sheet to the four vertical sides of the frame, leaving the top and bottom open.

Non-turning composting process

The compost production process was adapted from Maejo Engineering Maejo 1 composting method. The steps were as follows:

Step 1: The composting area was prepared by selecting a suitable location with easy accessibility, a convenient water supply for watering, and an open space with sufficient sunlight.

Step 2: The compost mixtures were determined, and the experiment was designed using a Completely Randomized Design (CRD). The experiment consisted of three treatments with three replicates each. The treatments were as follows: Treatment 1 (T1): areca leaf sheaths, sugarcane leaves, and cow manure mixed at a weight ratio of 4:1:1 (w/w); Treatment 2 (T2): areca leaf sheaths, rubber tree leaves, and cow manure mixed at a weight ratio of 4:1:1 (w/w); and Treatment 3 (T3): areca leaf sheaths, rice straw, and cow manure mixed at a weight ratio of 4:1:1 (w/w).

Step 3: The prepared composting cages were placed at the planned spots to ensure they receive sufficient sunlight. The cages were arranged in three rows, with a spacing of 50 cm between rows.

Step 4: Compost mixture in each treatment was mixed according to the specified ratio as follows:

4.1 Treatment 1 (T1): The compost mixture consisted of 8 kg of areca leaf sheaths, chopped into pieces not larger than 5 cm, 2 kg of cow manure, and 2 kg of chopped sugarcane leaves (4:1:1). The mixture was placed into a

60 × 60 × 60 cm composting cage. The treatment was prepared in triplicate. Watering was carried out twice per day: in the morning (08:30–09:00) and in the afternoon (16:30–17:00), using two 10-L watering cans each time (20 L). The total water applied was 40 L per day. The mixture was composted using the non-turning method for 60 days as shown in Fig. 2

4.2 Treatment 2 (T2): The compost mixture consisted of 8 kg of areca leaf sheaths, chopped into pieces not larger than 5 cm, 2 kg of cow manure, and 2 kg of rubber tree leaves (4:1:1). The mixture was placed into a 60 × 60 × 60 cm composting cage. The treatment was prepared in triplicate. Watering was carried out twice per day: in the morning (08:30–09:00) and in the afternoon (16:30–17:00), using two 10-L watering cans each time (20 L per watering). The total water applied was 40 L per day. The mixture was composted using the non-turning method for 60 days as shown in Fig. 3

4.3 Treatment 3 (T3): The compost mixture consisted of 8 kg of areca leaf sheaths, chopped into pieces not larger than 5 cm, 2 kg of cow manure, and 2 kg of rice straw (4:1:1). The mixture was placed into a 60 × 60 × 60 cm composting cage. The treatment was prepared in triplicate. Watering was carried out twice per day: in the morning (08:30–09:00) and in the afternoon (16:30–17:00), using two 10-L watering cans each time (20 L). The total water applied was 40 L per day. The mixture was composted using the non-turning method for 60 days as shown in Fig. 4

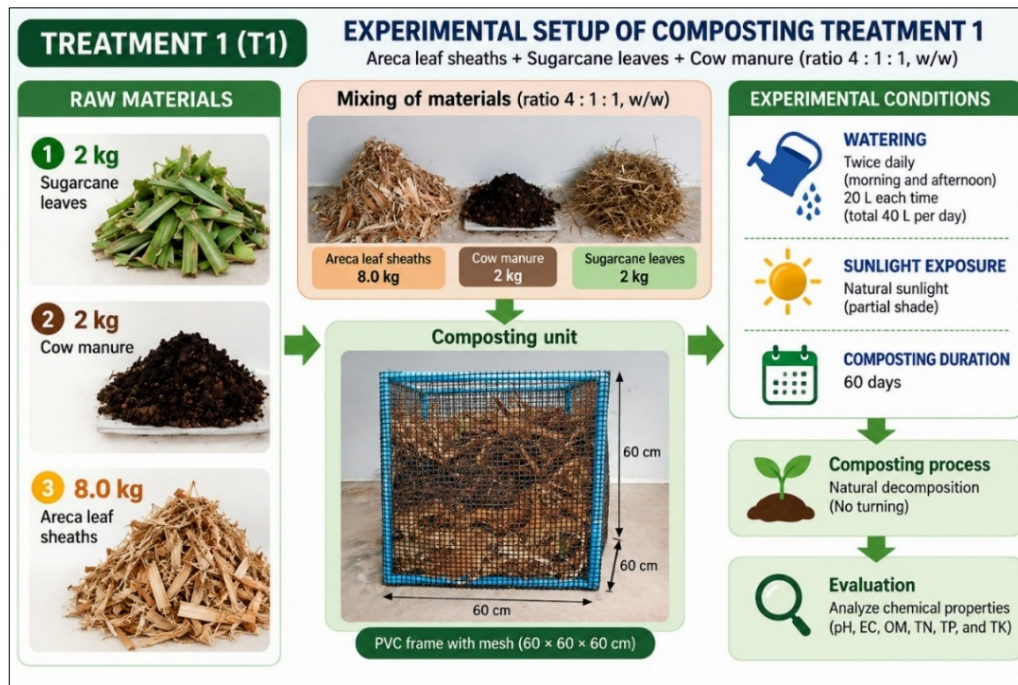


Fig. 2 Procedure for adding materials to the treatment 1 (T1) composting cage.

Sample Collection and Data Analysis

Chemical analysis: Compost samples were air-dried, ground, and sieved to obtain homogeneous material prior to analysis. The pH was determined in a 1:2 (w/v) compost-to-water suspension using a calibrated pH meter. Electrical conductivity (EC) was measured in a 1:10 (w/v) compost-to-water extract using an EC meter and expressed as dS/m. Organic matter content was determined using the Walkley

and Black method. Total nitrogen (TN) was quantified using the Kjeldahl method following acid digestion and distillation [15]. Total phosphorus (TP) was analyzed using the vanado-molybdate colorimetric method, with absorbance measured by spectrophotometry. Total potassium (TK) was determined by atomic absorption spectroscopy (AAS) after digestion. All results were reported on a dry weight basis, as shown in Table 1.



Fig. 3 Procedure for adding materials to the treatment 2 (T2) composting cage.

Statistical Analysis

The experiment was arranged in a Completely Randomized Design (CRD) with three treatments and three replicates per treatment ($n = 3$). The measured physicochemical properties of the compost, including pH, electrical conductivity (EC), organic matter (OM), total nitrogen (TN), total phosphorus (TP), and total potassium (TK), were expressed as mean $\pm$ standard deviation (SD).

The data were analyzed using one-way analysis of variance (ANOVA) to determine whether significant differences existed among the three treatments. Statistical significance was evaluated at the 5% probability level ($p < 0.05$). When significant differences were detected by ANOVA, Tukey's honestly significant difference (HSD) test was performed for pairwise comparisons among treatment means.

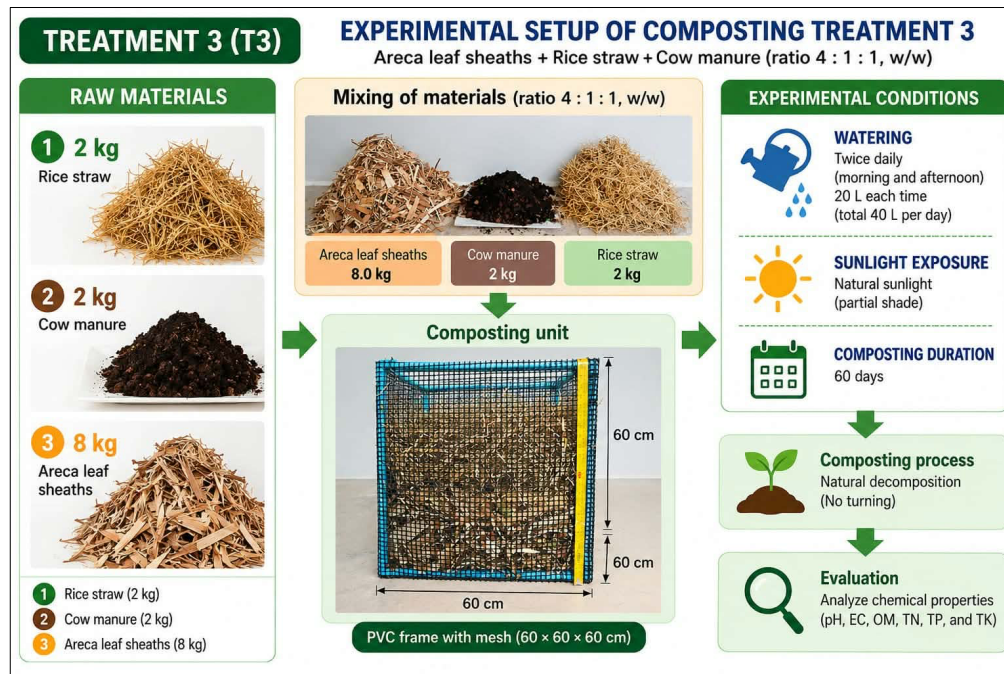


Fig. 4 Procedure for adding materials to the treatment 3 (T3) composting cage.

Table 1 Organic fertilizer standards of the department of land development.

Organic Fertilizer Properties	Unit	Standard
pH	-	7.0–8.0
EC	dS/m	0–2.0
C/N Ratio	-	0–20:1
OM	%	35–40
N	%	> 1.0
P	%	> 0.5
K	%	> 0.5
Moisture	%	0–35
Impurities	%	0–5

Notes: The quality criteria presented in this table are based on the organic fertilizer standards established by the Department of Agriculture, Thailand (2005), and were used as reference criteria for evaluating the quality of the compost produced in this study.

3. Results and Discussion

This section reports and discusses the composting performance and final chemical properties of compost obtained from areca palm leaf sheath residues processed using the non-turning composting method. Three treatments were compared at the same mixing ratio of 8:2:2 (w/w): areca leaf sheaths combined with sugarcane leaves (T1), rubber tree leaves (T2), or rice straw (T3), together with cow manure. The composting process was conducted under

static pile conditions, where aeration depended mainly on pile structure rather than turning.

Chemical properties of composts

Different composts were analyzed to determine their chemical properties (Table 2). The results were compared with the organic fertilizer standards specified by the Department of Agriculture [16]. The chemical properties of the composts produced from the three treatments are

presented in Table 2. The pH of composts ranged from 6.23 to 6.72, indicating near-neutral conditions conducive to the growth of diverse microorganisms that efficiently decompose organic matter. In aerobic composting, maintaining a suitable balance between nitrogen-rich (green) and carbon-rich (brown) materials, along with sufficient aeration, generally keeps the pH within the optimal range for microbial activity, thereby promoting efficient compost stabilization and maturation [17]. Moisture content is also an important factor influencing aerobic composting, as it affects microbial activity, heat

generation, oxygen transfer, and organic matter decomposition. Makan *et al.* [18] reported that initial moisture content significantly affected the aerobic composting process and the degradation of organic matter. Gurusamy *et al.* [19] similarly demonstrated that moisture content can influence measured compost stability. T1 showed the lowest pH (6.23), whereas T2 and T3 were slightly higher (6.72 and 6.68, respectively). EC values were low in all treatments (0.14 – 0.29 dS/m) and were far below the DOA standard (≤ 10 dS/m), suggesting minimal salinity risk when applied to soil.

Table 2 Chemical properties of compost produced from areca palm leaf sheath residues under different treatments.

Treatment	pH	EC (dS/m)	OM (%)	TN (%)	TP (% P ₂ O ₅)	TK (% K ₂ O)
T1	6.23 $\pm$ 0.02 ^a	0.247 $\pm$ 0.006 ^b	10.56 $\pm$ 0.03 ^a	0.383 $\pm$ 0.021 ^a	0.093 $\pm$ 0.021 ^a	1.30 $\pm$ 0.03 ^a
T2	6.72 $\pm$ 0.01 ^b	0.143 $\pm$ 0.015 ^a	13.48 $\pm$ 0.01 ^c	0.437 $\pm$ 0.021 ^{ab}	0.053 $\pm$ 0.025 ^a	1.66 $\pm$ 0.02 ^c
T3	6.68 $\pm$ 0.03 ^b	0.290 $\pm$ 0.010 ^c	12.66 $\pm$ 0.01 ^b	0.480 $\pm$ 0.017 ^b	0.080 $\pm$ 0.017 ^a	1.57 $\pm$ 0.01 ^b
F-value	416.44	139.36	19,078.41	18.09	2.73	268.54
p-value	< 0.001	< 0.001	< 0.001	0.003	0.143	< 0.001
DOA Notification	–	≤ 10	≥ 20	≥ 1.0	≥ 0.5	≥ 0.5

Note: Values are presented as mean $\pm$ standard deviation (SD), n = 3. Different superscript letters within the same column indicate significant differences among treatments according to Tukey's HSD test at $p < 0.05$. EC = electrical conductivity; OM = organic matter; TN = total nitrogen; TP = total phosphorus, expressed as P₂O₅; TK = total potassium, expressed as K₂O. The values for OM, TN, TP, and TK are expressed on a dry-weight basis. The DOA Notification values represent the relevant standards cited in this study.

Organic matter (OM) content varied from 10.56% to 13.48%, with the highest OM observed in T2 (13.48%), followed by T3 (12.66%) and T1 (10.56%). However, the OM content in all treatments remained below the DOA standard ($\geq 20\%$), suggesting that the composting process requires further optimization. The low organic matter (OM) content observed in the compost may be attributed primarily to carbon loss during the composting process. Composting conditions, particularly moisture availability, may also influence microbial activity and the rate of organic matter decomposition. Makan *et al.* [18] demonstrated that initial moisture content significantly affected aerobic composting and organic matter degradation. As microorganisms decompose organic materials, they utilize carbon as an energy source and release it mainly as carbon dioxide (CO₂), resulting in a gradual decline in both total carbon and organic matter content [20, 21]. Furthermore, extending the composting period beyond the maturity stage may promote the continued decomposition of the remaining organic matter by microorganisms, leading to additional carbon loss and a further reduction in OM content.

Therefore, selecting an appropriate composting duration and maintaining a balanced carbon-to-nitrogen (C/N) ratio in the initial feedstock are essential strategies for minimizing carbon loss and preserving organic matter in the finished compost [21]. In addition, incorporating carbon-rich materials as co-composting feedstocks is recommended to increase the organic matter content and improve compost quality when OM remains below the required standard [22]. TN ranged from 0.38% to 0.48% and did not meet the DOA

standard ($\geq 1.0\%$). TP ranged from 0.05% to 0.094%, also below the minimum DOA standard ($\geq 0.5\%$). In contrast, TK was relatively high (1.30–1.66%) and exceeded the DOA standard ($\geq 0.5\%$) in all treatments, reflecting the naturally high potassium content in plant residues. Overall, the composts produced through the non-turning composting method were characterized as low salinity and high potassium; however, improvements in OM, N, and P are required to comply with the DOA organic fertilizer standards.

Organic matter content differed significantly among treatments ($F = 19,078.41$, $p < 0.001$), with T2 showing the highest OM content ($13.48 \pm 0.01\%$), followed by T3 ($12.66 \pm 0.01\%$) and T1 ($10.56 \pm 0.03\%$). Total nitrogen also differed significantly among treatments ($F = 18.09$, $p = 0.003$). T3 had the highest TN content ($0.480 \pm 0.017\%$), which was significantly higher than that of T1 ($0.383 \pm 0.021\%$), whereas T2 ($0.437 \pm 0.021\%$) did not differ significantly from either treatment. In contrast, TP did not differ significantly among treatments ($F = 2.73$, $p = 0.143$), despite the numerical differences in mean values. Total potassium differed significantly among treatments ($F = 268.54$, $p < 0.001$), with T2 having the highest TK content ($1.66 \pm 0.02\%$), followed by T3 ($1.57 \pm 0.01\%$) and T1 ($1.30 \pm 0.03\%$), and all three treatments differed significantly from one another. Compost derived from agricultural residues and animal manure can provide nutrients and contribute to nutrient cycling while potentially improving soil chemical, physical, and biological properties. The effectiveness of organic amendments, however, depends on

the characteristics of the organic materials, application conditions, and crop species [23]. The use of organic amendments such as compost and animal manure can contribute to soil fertility and soil health by influencing nutrient availability and other important soil properties [24].

The study of the chemical properties of composts produced from areca leaf sheath residues combined with agricultural residues and cow manure at a ratio of 4:1:1 (w/w) in three treatments-T1 (areca leaf sheaths, sugarcane leaves, and cow manure), T2 (areca leaf sheaths, rubber tree leaves, and cow manure), and T3 (areca leaf sheaths, rice straw, and cow manure)-revealed that all compost treatments exhibited appropriate physical characteristics. The composts were dark in color, had an earthy smell, and possessed a loose and friable texture, as shown in Fig. 5.

The pH values ranged from 6.23 to 6.72, indicating slightly acidic conditions. This was likely due to the non-turning composting method, which resulted in low oxygen levels and high carbon dioxide concentrations within the compost piles. Nevertheless, the pH values were close to neutral (7.00) and were considered suitable for the composting process as well as for soil application. T1 exhibited the lowest pH, whereas T2 and T3 showed slightly higher values. A near-neutral pH provides an optimal

environment for a wide range of microorganisms to thrive and efficiently decompose organic matter. In aerobic composting, maintaining an appropriate balance between nitrogen-rich (green) and carbon-rich (brown) materials, together with adequate aeration, generally stabilizes the pH within the optimal range for microbial activity, thereby enhancing compost stabilization and maturation [25]. These findings are consistent with those reported by Oued Lhaj *et al.* [26], who investigated the evolution of compost stability and maturity during the co-composting of green waste and sheep manure over 120 days. They found that compost produced from fallen leaves exhibited a near-neutral pH (6.80), together with an EC of 2.45 mS/cm, 55% organic matter, and a C/N ratio of 16.15, indicating a mature and high-quality compost with strong potential for improving soil quality.

The EC values of all compost treatments were very low (0.14–0.29 dS/m) and clearly below the DOA organic fertilizer standard. The low EC values observed in all treatments indicate a low potential for salinity-related effects when the compost is applied to soil. However, the effects of organic amendments on soil EC may depend on the type and application rate of the organic waste, as organic amendments can alter the availability of soluble nutrients and other ions in the soil [27].

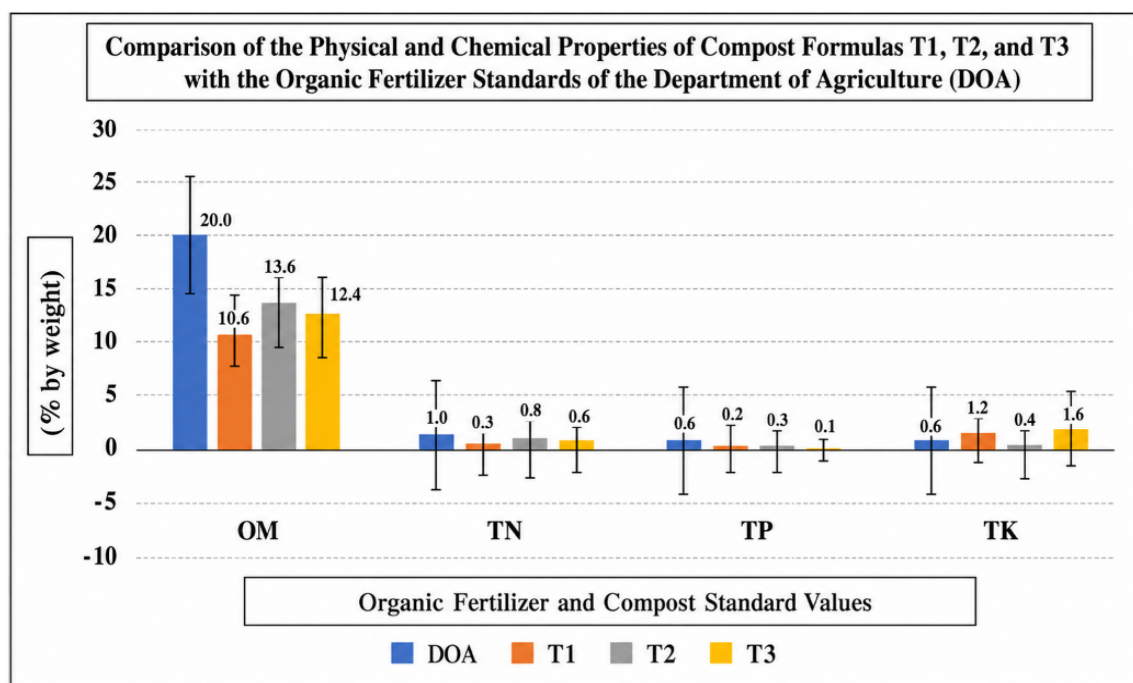


Fig. 5 Comparison of the physical and chemical properties of composts from Treatments 1 (T1), 2 (T2), and 3 (T3) with the organic fertilizer standards of the DOA.

The results are consistent with those reported by Wattanapornchai *et al.* [28], who investigated the optimal ratio of herbal medicine to agricultural residues for organic fertilizer production and evaluated the properties of the organic fertilizer produced from herbal medicine and agricultural residues. Their study found that the resulting organic fertilizer was in powder form with a dark brown

color, a pH of 8.92, and an EC of 1.08 dS/m. Similarly, the results aligned with those presented by Ruayruen *et al.* [29], who studied the production and properties of compost from agroforestry residues within a community context. Composting was performed using the non-turning method with two different formulations over 45 and 60 days. It was found that Compost Formula 1 (comprising weed and leaf

residues and animal manure at a 3:1 ratio) with a 60-day composting period produced the highest quality compost. The primary nutrient contents of N, P, and K were 2.88%, 2.52%, and 1.85%, respectively, while the moisture content and OM were 26.55% and 36.85%, respectively. The pH was 6.75, and the C/N ratio was 11:1, all of which met the DOA organic fertilizer standards.

Regarding nutrient contents, OM ranged from 10.56% to 13.48%, with T2 showing the highest OM content, followed by T3 and T1, respectively. However, the OM content in all treatments remained below the DOA organic fertilizer standard ($\geq 20\%$). Similarly, TN was only 0.38–0.48%, and TP (as P_2O_5) ranged from 0.05% to 0.094%, both failing to meet the minimum DOA standards. In contrast, TK (as $\%K_2O$) was high across all treatments (1.30–1.66%) and fully complied with the required standard.

These findings can be compared with the study by Thammayod *et al.* [30] who developed high-quality organic fertilizer from biomass waste and applied biochar in local areas of Sakon Nakhon Province, northeastern Thailand. Their study demonstrated the potential of utilizing locally available biomass waste and biochar to produce organic fertilizer with improved nutrient characteristics. This finding supports the potential of biomass residues as feedstocks for organic fertilizer production and suggests that the selection and combination of complementary materials may be important for improving the nutrient quality of compost.

These results are consistent with the compost produced from weeds, leaf residues, animal manure, and bio-extract in the Phammub Sub-district, Lablue District, Uttaradit Province, and with the compost produced from aquatic weeds and agricultural residues in the Pak Phanang River Basin, Nakhon Si Thammarat Province, which reported TP levels between 0.3% and 1.79% [31, 32]. This highlights the potential of plant residues as a natural source of potassium. In conclusion, the notable characteristics of compost produced from areca palm leaf sheath residues using the Maejo Engineering 1 non-turning method were low salinity and high potassium content, making it suitable for improving soil potassium levels. However, to meet the organic fertilizer standards, further improvements are necessary, especially regarding organic matter, nitrogen, and phosphorus content. This may be attained by adding materials rich in carbon or essential nutrients and/or extending the composting period to enhance the maturity and stability of the compost in the future.

4. Conclusion

This study demonstrated the feasibility of producing compost from areca palm leaf sheath residues using the Maejo Engineering Maejo 1 composting method non-turning composting method with locally available agricultural residues and cow manure. Three compost formulations containing areca palm leaf sheaths, sugarcane leaves (T1), rubber tree leaves (T2), or rice straw (T3) were evaluated after 60 days of composting. All treatments produced compost with desirable physical characteristics,

including a dark color, earthy odor, and loose and friable texture. The resulting composts exhibited near-neutral pH values (6.23–6.72) and low electrical conductivity (0.14–0.29 dS/m), indicating low salinity and potential suitability for soil application. Significant differences among treatments were observed in pH, EC, organic matter, total nitrogen, and total potassium, whereas total phosphorus did not differ significantly. Among the treatments, T2 produced the highest organic matter and potassium contents, while T3 provided the highest total nitrogen content. However, the organic matter (10.56–13.48%), total nitrogen (0.383–0.480%), and total phosphorus (0.053–0.093% as P_2O_5) contents remained below the relevant organic fertilizer criteria, whereas total potassium (1.30–1.66% as K_2O) exceeded the specified minimum requirement in all treatments. Overall, the non-turning composting method provides a practical community-scale approach for converting areca palm leaf sheath residues and other agricultural residues into useful compost while reducing the accumulation and open burning of biomass waste. Nevertheless, optimization of the composting formulation and process is required to increase organic matter, nitrogen, and phosphorus contents and to improve the overall nutrient quality of the final compost. Future studies should evaluate optimized formulations and their effects on soil properties and crop growth under field conditions to establish a practical and replicable community-based compost production model.

5. Suggestions

1) Based on this research, the community can produce compost from areca leaf sheaths and agricultural residues by applying the formulations and appropriate ratios identified in this study. Locally available agricultural residues with similar characteristics can also be utilized as raw materials. Community enterprises may further utilize these formulations to produce organic fertilizer for commercial distribution, thereby promoting a circular economy and reducing accumulated waste within the area.

2) Local administrative organizations and relevant agencies should establish and promote policies encouraging the use of organic fertilizers to enhance soil conservation. Additionally, they should recommend compost production, particularly by supporting the adaptation of compost formulations using areca leaf sheaths and agricultural residues to suit local conditions.

3) Further studies should investigate the effectiveness of organic fertilizer produced from areca leaf sheath residues and agricultural residues on the growth performance of household vegetables and locally cultivated crops. Experimental designs should follow established agricultural research methodologies to provide concrete evidence of fertilizer quality and to develop a practical model that can be replicated in communities with similar contexts and environmental conditions.

6. Acknowledgement

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7. Declaration of Generative AI in Scientific Writing

The authors maintain that during preparation of the manuscript all generative AI tools including language models were used only to enhance the overall coherence and readability of the English text. The manuscript was developed and analyzed by the authors, ensuring that the content is authentic and original

8. CRediT Author Statement

Kanda Pumsin: Conceptualization, Methodology Investigation, Writing Original draft preparation, Visualization, Writing Reviewing and Editing. **Sirirat Jangkon:** Methodology, Investigation, Validation. **Narumol Sota:** Methodology, Investigation Validation. **Phasita Toonsiri:** Methodology, Data curation, Data analysis, Validation.

9. Research Involving Human and Animals Rights

Not applicable

10. Ethics Approval and Consent to Participate

Not applicable

11. Declaration of Competing Interest

The authors declare that they have no competing interests

12. References

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