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Effect of storage period on physico-chemical properties of coconut water at different maturity stages

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Abstract
Coconut, a highly consumed fruit grown in tropical regions, is known as the "Tree of Life" due to its rich content of carbohydrates, vitamins, minerals, proteins and amino acids. The physico-chemical and microbiological analysis of coconuts at different maturity stages was evaluated which also ensure their quality, safety and potential applications. The tender coconuts are susceptible to microbial contamination upon opening the shell. The quality evaluation of coconut water aimed to extend its shelf life. Therefore, present study examined the physiochemical and microbiological characteristics of coconuts at various maturity stages. Increasing the time, water present in coconuts found to be decreased from 425 to 75 milliliters (mL) whereas for 12th month it found to be 0 mL. The average of green coconuts was about 2.34 kg whereas for dry coconuts it was found to be 0.36 kg. Tender coconuts had higher levels of antioxidants and phenolic compounds, while mature coconuts had higher sugar content. The microbiological analysis detected total coliforms, molds, and yeasts in all samples within acceptable limits, 20000–30000 CFU/ml while 300 CFU/ml for yeast and mold. The analysis was carried out for 3 days as the colonies were too numerous to count. Mold count in coconut water varied over time, while total coliform counts showed fluctuations with a significant surge in the 11th month. These findings provide insights into the changes in composition, quality, and safety of coconuts as they mature.

Keywords: Coconut kernel, coconut water, microbial analysis, physicochemical properties, tiptur tall

Introduction
Coconut (*Cocos nucifera*. L) is a highly consumable fruit globally widely grown in tropical regions [1]. Coconut, scientifically known as *Cocos nucifera* L., is a widely consumed fruit grown in tropical regions. It is renowned for its versatility and numerous health benefits. The coconut consists of a hard, fibrous shell enclosing a meaty center and coconut water. This tropical fruit is not only delicious but also a rich source of essential vitamins, minerals, and healthy fats. Coconut is utilized in various ways across the globe. Its unique sweetness, aroma, and composition make it a prized ingredient in skincare and haircare products, as well as in cuisines, desserts, and beverages. The meat of the coconut can be grated, shredded, or blended to produce coconut milk, cream, or oil, which are commonly used in cooking. The early stages of the growth of the coconut industry in India occurred at the same time that industrialization in Europe accelerated in the second decade of the nineteenth century. The continent's industrial progress made the rise of the European cooking oil and soap production industries possible. The businesses relied on coconut oil from India and other former colonies as a primary ingredient for their businesses. The root wilt disease started to gradually expand, and reports of its occurrence in nearby patches confirmed its presence there. Later, an independent agency was established in many States to handle agriculture. Following that, the issue of coconut cultivation became more prominent [2].
The Committee took control of the Coconut Research Station, Kasaragod, which had been run by the Madras government when it was established in 1947 to accelerate advancements in science and technology. The Committee then established a second Research Station in Kayamgulam in Kerala in order to conduct research on the root, leaf, and other diseases of the coconut palm as well as to identify and manage its various pests.

The Central Government formed the Coconut Development Board in 1981 through a parliamentary act known as the Coconut Development Board Act 1979 which takes care of the coconut plantation in India [3].

The annual production of 0.017 MT coconut contributes about 15000 crores of economic benefit to GDP the of the nation [4, 5]. The majority of the world's coconut is produced in the four Indian states (Kerala, Karnataka, Tamil Nadu, and Andhra Pradesh) which account for more than 90% of the total production [6]. As per production statistics for 2017–18, Kerala produced 5.8 lakh MT of coconut covering an area of 8.07 lakh hectares, followed by Karnataka 4.3 lakh [7]. Coconut is also known as "Tree of Life", "Tree of Heaven" or "Drupe" because it contains carbohydrate, vitamin, mineral, growth-promoting agent, protein and amino acids [8]. The coconut is divided into two different varieties tall and dwarf. These varieties are comprised of coconut water (CW) and coconut kernel (CK). The coconut It takes five years for the tall coconuts to flower, and three years for dwarf coconuts. Coconuts are tender between 7 to 10th month and mature between 11 to 12th month [9]. The percentage of coconut water (CW) in tender nuts is composed of 95% and coconut kernel (CK) as 5%, whereas for mature nuts it contains 18% water and 33% of kernel [7] [10]. The coconut components can be used for various purposes such as nutrients in the form of copra, hydration in the shape of tender-nut water, fiber for stuffing, wood for combustible and construction of structures, as well as supplies of coconut sugar, coconut oil, virgin coconut oil, coconut chips and coco pits [11].

The combination of coconut water with Tobago's and Mauby bark syrup (*Colubrina arborescens*) can help hypertensive people to decrease their blood pressure. The soft, potassium-rich coconut water increases renal output [12, 4]. Farmers frequently harvest the nut around 7th month, the jelly is less than 0.5 cm thick, soft, and transparent during the maturity stages between 7th to 9th month; after the 9th month, the jelly thickens and the water content begins to drop [13]. The tender coconut is very prone to microbial contamination once the shell is opened. The safety and shelf life of any food product depends on how chemical, physical and microbiological factors interact with it [14]. Furthermore, the conduction of microbiological examination to identify the presence of molds, yeasts, and total coliforms in the coconuts. The examination was carried out from the first day of the study until the point where the microbial count reached 300 CFU/ml (Colony Forming Units per milliliter). The target microbial count of 20,000-30,000 CFU/ml was achieved, indicating the level of microbial contamination in the coconuts. Overall, this study aimed to provide a comprehensive assessment of the physiochemical and microbiological properties of coconuts at different maturity levels, contributing to our understanding of the quality and safety aspects of coconuts for consumption [15].

Material and Methods

The coconut samples were procured from the Coconut Development Board (CDB) located in Mandya, Karnataka. The samples were collected at various stages of maturity, ranging from the seventh month to the twelfth month. For the tender coconuts, the water was extracted by breaking open the coconut and the volume of water was measured. The kernel was then scraped and the weight of the coconut was recorded. As for the mature coconuts they were first de-husked and then sliced open.

Chemicals Used

Distilled water, Phenolphthalein indicator, Sodium Hydroxide solution, Ethanol, Phenol, Sulphuric acid, Folin-Ciocalteu reagent, Sodium Carbonate, and Gallic acid.

Equipment

Digital pH meter, Lab Matrix Manufacturing LLP Hot air oven, Nihar Digital Weighing machine, Lab Matrix Manufacturing LLP Muffle furnace, Vernier caliper, Refractometer, UV-Vis Spectrophotometer, Laminar air flow chamber, Incubator, and Measuring tape.

Physical Parameters

Coconut length and diameter were measured using a tape to assess size and maturity. Length was measured from top to bottom along the coconut's axis, while diameter was measured around its widest part [6]. Further, the coconuts were weighed using an electronic weighing balance with a precision of grams, and the readings were summed. The findings were documented, and the mean mass was calculated. The use of an electronic weighing balance ensured accurate and precise measurements, allowing for a comprehensive assessment of the coconut masses [6].

Shell Thickness

The diameter of the coconut shell was measured using a tape by encircling it around the circumference. The equation used to find the diameter of the shell thickness was

$$d = c/\pi \quad (1)$$

Where, c- circumference of the coconut, d-diameter of the coconut shell, π-3.14 [6].

Kernel Thickness

The thickness of the coconut kernel (fruit endosperm) was examined in terms of its physical features using a Vernier caliper [6].

Chemical parameters

pH and Titratable Acidity

The pH of the coconut water was determined using a digital pH meter, while the titratable acidity was measured using a titration method. A 5 ml sample of coconut water was diluted with 100 ml of water. A 10 ml portion of this diluted sample was transferred to a 100 ml conical flask, and a few drops of phenolphthalein indicator were added.

Titratable acidity was determined by titrating the sample with 0.1 N NaOH until a pale pink color was reached (indicating the final point). This process was repeated to obtain consistent results. The titratable acidity was then estimated using a formula that calculates the equivalent amount of citric acid [16].

$$\text{Acidity (\%)} = \frac{\text{Titre value} \times \text{Normality of the alkali} \times \text{molecular wt. of citirc acid}}{\text{weight of the sample taken}} \times 100 \quad (2)$$

Citric acid milli equivalent weight = 0.06404

Total Soluble Solids (TSS)
A Digital Refractometer, measured in degrees Brix, was used to determine the Total Soluble Solids (TSS) of coconut water. It measures the refractive index of the liquid, providing a reading that corresponds to the sugar content or TSS concentration in the coconut water [5].

Total Sugars
A 500 ml beaker was used, and 5g of the sample was added to it. Then, 100 ml of warm water was added and neutralized with 10% NaOH. Following that, 2 ml of lead acetate solution was added and left for 10 minutes. The necessary amount of sodium oxalate solution was added to remove the excess lead, and the volume was adjusted accordingly. The solution was then filtered and transferred to a 250 ml flask where 50 ml of the clarified and deleaded solution was transferred later about 10 ml of 1N HCl was added into the flask and boiled for 2 minutes.
The titration continued until the color completely disappeared. The Percentage of the sugar was calculated by the following formula

$$\text{Total sugars Mg/ 100ml} = \frac{\text{Factor x 100}}{\text{Titre}}$$

$$\%\ \text{Total Sugar} = \frac{\text{mg /100 ml x Dilution x 100}}{\text{Weight of the sample x 1000}}$$

Determination of Factor (for Invert Sugar) of Fehling Solution
Approximately 4.75 g of annular sucrose was accurately weighed and transferred to a 500 ml volume flask, along with 50 ml of distilled water. Then, 5 ml of concentrated HCl was added, and the mixture was allowed to stand for 24 hours. Afterward, it was neutralized using NaOH solution and made up to the desired volume.
The solution was mixed thoroughly, and then 50 ml of it was transferred to a 100 ml volumetric flask and made up to the volume. Finally, the solution was transferred to a burette, which had an offset tip for accurate measurement [AOAC 1998]. To perform the titration of Fehling solution following the similar procedure as above:

$$\text{Fehling Factor (for Invert Sugar)} = \frac{\text{Titre x Weight of Sucrose in g}}{500} \quad (3)$$

Moisture Content
To determine the moisture content of the sample, 5 grams of crushed material were placed in Petri dishes and baked for two hours at 100 °C, aiming to maintain a steady weight. This process involved subjecting the sample to elevated temperature to remove any moisture present. Subsequently, the moisture content was computed based on the dry weight of the material, allowing for an accurate assessment of the proportion of moisture relative to the sample's dry mass [5].

$$\text{Moisture Content (\%)} = \frac{\text{(weight of initial sample- weight of final sample)}}{\text{weight of final sample}} \times 100 \quad (4)$$

Ash Content
The material was burned until the organic components were completely consumed, leaving behind the ash residue. After cooling the crucibles in a desiccator to prevent moisture absorption, the weight of the ash was determined using a weighing balance. This process allowed for the calculation of the ash content, providing valuable information about the inorganic mineral content present in the material [6].

$$\text{Ash Content (\%)} = \frac{\text{(Weight of ash)}}{\text{(Weight of sample)}} \times 100 \quad (5)$$

Total Phenolic Content (TPC)
The concentration of phenolics in the plant sample was determined using the spectrophotometric method, specifically the folin-Ciocalteu assay. In this method a reaction mixture was prepared by combining 1 ml of alcoholic extract from the plant sample with 9 ml of distilled water in a volumetric flask (25 ml). To this mixture 1 ml of Folin-Ciocalteu phenol reagent was added and thoroughly shaken. After a 5-minute incubation period 10 ml of 7% Sodium carbonate ($Na2CO_3$) solution was added to the mixture [5].

Total Antioxidants
These known concentrations of ascorbic acid were used to determine the relationship between the absorbance and the antioxidant capacity [AOAC 1998].

$$\text{Inhibition (\%)} = \frac{\text{absorbance (constant)-absorbance (sample)}}{\text{absorbance (constant)}} \times 100 \quad (6)$$

Microbiological Analysis
Identification of Yeats and Molds
To assess the presence of yeasts and molds, a standardized procedure was followed. Each sample was diluted with 9 ml of distilled water in serial dilutions, with 1 ml of the diluted sample used for further analysis. Subsequently, 100 µl of the supernatant from each dilution was aseptically transferred onto disinfected and labeled petri plates. To support the growth of yeasts and molds, 20 ml of melted Potato Dextrose Agar (PDA) was poured into each plate [17].

Total Coliform Count
The EMB agar is commonly employed in water quality studies to differentiate between Total Coliforms and fecal coliforms which are indicators of potential pathogenic microbe contamination. Following the inoculation, the plates were incubated under aerobic conditions at a temperature range of 35 to 37 °C. It was important to protect the plates from light during the incubation period. The incubation duration typically lasted between 18 to 24 hours allowing sufficient time for bacterial growth and the development of distinct colonies. This standardized procedure facilitated the identification and differentiation of indicator bacteria, aiding in the assessment of potential microbial contamination in water samples [18].

Statistical Analysis
The average values and standard deviations (SD) obtained from triplicate analyses are reported. Each analysis was performed on coconut water and kernel samples. To determine significant differences between the samples, a one-way analysis of variance (ANOVA) was conducted using Minitab software. The ANOVA analysis allowed for the comparison of means across multiple groups. In order to establish significant differences at a confidence level of p-value ≤ 0.05, a two-tailed p-value was calculated. This statistical approach helped to assess the significance of variations observed between the coconut water and kernel samples, providing valuable insights into the characteristics and composition of the samples [5].

Results and Discussion

The results and discussions presented in this chapter aim to offer valuable insights into the changes that occur within the coconut during different stages of maturity. By examining these findings, it is possible to establish a clear guide for determining the optimal moment to harvest and utilize coconuts for various applications.

Physicochemical analysis

Table 1: Water volume in Coconut Water

Sl. No	Maturity Stages	Average	SD	Final Value
1	7th month	425	0	425±0[a]
2	8th month	415	0	415±0[b]
3	9th month	385	0	385±0[c]
4	10th month	270	0	270±0[d]
5	11th month	75	0	75±0[e]
6	12th month	0	0	0±0[f]

P value is 0 which means they are not significantly different.

The above table 1 showed that the volume of water decreased as the coconuts matured. There was significant difference in the p-value. The volume of water was highest in the tender nut stage (7th month) whereas the water volume was less in the mature nut stage (11th month). There was no water present in the 12th month as it was fully copra. The researchers observed a significant difference in the p-value, indicating distinct variations in water content. Specifically, the volume of water was highest during the tender nut stage (7th month) and decreased as the nuts reached the mature nut stage (11th month). Notably, the 12th month exhibited no water content, as it corresponded to the stage when the coconut had fully transitioned into copra. The water reduced due to the formation of jelly from 8th month.

The results were similar observed by other researches supporting the data that water volume decreases as coconuts mature. The researchers also noted significant differences among various stages of maturity ($p < 0.05$). The highest water volume was again observed during the tender nut stage, while the mature nut stage showed a decrease in water content. Additionally, the formation of a "jelly" within the nut was mentioned as a significant factor contributing to the reduction in water volume. This jelly formation occurred between stages 9 and 10, causing a decrease in the overall water content. The study also introduced the concept of variety-specific differences, highlighting the MT variety as having larger nuts and producing a higher volume of nut water throughout maturation compared to other varieties. [17].

Weight of Coconut

Table 2: Weight of Coconut

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	2724.83	0.235	2724.83±0.235[b]
2	8th month	3043.66	0.235	3043.66±0.235[a]
3	9th month	1869	0.707	1869±0.707[c]
4	10th month	1754	0	1754±0[d]
5	11th month	397.16	0.235	397.16±0.235[e]
6	12th month	328.83	0.235	328.83±0.235[f]

The above table 2 show the weight of coconut at different maturity stages in grams. There was significant difference in the p-value. The above data showed the weight of coconuts at different maturity stages and finds a significant difference in weight across these stages. The tender stage shows a growth in weight until the 8th month, followed by a decrease in weight thereafter. The study reports average weights of approximately 2.34 kg for green coconuts and 0.36 kg for dry coconuts.

On the other hand, previous studies focused on comparing the weight difference between dry and green coconuts. It finds a highly significant difference, with green coconuts having an average weight of 1.30 kg and dry coconuts weighing around 0.98 kg. While both studies demonstrate variations in coconut weight they differ in terms of the specific comparisons made and the average weight values reported. These differences were because of attributed to factors such as sample selection or variations in coconut varieties [19].

Size of Coconut

Table 3: Length of Coconut

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	311.33	0.942	311.33±0.942[b]
2	8th month	291.33	0.942	291.33±0.942[a]
3	9th month	258	0.816	258±0.816[c]
4	10th month	245.66	0.471	245.66±0.471[d]
5	11th month	243	0.816	243±0.816[f]
6	12th month	183.66	0.471	183.66±0.471[e]

The above table 3 shows the length of coconut in mm for different maturity stages. There was significant difference in the p value. The average length of mature coconuts was reported to be 276.58 mm, while the tender coconuts had an average length of 224.16 mm. These findings indicate that coconuts tend to grow longer as they mature. The study showed that the length differences across various maturity stages emphasizing the contrast between mature and tender coconuts. In contrast previous studies focused specifically on comparing the length of dry and green coconuts. The average length of dry coconuts was found to be 246.98 mm, while green coconuts exhibited an average length of 248.89 mm. Interestingly, there appears to be a marginal difference in length between the two coconuts, with green coconuts being slightly longer on average and reported slightly different average lengths for each coconut [20].

Table 4: Diameter of Coconut

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	538	0.816	538±0.816[b]
2	8th month	562	0.816	562±0.816[a]
3	9th month	472	0.816	472±0.816[c]
4	10th month	452	0.816	452±0.816[d]
5	11th month	243	15.326	243±15.326[e]
6	12th month	308	0.707	308±0.707[f]

The above table 4 show the diameter of coconut in mm for different maturity stages. There was significant difference in the p-value. The average diameter of tender coconuts is reported to be 506 mm, while dry coconuts exhibit a considerably smaller average diameter of 286.33 mm. These findings indicate a clear variation in diameter between tender and dry coconuts, with tender coconuts being significantly larger. It primarily focused on the diameter differences between tender and dry coconuts, highlighting the significant disparity in size between these maturity

stages. On the other hand, the researchers studied the distinction between dry and green coconuts, noting a relatively smaller difference in diameter. It is important to acknowledge that the observed differences in diameter might be influenced by additional factors such as the age of the coconuts, environmental conditions, or genetic variations The two studies showed significant differences in the diameter of coconuts at different stages for tender and dry coconuts [21].

Table 5: Kernel Thickness of Coconut

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	0	0	0±0 b
2	8th month	1.2	0.216	1.2±0.216a
3	9th month	1.38	0.008	1.38±0.008a
4	10th month	1.46	0.047	1.46±0.047a
5	11th month	1.5	0.081	1.5±0.081a
6	12th month	1.66	0.169	1.66±1.66a

The above table 5 show the kernel thickness of coconut in mm for different maturity stages. There was significant difference in the p-value. In the 7th month, the coconut was filled with water and the kernel was not yet present. As the coconut gradually matured, the water transformed into a jelly-like substance which then developed into a kernel. By the 8th month, the jelly was transparent and by the 11th month it had transformed into a thick, milky white kernel. Finally, in the 12th month, the kernel had fully transitioned into copra. The study reveals that the kernel thickness increased from an initial measurement of 1.2±0.216a to 1.66±1.66a as the coconut matured. The thickest kernel was observed in the 12th month. These findings provide insights into the changes that occur in the kernel thickness of coconuts during the maturation process [21].

Table 6: Shell Thickness of Coconut

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	5.246	0.024	5.246±0.024c
2	8th month	6.752	0.000	6.752±0.000b
3	9th month	4.713	0.001	4.713±0.001d
4	10th month	7.297	0.004	7.297±0.004a
5	11th month	1.657	0.000	1.657±0.000e
6	12th month	1.66	0.169	1.66±0.169e

The above table 6 shows the shell thickness of coconut in mm for different maturity stages. There was a significant difference in the p-value. The study focused on the variations in husk thickness between mature and tender coconuts. It showed that mature coconuts have a thicker husk at specific locations, such as the pedicel end, apex, and halfway along the shell. In contrast, tender coconuts exhibit a thicker shell profile at the ¼th and ¾th distance along the shell. These findings suggest a differential distribution of husk thickness at different maturity stages. Dry coconuts have a thicker husk at the pedicel end, apex, and halfway distance, while green coconuts demonstrate a thicker husk at the ¼th and ¾th distance along the shell. The significance of this difference is tested at a 0.5 significance level. Both the studies provide valuable insights into the variations in coconut shell thickness, emphasizing the influence of maturity and coconut type [22].

Chemical Parameters

The following parameters are done for coconut water (CW)

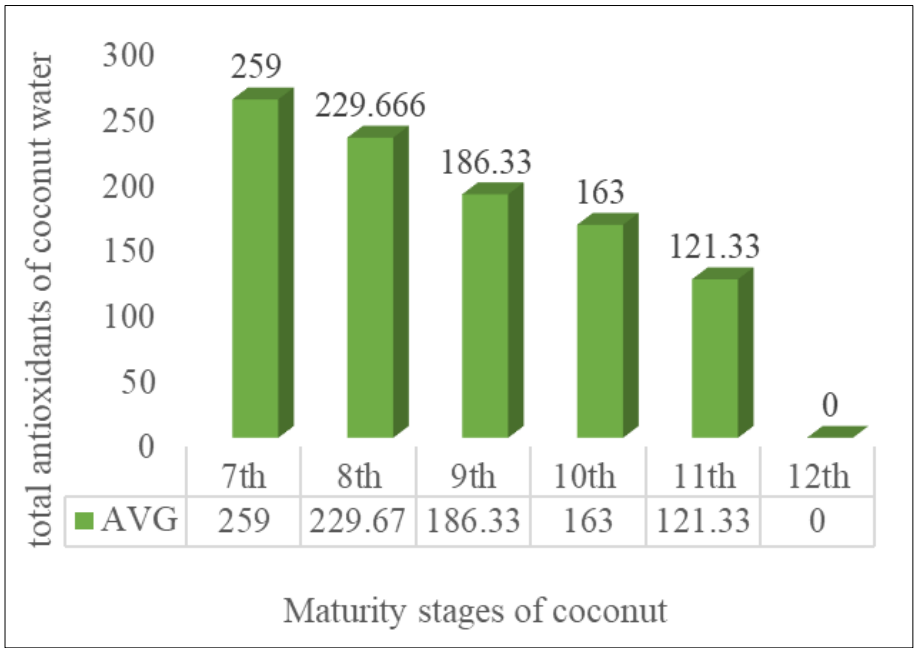

Fig 1: Total Antioxidants of Coconut Water

The above fig 1 show the total antioxidants of coconut water for different maturity stages. There was significant difference in the p-value. This study analyzed the total antioxidants of coconut water at different maturity stages. The results showed a significant difference in the p-value, indicating that antioxidant activity varied with coconut maturity. The total antioxidants decreased gradually as the coconuts matured. The highest levels were observed in the 7th month, followed by a decline in the 11th month. Additionally, it was noted that there was no water present in the 12th month. However, the specific antioxidant compounds or measurement methods used in this study was not carried out. These results were supported by a researcher who observed that the ability of coconut water to scavenge DPPH, ABTS, and superoxide radicals was significantly reduced as the coconut grew older. This suggests a decline

in the antioxidant activity of coconut water with increasing coconut maturity. However, it was also mentioned that coconut water showed significantly higher antioxidant activities when measured using DPPH, FRAP, and ABTS methods. The study concluded that coconut water contained higher amounts of antioxidants, indicating better antioxidant properties [23].

Total Phenolic Content

Table 7: Total Phenolic content of Coconut Water

Sl.no	Maturity stages	Average	SD	Final value
1	7th month	51.33	0.124	51.33±0.124 a
2	8th month	46.96	0.124	46.96±0.124b
3	9th month	42.23	0.124	42.23±0.124c
4	10th month	36.6	0.081	36.6±0.081 d
5	11th month	28.2	0.124	28.2±0.124e
6	12th month	0	0	0±0f

The above table 7 show the total phenolic content of coconut water for different maturity stages. There was significant difference in the p-value. In this study the total phenolic content of coconut water was found to decrease gradually as the coconuts progressed in maturity. The highest levels of phenolic content were detected in the 7th month, suggesting a peak in antioxidant activity during that stage. However, the phenolic content exhibited a decline in the 11th month, indicating a potential decrease in antioxidant potential as the coconuts matured further. The absence of water in the 12th month indicates a potential decrease in overall phenolic compounds available in the water [6]. These results were supported by a researcher who demonstrated that coconut water had a significantly lower total phenolic content compared to another substance. This suggests that as the coconuts grew older, the total phenolic content of coconut water diminished even more, indicating a potential decline in its antioxidant properties. Both studies reported a significant difference in the p-value, indicating variations in the phenolic content among these stages. Additionally, it was observed a consistent trend of decreasing total phenolic content as the coconuts mature (expressed as mg 100 g^{-1} gallic acid equivalent) [24].

Total Sugar

Table 8: Total Sugars of Coconut Water

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	7.80	0.004	311.33±0.942a
2	8th month	7.22	0.016	291.33±0.942b
3	9th month	6.81	0.012	258±0.816c
4	10th month	6.55	0.012	245.66±0.471d
5	11th month	5.70	0.009	243±0.816e
6	12th month	0	0	0±0 f

The above table 8 shows the total sugars of coconut water for different maturity stages. There was a significant difference in the p-value. The study on the total sugars of coconut water at different maturity stages provide consistent findings regarding the gradual decrease in sugar content as coconuts mature. The highest sugar levels are observed in the 7th month, with a subsequent decline in the 11th month. The absence of water in the 12th month suggests a potential decrease in sugar availability. The study also highlighted a shift in sugar composition, with reducing sugars like fructose and glucose being predominant in the early stages of maturation, constituting over 75% of the sugar content. However, as maturation progresses, there is an increase in the concentration of non-reducing sugar, particularly sucrose. The results were similar to research conducted by other researcher who reported a significant increase in total, reducing, and non-reducing sugars during maturation. The interaction between maturity and variety also influences sugar content. The highest total sugar content is recorded at a specific stage, followed by a gradual decrease towards full nut maturity. Similar results have been reported by other researchers, indicating the importance of glucose and fructose in the early months of maturation and an overall increase in sugar concentration [25].

pH of Coconut Water

Table 9: pH of Coconut Water

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	5.25	0.005	5.25±0.005 e
2	8th month	5.43	0.001	5.43±0.001 d
3	9th month	6.3	0	6.3±0a
4	10th month	5.484	0.073	5.484±0.073c
5	11th month	5.7	0.001	243±0.816b
6	12th month	0	0.0	0±0f

The above table 9 show the pH of coconut water for different maturity stages. There was a significant difference in the p-value. The pH of coconut water increased from 7th to 9th month and gradually decreased while the coconuts matured from 10th to 11th based upon these recent studies, whereas there was no water present in the 12th month. The pH varied from 5.2 to 6.3 for the Tiptur tall variety. The study demonstrate that the pH of coconut water undergoes changes during the maturation process. According to other researchers, the study showed that the pH trend differs for the Yellow Dwarf variety. In the case of the Yellow Dwarf variety the pH steadily decreases throughout maturity except for a slight increase at stage 10. These variations in pH with maturity are consistent with the findings of Pue *et al*., who reported an increase in pH from 4.7 to 5.58 as coconuts matured in their samples [26].

Titratable Acidity of Coconut Water

Table 10: Titratable Acidity of Coconut Water

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	0.008613	7.408	0.008613±7.408a
2	8th month	0.007596	3.771	0.007596±3.771b
3	9th month	0.00755	2.160	0.00755±2.160 b
4	10th month	0.00732	8.164	0.00732±8.164c
5	11th month	0.00685	0.0001	0.00685±0.0001d
6	12th month	0	0	0±0e

The above table 10 show the Titratable acidity of coconut water for different maturity stages. There was significant difference in the p value. The Titratable acidity of coconut water decreased gradually while the coconuts matured based upon this recent studies. The Titratable acidity of coconut water was high in the 7th month and low in 11th month, whereas there was no water present in the 12th month. The results supported the studies conducted by another researcher who observed that varieties tend to have a concurrent reduction in titratable acidity. This phenomenon

was particularly evident in the Orange Dwarf and Mayapan Tall varieties. The study conducted by other researcher also showed the decrease in titratable acidity as the the coconuts matured. The study showed the impact of acidity on the flavor of coconut water. The findings reveal that the highest titratable acidity value is observed in the first maturity stage, while the lowest value is observed in the fourth maturity stage [27].

Total Soluble Solids of Coconut Water

Table 11: Total Soluble Solids of Coconut Water

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	5.3	0	5.3±0^{d}
2	8th month	6	0	6±0^{b}
3	9th month	6.3	0	6.3±0^{a}
4	10th month	5.2	0	5.2±0^{e}
5	11th month	5.8	0	5.8±0^{c}
6	12th month	0	0	0±0^{f}

Table 11 show the Total soluble solids of coconut water for different maturity stages. There was significant difference in the p-value. The data shows a gradual increase in total soluble solids from the 7th to the 9th month, reaching 5.3 to 6.3° Brix. However, in the 10th month, there is a decrease to 5.2° Brix, followed by another increase in the 11th month. It is important to note that there is no water present in the 12th month. The results were also supported by another researcher who reported a steep decline in the total solids content of coconut water during maturation. While specific details regarding the maturity stages and measurement units are not mentioned, the study aligns with the notion that the total solids content decreases as the coconuts mature. These variations emphasize the complexity of changes in the composition of coconut water as it progresses through different maturity stages [22]. The following parameters are done for coconut kernel (CK)

Moisture Content for Coconut Kernel

Table 12: Moisture content of Coconut Kernel

Sl. No	Maturity stages	Average	STD	Final value
1	7th month	0	0	0±0^{f}
2	8th month	83.01	0.0001	83.01±0.0001^{a}
3	9th month	74.06	0.0001	74.06±0.0001^{b}
4	10th month	72.72	0.0002	72.72±0.0002^{c}
5	11th month	65.01	8.3e-05	65.01±8.3e-05^{d}
6	12th month	56.02	0.0001	56.02±0.0001^{e}

The above table 12 show the Moisture Content of coconut kernel for different maturity stages. There was significant difference in the p-value. The moisture content of coconut kernel decreased gradually from the 8th to 12th month from 83% to 56%, whereas there was no kernel present in the 7th month as it was full of nut water based on these studies. The results were similar to conducted by a researcher who examined the moisture content of coconut kernel. The specific values mentioned are 85.3%, 78.2%, and 51%. The studies inferred that the moisture content decreases over time. Overall, the studies provide evidence that as the coconut kernel matures, the moisture content decreases [5].

Ash Content for Coconut Kernel

Table 13: Ash content of Coconut Kernel

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	0	0	0±0^{f}
2	8th month	1.75	0.042	1.75±0.042^{a}
3	9th month	1.48	0.040	1.48±0.040^{b}
4	10th month	1.31	0.024	1.31±0.024^{c}
5	11th month	0.93	0.047	0.93±0.047^{d}
6	12th month	0.81	0.024	0.81±0.024^{e}

The above table 13 show the Ash Content of coconut kernel for different maturity stages. There was significant difference in the p-value. The ash content of coconut kernel decreased gradually from 8th to 12th month from 1.75% to 0.81%, whereas there was no kernel present in the 7th month as it was full of nut water based upon these studies. These results were supported by a researcher who mentioned that the ash content in defatted coconut kernel (CK) decreases with maturity. both indicate a decrease in ash content as the coconut kernel matures. Overall, both studies support the notion that as the coconut kernel matures, the ash content tends to decrease [5].

pH for CK

Table 14: pH of Coconut Kernel

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	0	0	0±0^{c}
2	8th month	7.84	0.0008	7.84±0.0008^{a}
3	9th month	7.16	0.016	7.16±0.016^{b}
4	10th month	7.1	0.010	7.1±0.010^{a}
5	11th month	7.05	0.011	7.05±0.011^{b}
6	12th month	7.02	0	7.02±0^{b}

The above table 14 show the pH of coconut kernel for different maturity stages. There was a significant difference in the p-value. In this study, the pH of coconut kernels decreased slowly from the 8th month to the 12th month, going from 7.8 to 7.0. This showed that as the coconut matures, the pH of the kernel becomes slightly more acidic. Additionally, in the 7th month, there was no kernel present as it was filled with nut water. This indicates that at this stage, the coconut is primarily composed of the liquid content known as nut water or coconut water, rather than having a developed kernel [17].

Total Soluble Solids for CK

Table 15: Total soluble solids of Coconut Kernel

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	0	0	0±0^{f}
2	8th month	8	0	8±0^{e}
3	9th month	9.33	0.047	9.33±0.047^{d}
4	10th month	10.16	0.124	10.16±0.124^{c}
5	11th month	10.53	0.124	10.53±0.124^{b}
6	12th month	11.383	0.062	11.383±0.062^{a}

Table 15 show the Total Soluble Solids of coconut kernel for different maturity stages. There was significant difference in the p-value. In this study, the TSS of the coconut kernel increased gradually from the 8th month to the 12th month, rising from 8° Brix to 11.3° Brix. An increase in

TSS indicates that the coconut kernels became sweeter or had a higher concentration of soluble solids as they matured.

Microbiological Analysis

Coconut water (CW) and coconut kernel (CK) samples were subjected to a 10^{-3} serial dilution microbiological analysis. The daily growth of yeasts, molds, and total coliforms is the focus of the results and debates that follow below.

According to ISO, an Indian standards group, the acceptable limit for yeast, mold, and coliforms is 20000–30000 CFU/ml while it is 150 CFU/ml for yeast and mold. These recent studies' data were gathered for days 1, 2, and 3 since there were too many colonies to count on day 4. 250–300 colonies CFU/ml are the maximum countable colonies in a Petri dish [16].

Yeasts and Molds in Coconut Water

Table 16: Yeasts and Molds in Coconut Water Day-1

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	7.33×10^{-3}	0.471	7.33 ± 0.471^{b}
2	8th month	13×10^{-3}	0.816	13 ± 0.816^{a}
3	9th month	3.33×10^{-3}	0.471	3.33 ± 0.471^{c}
4	10th month	7×10^{-3}	0	7 ± 0^{b}
5	11th month	7.66×10^{-3}	0.471	7.66 ± 0.471^{b}
6	12th month	0	0	0 ± 0^{d}

Table 16 shows the yeasts and mold growth in coconut water for different maturity stages on the first day. There was significant difference in the p-value. The analysis revealed that molds and yeasts were detected in all the samples analyzed, with the microbial counts exceeding the permissible limit of 300 Colony-Forming Units (CFU) per milliliter. The counts were obtained by multiplying the number of colonies with the corresponding serial dilution (10^{-3}). The observations showed fluctuations in mold and yeast populations over time. On the first day (day-1), the mold count increased from the 7th month to the 8th month, followed by a decrease in the 9th month. However, the count rose again during the 10th month and then diminished in the 11th month. There was no water present in the 12th month, as it had fully transformed into copra. These variations in mold and yeast populations provide valuable insights into the growth patterns of these microorganisms as coconut water matures. The significant difference in p-value indicates that the maturity stage has an impact on the microbial growth in coconut water. These results were supported by a researcher who detected the molds and yeasts in all the samples analyzed, and the microbial counts exceeded the test limit of 300 Colony-Forming Units (CFU) per milliliter. This information highlights the importance of maintaining refrigeration for foods that undergo microbial reduction processes, as refrigeration failure can lead to an increase in microbial load. Both studies emphasize the presence and growth of molds and yeasts in coconut water [20].

Table 17: Yeasts and Molds in Coconut Water Day-2

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	19×10^{-3}	0.816	19 ± 0.816^{b}
2	8th month	38.33×10^{-3}	0.942	38.33 ± 0.942^{a}
3	9th month	14.33×10^{-3}	0.942	14.33 ± 0.942^{c}
4	10th month	18.66×10^{-3}	0.471	18.66 ± 0.471^{b}
5	11th month	19×10^{-3}	0	19 ± 0^{b}
6	12th month	0	0	0 ± 0^{d}

Table 17 shows the yeasts and mold growth in coconut water for different maturity stages on the second day. There was a significant difference in the p-value. The molds and yeasts were detected in all the analyzed samples, and their counts exceeded the permissible limit of 300 Colony-Forming Units (CFU) per milliliter. The counts were obtained by multiplying the number of colonies with the corresponding serial dilution (10^{-3}). Observations from the data indicate that the mold count doubled within 24 hours on the second day. Furthermore, the mold count increased from the 7th month to the 8th month and then decreased in the 9th month. The count rose again during the 10th month and continued to increase until the 11th month. There was no water present in the 12th month as it had fully transformed into copra. These findings provide valuable insight into the growth patterns of molds and yeasts in coconut water as it matures over time. The significant difference in the p-value suggests that the maturity stage influences the growth of these microorganisms. The molds and yeasts were also detected in all the samples analyzed by These results were supported by a researcher who and their counts exceeded the test limit of 300 Colony-Forming Units (CFU) per milliliter. The results were similar to their studies a molds and yeasts multiplied within 24 hours [21].

Table 18: Yeasts and Molds in Coconut Water Day-3

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	36×10^{-3}	0.816	36 ± 0.816^{d}
2	8th month	87×10^{-3}	0.816	87 ± 0.816^{a}
3	9th month	51×10^{-3}	0	51 ± 0^{b}
4	10th month	42×10^{-3}	1.414	42 ± 1.414^{c}
5	11th month	40.33×10^{-3}	0.471	40.33 ± 0.471^{c}
6	12th month	0	0	0 ± 0^{e}

Table 18 shows the yeasts and mold growth in coconut water for different maturity stages on the third day. There was a significant difference in the p-value. The results indicate that molds and yeasts were present in all the analyzed samples, with microbial counts exceeding the test limit of 300 Colony-Forming Units (CFU) per milliliter. The counts of molds and yeasts were determined by multiplying the number of colonies with the corresponding serial dilution (10-3). It was noted that all the colonies observed were below the permissible limit of 300 CFU/ml. Observations revealed that within a 24-hour period on the third day, the mold count doubled. Furthermore, the mold count increased from the 7th month to the 8th month and gradually decreased starting from the 9th month. It is worth mentioning that no water was present in the 12th month as it had fully transformed into copra. These fluctuations in the populations of molds and yeasts over time provide valuable insights into their growth patterns as coconut water matures. The significant difference in the p-value indicates that the maturity stage has an influence on the growth of these microorganisms. The results were similar to the ISO standards of identification of yeasts and molds growth [27].

Yeasts and Molds in Coconut Kernel

Table 19: Yeasts and Molds in Coconut Kernel Day-1

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	0	0	0 ± 0^{c}
2	8th month	15×10^{-3}	0.816	15 ± 0.816^{a}
3	9th month	14.66×10^{-3}	0.471	14.66 ± 0.471^{a}
4	10th month	8×10^{-3}	0.816	$8\pm0.816^{a, b}$
5	11th month	11.66×10^{-3}	0.471	11.66 ± 0.471^{a}
6	12th month	1×10^{-3}	0	$1\pm0^{b, c}$

Table 19 shows the yeasts and mold growth in coconut kernel for different maturity stages on the first day. There was significant difference in the p-value. Molds and yeasts were detected in all analyzed samples, with microorganism counts surpassing the test limit of 300 Colony Forming Units (CFU) per milliliter. The readings are taken based on the number of colonies multiplied by the serial dilution (10^{-3}). The following data showed that all the colonies were below 300 CFU/ml which is the permissible limit. Observations showed that the mold count increased in coconut kernel on the first day (day-1) from the 8th month to the 9th month and then decreased on the 10th month. Interestingly, the count rose again during the 11th month but diminished by the 12th month. There was no kernel present in the 7th month as the coconut was full of nut water. These fluctuations in mold and yeast populations provide valuable insight into the growth patterns of these microorganisms over time based on these recent studies.

Table 20: Yeasts and Molds in Coconut Kernel Day-2

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	0	0	0 ± 0^{d}
2	8th month	45.33×10^{-3}	0.471	45.33 ± 0.471^{a}
3	9th month	46.33×10^{-3}	0.471	46.33 ± 0.471^{a}
4	10th month	23×10^{-3}	0	23 ± 0^{c}
5	11th month	31.33×10^{-3}	0.942	31.33 ± 0.942^{b}
6	12th month	1×10^{-3}	0	1 ± 0^{d}

Table 20 shows the yeasts and mold growth in coconut kernel for different maturity stages on the second day. There was significant difference in the p-value. Molds and yeasts were detected in all analyzed samples, with microorganism counts surpassing the test limit of 300 Colony-Forming Units (CFU) per milliliter. The readings are taken based on the number of colonies multiplied by the serial dilution (10^{-3}). The following data showed that all the colonies were below 300 CFU/ml which is the permissible limit. Observations showed that the mold count doubled within 24hrs and increased in coconut kernel on the second day (day-2) from the 8th month to the 9th month and then decreased on the 10th month. The count rose again during the 11th month but diminished by the 12th month. There was no kernel present in 7th month as the coconut was full of nut water. These fluctuations in mold and yeast populations provide valuable insight into the growth patterns of these microorganisms over time based on these recent studies.

Table 21: Yeasts and Molds in Coconut Kernel Day-3

Sl. No	Maturity stages	Average	STD	Final value
1	7th month	0	0	0 ± 0^{d}
2	8th month	102.33×10^{-3}	0.942	8 ± 0^{a}
3	9th month	105×10^{-3}	0.816	9.33 ± 0.047^{a}
4	10th month	56.33×10^{-3}	1.699	10.16 ± 0.124^{c}
5	11th month	71×10^{-3}	0.816	10.53 ± 0.124^{b}
6	12th month	1×10^{-3}	0	11.383 ± 0.062^{d}

Table 21 shows the yeasts and mold growth in coconut kernel for different maturity stages on the third day. There was significant difference in the p-value. Molds and yeasts were detected in all analyzed samples, with microorganism counts surpassing the test limit of 300 Colony-Forming Units (CFU) per milliliter. The readings are taken based on the number of colonies multiplied by the serial dilution (10^{-3}). The following data showed that all the colonies were below 300 CFU/ml which is the permissible limit. Observations showed that the mold count doubled again within 24 hours and increased in coconut kernel on the third day (day-3) from the 8th month to the 9th month and then decreased on the 10th month. The count rose again during the 11th month but diminished by the 12th month. The yeasts and mold in 12th month remained one but kept growing in the surface area. There was no kernel present in 7th month as the coconut was full of nut water. These fluctuations in mold and yeast populations provide valuable insight into the growth patterns of these microorganisms over time based on these recent studies. The mold and yeasts count on the third day were between 1 to 102.33 for the various maturity stages. These results were supported by a researcher in his studies [20].

Total Coliforms in Coconut Water

Table 22: Total coliforms in Coconut Water Day-1

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	4.66×10^{-3}	0.471	4.66 ± 0.471^{b}
2	8th month	7×10^{-3}	0.816	7 ± 0.816^{a}
3	9th month	5.33×10^{-3}	0.471	5.33 ± 0.471^{b}
4	10th month	1.33×10^{-3}	0.471	1.33 ± 0.471^{c}
5	11th month	5×10^{-3}	0	5 ± 0^{b}
6	12th month	0	0	0 ± 0^{c}

Table 22 shows the growth of Total Coliforms in coconut water for different maturity stages on the first day. There was significant difference in the p-value. The permissible limit for total coliforms in coconut water ranges between 20,000 to 30,000 MPN/ml. The readings are taken based on the number of colonies multiplied by the serial dilution (10^{-3}). The following data showed that all the colonies were below 20,000 to 30,000 MPN/ml which is the permissible limit [36, 37].

During the course of the study, it was observed that the total coliform count gradually increased from the 7th month to the 8th month. Interestingly, this count experienced a decline in the 9th month, followed by a rapid decrease in the 10th month. However, the 11th month witnessed a significant surge in total coliforms, necessitating further examination. In the 12th month of the study, it was noted that no coconut water was present due to the formation of fully ripened copra. On the first day the coliforms were less than 200 MPN/ml. These fluctuations in total coliform populations throughout the maturation process provide valuable insights into the growth patterns of these microorganisms. This was supported by other studies where the researcher observed that thermotolerant coliforms were found in four out of ten fresh samples with colony count less than of 200 MPN/ml. Recent studies have also highlighted the importance of environmental factors in influencing bacterial counts. Continuous monitoring and assessment of these patterns can contribute to improved production practices, ensuring the quality and safety of coconut water for consumers [20]. The growth of Total Coliforms in coconut water for different maturity stages on the second day. There was significant difference in the p-value. The permissible limit for total coliforms in coconut water ranges between 20,000 to 30,000 CFU/ml [36, 37]. The readings are taken based on the number of colonies multiplied by the serial dilution (10^{-3}). The

following data showed that all the colonies were below 20,000 to 30,000 CFU/ml which is the permissible limit. During the course of the study, it was observed that the total coliform count doubled within 24 hours and increased in coconut water on the second day (day-2). The coliform count gradually increased from the 7th month to the 8th month. Interestingly, this count experienced a decline in the 9th month, followed by a rapid decrease in the 10th month. However, the 11th month witnessed a significant surge in total coliforms, necessitating further examination. In the 12th month of the study, it was noted that no coconut water was present due to the formation of fully ripened copra. These fluctuations in total coliform populations provide valuable insight into the growth patterns of these microorganisms throughout the maturation process.

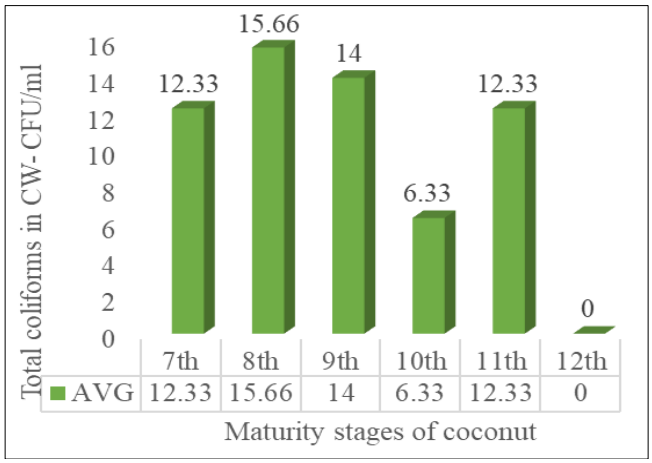

Fig 2: Total Coliforms in cocout water DAY-2

Table 23: Total coliforms in Coconut Water Day-3

Sl. No	Maturity stages	Average	STD	Final value
1	7th month	28.66×10^{-3}	0.471	28.66 ± 0.471^{d}
2	8th month	41×10^{-3}	0	41 ± 0^{a}
3	9th month	37×10^{-3}	0.816	37 ± 0.816^{b}
4	10th month	18×10^{-3}	0.471	18 ± 0.471^{e}
5	11th month	33×10^{-3}	0.816	33 ± 0.816^{c}
6	12th month	0	0	0 ± 0^{f}

Table 23 shows the growth of Total Coliforms in coconut water for different maturity stages on the third day. There was significant difference in the p-value. The permissible limit for total coliforms in coconut water ranges between 20,000 to 30,000 CFU/ml [36, 37]. The readings are taken based on the number of colonies multiplied by the serial dilution (10^{-3}).

The following data showed that all the colonies were below 20,000 to 30,000 CFU/ml which is the permissible limit. During the course of the study, it was observed that the total coliform count doubled again within 24 hours and increased in coconut water on the third day (day-3). The coliform count gradually increased from the 7th month to the 8th month. The colony count experienced a decline in the 9th month, followed by a rapid decrease in the 10th month. However, the 11th month witnessed a significant surge in total coliforms. In the 12th month of the study, it was noted that no coconut water was present due to the formation of fully ripened copra. These fluctuations in total coliform populations provide valuable insight into the growth patterns of these microorganisms throughout the maturation process.

Total Coliforms in Coconut Kernel

Table 24: Total coliforms in Coconut Kernel Day-1

Sl. No	Maturity stages	Average	STD	Final value
1	7th month	0	0	0 ± 0^{e}
2	8th month	133.66×10^{-3}	0.942	133.66 ± 0.942^{a}
3	9th month	62.66×10^{-3}	1.699	62.66 ± 1.699^{b}
4	10th month	17×10^{-3}	0	17 ± 0^{c}
5	11th month	17.33×10^{-3}	0.471	17.33 ± 0.471^{c}
6	12th month	11.33×10^{-3}	0.471	11.33 ± 0.471^{d}

Table 24 shows the growth of Total Coliforms in coconut kernel for different maturity stages on the first day. There was a significant difference in the p-value. The permissible limit for total coliforms in coconut kernel ranges between 20,000 to 30,000 CFU/ml. The readings are taken based on the number of colonies multiplied by the serial dilution (10^{-3}). The following data showed that all the colonies were below 20,000 to 30,000 CFU/ml which is the permissible limit. During the course of the study, it was observed that the total coliform in coconut kernel count gradually increased from the 8th month and decreased on the 9th month and kept decreasing till the 12th month. There was no kernel present in the 7th month as the nut was full of water. The highest colonies were in the 8th month in which the kernel was jelly like formation. These fluctuations in total coliform populations provide valuable insight into the growth patterns of these microorganisms throughout the maturation process.

Table 25: Total coliforms in Coconut Kernel Day-2

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	0	0	0 ± 0^{e}
2	8th month	270.33×10^{-3}	0.471	270.33 ± 0.471^{a}
3	9th month	137.66×10^{-3}	1.247	137.66 ± 1.247^{b}
4	10th month	40.66×10^{-3}	0.471	40.66 ± 0.471^{c}
5	11th month	42.66×10^{-3}	0.471	42.66 ± 0.471^{c}
6	12th month	25.33×10^{-3}	0.471	25.33 ± 0.471^{d}

Table 25 shows the growth of Total Coliforms in coconut kernel for different maturity stages on the second day. There was significant difference in the p-value. The permissible limit for total coliforms in coconut kernel ranges between 20,000 to 30,000 CFU/ml. The readings are taken based on the number of colonies multiplied by the serial dilution (10^{-3}). The following data showed that all the colonies were below 20,000 to 30,000 CFU/ml which is the permissible limit. During the course of the study, it was observed that the total coliform count multiplied rapidly within 24 hours and increased on the second day (day-2). The coliform count gradually increased from the 8th month and decreased on the 9th month and kept decreasing till the 12th month. There was no kernel present in the 7th month as the nut was full of water. These fluctuations in total coliform populations provide valuable insight into the growth patterns of these microorganisms throughout the maturation process.

Table 26: Total coliforms in Coconut Kernel Day-3

Sl. No	Maturity stages	Average	SD	Final value
1	7th month	0	0	0 ± 0^{f}
2	8th month	548.33×10^{-3}	2.357	548.33 ± 2.357^{a}
3	9th month	303×10^{-3}	1.414	303 ± 1.414^{b}
4	10th month	96.66×10^{-3}	0.471	96.66 ± 0.471^{d}
5	11th month	107.66×10^{-3}	0.471	107.66 ± 0.471^{c}
6	12th month	61.66×10^{-3}	0.942	61.66 ± 0.471^{e}

Table 26 shows the growth of Total Coliforms in coconut kernel for different maturity stages on the third day. There was a significant difference in the p-value. The permissible limit for total coliforms in coconut kernel ranges between 20,000 to 30,000 CFU/ml. The readings are taken based on the number of colonies multiplied by the serial dilution (10^{-3}). The following data showed that all the colonies were below 20,000 to 30,000 CFU/ml which is the permissible limit. During the course of the study, it was observed that the total coliform count multiplied rapidly again within 24 hours and increased on the third day (day-3). The coliform count gradually increased from the 8th month and decreased in the 9th month and kept decreasing till the 12th month. There was no kernel present in the 7th month as the nut was full of water. The coliforms were too numerous to count in the 8th month. These fluctuations in total coliform populations provide valuable insight into the growth patterns of these microorganisms throughout the maturation process.

Conclusion

The present study investigated effect of various storage period on the physico-chemical analysis of tender coconut water. The findings indicated that tender coconuts had higher levels of total antioxidants and phenolic compounds compared to mature coconuts. These compounds are known for their beneficial effects on health. However, mature coconuts exhibited a higher sugar content, which resulted in a less sweet flavor compared to tender coconuts. These variations in chemical composition contribute to the distinct characteristics and taste of tender and mature coconuts. Tender coconuts are more susceptible to contamination by microorganisms compared to mature coconuts. Therefore, proper handling and storage practices are crucial to maintain the sterility and quality of tender coconut water.

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Conflict of Interest

The author (s) declare no conflict of interest.

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