International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 14-09-2025, Accepted: 14-10-2025, Published: 29-10-2025
Volume 10, Issue 5, 2025, Page No. 51-56

Standardisation and quality evaluation of coconut milk based RTS beverage

Aiswarya SP[1*], Dr. Suman KT[2], Dr. Sudheer KP[3], Dr. Seeja Thomachan Panjikkaran[4], Dr. Lakshmy PS[5]
[1] Department of Community Science, College of Agriculture, Kerala Agricultural University, Vellanikkara, Thrissur, Kerala, India
[2] Professor, Department of Community Science, College of Agriculture, Kerala Agricultural University, Vellanikkara, Thrissur, Kerala, India
[3] Professor and Head, Department of Agricultural Engineering, Kerala Agricultural University, Vellanikkara, Thrissur, Kerala, India
[4] Professor and Head, Department of Community Science, College of Agriculture, Kerala Agricultural University, Vellanikkara, Thrissur, Kerala, India
[5] Assistant Professor, Krishi Vigyan Kendra, Kerala Agricultural University, Palakkad, Vellanikkara, Thrissur, Kerala, India

Abstract

The study was undertaken to standardise a nutritionally balanced and organoleptically acceptable ready to serve (RTS) beverage by blending coconut milk with tender coconut water in different proportions. Coconut milk and tender coconut water were combined at ratios of 30:70, 40:60, 50:50, 60:40, and 70:30, with the addition of sugar, carboxymethyl cellulose (CMC), and gellan gum to enhance taste and stability. The formulations were homogenised, packed in retortable pouches, pasteurised in retort at 85°C for 30 minutes, and stored under refrigerated condition. Sensory evaluation using a nine-point hedonic scale revealed that the formulation containing 40% coconut milk and 60% tender coconut water received the highest scores for flavour, taste, consistency, and overall acceptability, indicating an optimal balance of creaminess and refreshment. Physicochemical analysis of the selected beverage showed moderate acidity, pH, and total soluble solids within the desirable range. The beverage contained moderate carbohydrate levels derived from both coconut components and added sugar, low fat due to dilution with tender coconut water, and protein contributed mainly by the coconut milk fraction. The results demonstrated that blending coconut milk with tender coconut water effectively reduced fat content while retaining nutritional quality and sensory appeal. The inclusion of stabilisers such as CMC and gellan gum improved emulsion stability and texture, ensuring a smooth and homogeneous product. The developed RTS coconut milk beverage offers a light, refreshing, low fat functional drink suitable for health-conscious consumers and holds strong commercial potential as a plant-based beverage catering to the growing demand for nutritious and convenient RTS drinks.

Keywords: Coconut milk, tender coconut water, ready to serve beverage, functional drink, sensory evaluation, shelf life

Introduction

Coconut milk is a creamy white liquid extracted from the grated kernel of mature coconuts (*Cocos nucifera* L.). It is widely used in tropical regions as both a nutritive food ingredient and a functional component in culinary and industrial applications. This plant-based milk is an ideal option for individuals with lactose intolerance and for those adopting a plant-based lifestyle (Tulashie *et al.*, 2022) [31]. One of its most notable features is the high content of medium chain triglycerides (MCTs), a type of fat that is rapidly absorbed and metabolised to provide instant energy rather than being stored as body fat (Roopashree *et al.*, 2021) [24]. In addition to these healthy fats, coconut milk provides essential vitamins, minerals, and antioxidants that contribute to overall health and wellness.

Beyond its nutritional value, coconut milk's silky texture and mild nutty flavour make it a favourite in both traditional cuisines and modern plant-based beverages. These sensory qualities enhance the taste, mouthfeel, and overall acceptability of food products, while its natural viscosity and aroma contribute functional benefits such as richness, stability, and body to the final formulation. Collectively, these nutritional and sensory properties make coconut milk a versatile and valuable ingredient for developing healthy, flavour ful, and innovative foods and beverages (Magwere *et al.*, 2025) [15].

Globally, the beverage industry is undergoing a significant transformation, driven by increasing consumer demand for healthier, sustainable, and plant-based products (Park and Namkung, 2024) [19]. In this evolving market, RTS beverages formulated with plant-based ingredients are gaining rapid popularity, catering to health-conscious consumers seeking natural, functional, and convenient options. With its rich nutritional profile and desirable sensory characteristics, coconut milk has emerged as a popular base ingredient for these beverages. Its use in RTS formulations not only aligns with consumer preferences for wellness and sensory appeal but also supports sustainability and ethical production trends, positioning it as a key component in the expanding market for plant-based drinks.

Previous studies have shown that coconut milk containing moderate fat levels (5–10%) exhibits good emulsion stability and digestibility, making it suitable for beverage formulations (Wang and Ng, 2005) [32]. Its natural composition, rich in phenolic compounds, antioxidants, and essential minerals, further supports its use as a sustainable and nutritious alternative to dairy milk (Tulashie *et al.*, 2022) [31]. Consumer research also highlights that while health, ethical, and environmental considerations drive the acceptance of plant-based beverages, sensory factors remain crucial in influencing purchasing decisions (Adamczyk *et al.*, 2022) [3]. Thus, the versatility of coconut milk offers beverage manufacturers an opportunity to develop a wide range of single or blended RTS beverages that meet current consumer demands for health, convenience, and innovation. Moreover, the growing awareness of environmental and ethical issues associated with dairy production continues to fuel interest in plant-based alternatives, positioning RTS coconut milk beverages as a sustainable and market relevant innovation.

Materials and Methods

Collection of raw ingredients

Coconut and tender coconut required for the study were procured from the Instructional farm, KAU, Vellanikkara. The other ingredients like sugar and additives needed for study were purchased from the local market.

Preparation of coconut milk

Fresh, mature coconuts were dehusked, split opened and the white kernel was grated. The grated coconut was then mixed with matured coconut water in 2:1 ratio. The mixture was thoroughly blended using a blender until a milky consistency was achieved. The blended mixture was then filtered through a cheesecloth to separate the coconut milk.

Standardisation of Ready to Serve (RTS) beverage

Coconut milk RTS beverage was standardised by blending the extracted coconut milk and tender coconut water in different proportions and the treatments are given in Table 1. Sugar 5 per cent, carboxt methy cellulose 0.3 per cent and gellan gum 0.1 per cent were added in all the treatments. All ingredients were homogenised to get a stable product. The RTS beverages were filled in nylon-polyethylene-aluminium laminated pouches (dimension of the pouch was 15 × 20 cm), steam flushed to exhaust off the air from the pouches and sealed using a sealing machine. The pouches were subjected to retort pasteurisation at 85°C for 30 minutes (Pulissery *et al*., 2023) [22]. After processing, the pouches were cooled readily and stored under refrigerated condition (4ºC± 1).

Table 1: Treatments for the formulation of coconut milk based RTS beverages

Sl.no	Treatments	Combinations
1.	T_1	CM 30 % + TCW 70%
2.	T_2	CM 40% + TCW 60%
3.	T_3	CM 50% + TCW 50%
4.	T_4	CM 60% + TCW 40%
5.	T_5	CM 70% + TCW 30%

(CM- Coconut milk, TCW – Tender coconut water)

Organoleptic evaluation

The sensory evaluation was carried out for the standardised RTS beverage using score card of nine-point hedonic scale with a panel of 20 judges for sensory parameters such as appearance, colour, flavour, consistency, taste and overall acceptability. Based on the organoleptic qualities best treatment was selected for further studies.

Physico-chemical qualities

The physicochemical qualities such as acidity, pH, TSS, moisture, carbohydrate, protein, fat, were determined.

Acidity

The titratable acidity of coconut milk based RTS beverage was determined using the A.O.A.C. (2023) method. About 10 mL of the sample was mixed with 50 mL of distilled water and titrated against 0.1 N NaOH using phenolphthalein as an indicator. The endpoint was identified by the appearance of a persistent pale pink colour. The acidity was calculated as % lauric acid.

Ph

The digital pH meter was calibrated against standard buffer solutions. The samples were mixed well to homogenise and the pH values were measured using the calibrated pH meter.

TSS

A hand refractometer was used to determine the total soluble solids (TSS) in the beverage. The values were taken at room temperature and expressed in degrees Brix.

Carbohydrate

The carbohydrate content was measured colourimetrically using anthrone reagent (Sadasivam and Manickam, 2022) [27]. RTS beverage 0.1mL was hydrolysed with 5 mL of 2.5 N HCl, cooled and the residue was neutralised with solid sodium carbonate. Made up the content to 100 mL in a standard flask and centrifuged. Pipetted 0.1 mL of supernatant, added1 mL of distilled water and 4 mL anthrone reagent. Heated the contents for eight minutes cooled and the intensity of colour from green to dark green was read at 630 nm. A standard graph was prepared using standard glucose at serial dilutions. From the standard graph, the amount of total carbohydrate present in the sample was estimated and expressed in percentage

Protein

Protein was estimated by the method of A.O.A.C. (2023). Sample (0.2 mL) was digested with six ml Conc. H_2SO_4 after adding 0.4 g of $CuSO_4$ and 3.5 g K_2SO_4 in a digestion flask until the colour of sample was converted to green. After digestion, it was diluted with water and 25 ml of 40 per cent NaOH was pumped. The distillate was collected in two per cent boric acid containing mixed indicators and then titrated with 0.2N HCl to determine the nitrogen content. The nitrogen content thus estimated was multiplied with a factor of 6.25 to get the protein content.

Fat

The fat content was estimated using a modified batch solvent extraction method. A 1 mL sample and 10 mL of hexane were added to a separatory funnel. The mixture was shaken vigorously, and the organic and aqueous phases were allowed to separate by gravity. The aqueous phase was then decanted, and the fat in the solvent was determined by evaporating the solvent and measuring the remaining fat mass (Min and Steenson, 1998) [16].

The percentage of fat was calculated using the formula:

$$\text{Percentage of fat} = \frac{\text{Weight of fat}}{\text{Initial weight of sample}} \times \mathbf{100}$$

Moisture

Moisture content of the RTS beverage was estimated by the method of A.O.A.C (2023). To determine the moisture content of the products, five grams of sample was taken in a petridish and dried at 600˚C to 700˚C in a hot air oven, cooled in a desiccator and weighed. The process of heating and cooling was repeated till constant weight was achieved. The moisture content of the sample was calculated from the loss in weight during drying.

Statistical analysis

The data on physico chemical attributes of coconut milk based RTS beverages was interpreted statistically using standard deviation. Organoleptic evaluation results were analysed with Kendall's Coefficient (W).

Results and Discussion

The organoleptic scores of RTS beverages are summarised in Table 2. Among the five formulations, Treatment T_2 containing 40 % coconut milk (CM) and 60 % tender coconut water (TCW) recorded the highest scores across most organoleptic parameters, particularly flavour (8.67), consistency (8.25), taste (8.61), and overall acceptability (8.75), resulting in the highest total score of 51.21. The superior performance of T_2 may be attributed due to the balanced blend of CM and TCW, which provided an appealing visual appearance, pleasant flavour, and smooth mouthfeel without the excessive richness or dilution found in other treatments. Abrar *et al*. (2020) [1] successfully developed acceptable coconut skim milk based RTS beverage with stabilisers and preservative. The judges had significant agreement in the evaluation of different quality attributes of coconut milk RTS beverage as evident from the mean rank scores and Kendall's value (w). Therefore, the treatment T_2 was selected as the best one.

For the development of coconut milk based RTS beverage, coconut milk was extracted from grated coconut kernel using mature coconut water in the ratio of 2: 1. This helped to reduce the creaminess of coconut milk to a considerable extent and helped to impart good flavour to the coconut milk. Usually, mature coconut water is considered as a waste in coconut oil industries and this study revealed that it can be effectively utilised for extracting coconut milk intended for beverages. Kamath (2020) [10] reported that the ideal formulation parameters for coconut milk-based beverages include a coconut meat to water ratio of 1:1.5 and a sugar concentration of 6 per cent.

Blending with tender coconut water further mellowed the creaminess of coconut milk, improving the overall mouthfeel and stability of the drink. Tender coconut water also imparted a mild natural sweetness and refreshing flavour, which enhances the sensory appeal of the product while lowering the need for added sugars. So, the use of sugar could be restricted at 5 per cent level in the development of RTS beverage. Shari *et al*. (2024) [26] developed coconut milk drink containing coconut milk, water, carboxymethyl cellulose (CMC), glyceryl monostearate (GMS) and sodium benzoate with added sugar at 5 to 7 per cent level. The drink added with 6 percent sugar had the highest ratings for general acceptability, colour, sweetness, and sourness.

The concentration of stabilizers and emulsifiers significantly influences the viscosity and overall stability of coconut milk drinks (Thanatrungrueang and Harnsilawat, 2018) [30]. Carboxy methyl cellulose (CMC) @ 0.30 % was used as emulsifier which effectively reduced layer formation and phase separation, leading to a more homogeneous product. According to Phungamngoen *et al*. (2004) [20], Khuenpet *et al*. (2016) [12] and Okafor *et al*. (2017) [18], to enhance emulsion stability, carboxymethyl cellulose (CMC) can be incorporated as a stabilizing agent, and sodium benzoate as a preservative. Based on previous studies, the most effective formulation was found to be 0.3% CMC and 0.25% glycerol monostearate (GMS). The combined addition of CMC and GMS, followed by homogenization, was shown to enhance product stability by decreasing droplet size, limiting aggregate and lipid droplet formation, improving particle dispersion, and contributing to a smoother texture and mouthfeel (Romulo, 2022) [23].

In this study, gellan gum @ 0.1 % was used as thickener. It can form a weak gel network that can suspend fat globules and insoluble particles, maintaining uniformity and smooth texture without thickening the beverage excessively. Addition of gellan gum could enhance the mouthfeel and ensured emulsion stability thereby maintaining product homogeneity and overall physical quality. Legal *et al.* (2021) [14] tried gellan gum in acerola smoothie and reported it as a promising stabilizer for smoothies and similar nutritious drinks. It improved the texture and stability of acerola smoothies, with higher viscosity and attractive colour.

The mean appearance score of the coconut milk based RTS beverages decreased as the proportion of coconut milk increased from 50% to 70%. Beverages prepared with 30 % CW and 70% TCW appeared watery and lacked body, whereas those with higher coconut milk content exhibited slightly thicker, creamier consistency. Among the formulations, the combination of 40% CM and 60% TCW provided an optimal balance of thickness and mouthfeel, resulting in the highest mean score for appearance (8.33) among the different treatments.

All treatments had a mean score above 8.0 for colour. The treatment with lowest content of CM had the highest mean score for colour (T_1). Lower coconut milk levels may have reduced the opacity, allowing the natural off-white hue of the beverage to appear more appealing and uniform. This results in a brighter and more visually attractive beverage, which may have perceived positively by the panelists, leading to the maximum colour score for T_1.

Maximum score for flavour consistency and taste was recorded for T_2. The maximum scores observed for T_2 can be attributed to the optimal balance of ingredients in this treatment. T_2 likely achieved the ideal proportion of coconut milk and TCW, resulting in a creamy yet smooth texture that enhanced mouthfeel. The combination may have also allowed the natural flavours to be more pronounced without being masked by excessive richness or dilution. Additionally, the appropriate level of sweetness could have contributed to a harmonious flavor profile, making it more appealing to the sensory panel compared to other treatments. The highest overall acceptability score (8.75) was also noted in T_2.

Table 2: Mean score for organoleptic qualities of coconut milk based RTS beverages

Treatments	Appearance	Colour	Flavour	Consistency	Taste	Overall acceptability	Total score
T_1	8.22 (3.08)	8.85 (2.38)	7.94 (2.87)	7.21 (3.01)	7.05 (2.77)	7.13 (3.14)	46.40
T_2	8.33 (3.88)	8.60 (4.05)	8.67 (4.53)	8.25 (4.62)	8.61 (4.37)	8.75 (4.68)	51.21
T_3	8.12 (2.65)	8.19 (2.94)	7.76 (2.63)	7.82 (2.61)	8.05 (2.71)	7.80 (2.62)	47.74
T_4	8.15 (2.73)	8.11 (2.85)	7.71 (2.42)	7.41 (2.26)	7.88 (2.49)	7.57 (2.21)	46.83

T_5	8..13 (2.68)	8.04 (2.79)	7.72 (2.56)	7.23 (2.51)	7.67 (2.67)	7.33 (2.35)	46.12
Kendall's W	0.111**	0.163**	0.319**	3.780**	0.248**	0.427**	

W - Kendall coefficient of concordance ** Significant at 1% level Values in parentheses indicate mean rank scores
T_1 - CM 30 % + TCW 70% T_2 - CM 40% + TCW 60% T_3 - CM 50% + TCW 50% T_4 - CM 60% + TCW 40% T_5 - CM 70% + TCW 30%
(CM - coconut milk, TCW - tender coconut water)

Physicochemical properties of Coconut milk based RTS beverage

The physicochemical properties of the coconut milk RTS beverage were and is given in Table 3**.**

Table 3: Physico chemical properties of Coconut milk based RTS beverage

Parameters	Mean ± SD
Acidity (%)	0.10 ± 0.134
pH	5.3 ± 0.20
TSS (° Brix)	12 ± 2.00
Carbohydrates (%)	6.5 ± 1.21
Protein (%)	1.2 ± 0.11
Fat (%)	3.12 ± 0.20
Moisture (%)	86.41 ± 3.10

The acidity of the coconut milk RTS beverage was recorded as 0.10 ± 0.134 %, which falls within the titratable acidity range of 0.10 to 0.15% (as lactic acid) reported for tiger nut–coconut milk drink blends by Obinna-Echem and Torporo (2018) [17]. Okafor *et al.* (2017) [18] reported a higher acidity of 0.4 to 0.7% in coconut milk orange blended beverage highlighting that the acidity may vary according to the fruit used for blending. In this study, blending was done with matured coconut water and TCW, resulting in lower acidity.

The pH value of the beverage was 5.3 ± 0.20, which lies between the typical pH range of coconut milk and tender coconut water. Coconut milk is generally near neutral, with reported values between 5.9 and 6.6 (Codex Alimentarius, 2019) [7], while tender coconut water exhibits a more acidic profile depending on nut maturity and variety. Jackson (2004) [9] observed pH values of 4.5 to 4.7 in very young nuts, and Tan *et al.* (2014) [28] noted an increase from 4.78 in immature to 5.71 in mature coconuts. Similarly, Kannangara *et al.* (2018) [11] reported pH values ranging from 5.39 to 6.32. According to Alyaqoubi *et al*. (2015) [4] the pH of cotanconut milk is 5.60. The blending of 40% coconut milk with 60% tender coconut water and extraction of coconut milk with mature coconut water may have resulted in a pH of 5.3 in the developed product. Snajana *et al.* (2022) reported pH of 6.41 in coconut milk based blended beverage and Shari *et al*. (2024) [26] reported pH of 6.64 in coconut milk drink.

The total soluble solid (TSS) of the beverage was found to be 12 ± 2.00 °Brix. According to Alyaqoubi *et al*. (2015) [4] the TSS of coconut milk is 7.50 Brix and for tender coconut water it is 5.23 Brix (Hemalatha and Chandegara, 2023) [8]. The addition of sugar and additives may have contributed to the rise in TSS to 12°Brix in this study. Similar results were obtained by Shari *et al.* (2024) [26], who reported an increase in TSS from 3.28 °Brix to 12.85 °Brix with the addition of sugar from 0 to 8% in coconut milk drink.

The carbohydrate content of the coconut milk RTS beverage was 6.5 ± 1.21 g/100 g. Shari *et al.* (2024) [26] reported carbohydrate content of 5.72% in coconut milk drink added with 6 % sugar. Tender coconut water typically contains 3.7 to 4.2 g/100 ml of carbohydrates, mainly in the form of simple sugars such as glucose, fructose, and sucrose (Prades *et al.*, 2012) [21]. The carbohydrate concentration in the present study can therefore be attributed to the natural sugars from both components, supplemented by added sugar to enhance sweetness and sensory acceptability.

The protein content of the RTS beverage was 1.2 ± 0.11 g/100 g. The protein content in coconut milk is reported to be 2.9 to 3.34 % and it varies with variety, maturity and extraction method *(*Benjakul *et al.*, 2017*)* [5]. But Alyaqoubi *et al.* (2015) [4] reported a protein content of 3.40% in coconut milk. The protein content of coconut water was reported to be 0.21 to o,54% (Chuku and Kalagbor, 2014) [6]. The protein content of the developed RTS is negligible as it contains 60 % TCW.

The fat content of the beverage was 3.12 ± 0.20 g/100 g, considerably lower than the fat levels typically observed in fresh coconut milk (17–24 g/100 g) as reported by Tangsuphoom and Coupland, 2008) [29]. This reduction is largely due to dilution with tender coconut water (60%), and mature coconut water used for extraction of coconut milk, which contains only trace amounts of fat less than 0.5 % (Prades *et al.*, 2012) [21].

The moisture content was 86.41 ± 3.10 g/100 g. Alyaqoubi *et al*. (2015) [4] reported 73.57 per cent moisture in coconut milk. The dilution with TCW increased the moisture content of beverage. Kumara *et al.* (2019) [13] has reported 82.91 % moisture in coconut milk pineapple beverage and Snajana *et al.* (2022) reported 83.97 to 90.73 % in coconut milk based blended beverages. The ingredient used for blending greatly influences the moisture content of beverages.

The physicochemical characteristics of the coconut milk RTS beverage indicate a well-balanced formulation that combines the nutritional richness of coconut milk with the refreshing qualities of tender coconut water. The moderate acidity and near neutral pH favour both sensory acceptability and product stability, while the measured levels of carbohydrates, protein, and fat support its nutritional value. These findings suggest that the developed coconut milk RTS beverage possesses desirable physicochemical properties suitable for consumer acceptance and potential commercial production.

Conclusion

The study successfully developed an RTS coconut milk beverage, with the blend containing 60% tender coconut water and 40% coconut milk being the most acceptable. It showed balanced acidity and pH values, and the total soluble solids were within the desirable range, indicating an optimal blend for taste, texture, and overall quality. The coconut milk-based beverage was rich in moisture with moderate carbohydrate and low-fat content, making it light and refreshing. Its protein was mainly contributed by the coconut milk fraction, while dilution with tender coconut water enhanced palatability and reduced fat levels. The developed coconut milk RTS beverage exhibited desirable physicochemical and sensory characteristics, offering a nutritionally balanced, low-fat, and palatable functional drink with potential for commercial development and consumer acceptance.

Acknowledgements
The authors wish to thank the College of Agriculture, Kerala Agricultural University, Vellanikkara, for providing analytical support. The financial support of Kerala Agricultural University is greatly acknowledged.

References
1. Abrar MMA, Sathees D, Jayasundara JMMA, Yalagama LLWC, Pathiraja PMHD. Development of Ready-to-Serve, RTS. beverage based on coconut skim milk. Proceedings of the 3rd National Symposium on Agriculture. NSA 2020, 2020, 19–25.
2. AOAC. Official and Tentative Methods of Analysis, 22th Ed. Association of Official Analytical Chemists, Washington, DC, 2023, 1141.
3. Adamczyk D, Jaworska D, Affeltowicz D, Maison D. Plant-based dairy alternatives, Consumers' perceptions, motivations, and barriers - results from a qualitative study in Poland, Germany and France. Nutrients,2022:14(10):2171.
4. Alyaqoubi S, Abdullah A, Samudi M, Abdullah N, Addai ZR, Musa KH. Study of antioxidant activity and physicochemical properties of coconut milk, *Cocos nucifera*, in Malaysia. Journal of Chemical and Pharmaceutical Research,2015:7(4):967–973.
5. Benjakul S, Patil U, Prodpran T, Senphan T, Cheetangdee N. A comparative study of the physicochemical properties and emulsion stability of coconut milk at different maturity stages. Italian Journal of Food Science,2017:29(1).
6. Chuku LC, Kalagbor GI. Protein and mineral element content of coconut, *Cocos nucifera*, water from different species. American Journal of Drug Delivery,2014:2(4):451–453.
7. Codex Alimentarius. Codex Standard for Aqueous Coconut Products, CODEX STAN 240–2003, Rev. 2019. FAO/WHO, 2019.
8. Hemalatha B, Chandegara VK. Study on packaging and storage of tender coconut water preservation by ultrasonication. Pharma Innovation Journal,2023:12(10):487–490.
9. Jackson JC, Gordon A, Wizzard G, McCook K, Rolle R. Changes in chemical composition of coconut, *Cocos nucifera*, water during maturation of the fruit. Journal of the Science of Food and Agriculture,2004:84(9):1049–1052.
10. Kamath R. Formulation of vegan health beverage using coconut milk and fortifying it with flaxseed oil. Journal of the Technical Association,2020:67(1):1–4.
11. Kannangara AC, Chandrajith VGG, Ranaweera KKDS. Comparative analysis of coconut water in four different maturity stages. Journal of Pharmacognosy and Phytochemistry,2018:7(3):1814–1817.
12. Khuenpet K, Jittanit W, Hongha N, Pairojkul S. UHT skim coconut milk production and its quality. SHS Web of Conferences,2016:23:03002.
13. Kumara A, Mahagamage Y, Arampath P. Ready-to-serve drink from pineapple juice and coconut milk: Physicochemical and sensory properties. North African Journal of Food and Nutrition Research,2019:3:214–218.
14. Legal A, Holanda L, Soares F, Costa J, Nascimento LGL, Carmo J, *et al*. Effect of gellan gum concentration on the physicochemical, rheological and sensory properties of acerola smoothie. Food Science and Technology,2021:42:10.1590/fst.05721.
15. Magwere AA, Keast R, Gamlath S, Nandorfy DE, Pematilleke N, Gambetta JM. A comparative study of the sensory and physicochemical properties of cow milk and plant-based milk alternatives. Journal of Food Science,2025:90(7):70370.
16. Min DB, Steenson DF. Crude fat analysis. In: Nielsen SS, ed. Food Analysis, 2nd Edition. Aspens Publisher, Inc., Gaithersburg, MD, USA, 1998, 201–215.
17. Obinna-Echem PC, Torporo CN. Physico-chemical and sensory quality of tigernut, *Cyperus esculentus*, coconut *Cocos nucifera*, milk drink. Agricultural and Food Science Research,2018:5(1):23–29.
18. Okafor DC, Ijioma BC, Ofoedu CE, Nwosu JC, Onyeka EU, Ihediohanma NC, Okafor TI. Effect of heat and chemical treatments on physico-chemical and sensory properties of coconut milk orange beverage. Asian Journal of Agriculture and Food Sciences,2017:5(2):50–56.
19. Park CI, Namkung Y. Consumer values, attitudes, and behavior towards plant-based alternatives. Foods,2024:13(16):2561.
20. Phungamngoen C, Chiewchan N, Siriwattanayothin S. Effect of some stabilizers on the quality of canned high-fat coconut milk. Research and Development Journal,2004:27(3):375–390.
21. Prades A, Dornier M, Diop N, Pain JP. Coconut water uses, composition and properties, A review. Fruits,2012:67(2):87–100.
22. Pulissery SK, Shahanas E, Vithu P, Kallahalli Boregowda S, Kothakota A, Pandiselvam R. Optimization of retort processing parameters for the production of ready-to-serve flavored skimmed coconut milk. Journal of Culinary Science and Technology, 2023, 1–16.
23. Romulo A. Nutritional contents and processing of plant-based milk, A review. IOP Conference Series Earth and Environmental Science,2022:998(1):012054.
24. Roopashree PG. Effect of medium chain fatty acid in human health and nutrition. Journal of Food Science and Technology,2021:58(5):1623–1631.
25. Sanjana K, Hema V, Sinija VR. Development of plant-based milk beverage from coconut and cashew nut milk. Pharma Innovation Journal,2022:11(7):3743–3748.
26. Shari N, Husin NN, Mat Rasid Z, Abdul Ghani M, Zulkifli NA. Formulated coconut milk drink, Physico-chemical, nutritional properties and sensory characteristics. Sarhad Journal of Agriculture,2024:40(S1):249–260.
27. Sadasivam S, Manickam A. Biochemical Methods for Agricultural Sciences, 8th ed. Wiley Eastern Ltd., New Delhi, 2022, 223.
28. Tan TC, Cheng LH, Bhat R, Rusul G, Easa AM. Composition, physicochemical properties and thermal inactivation kinetics of polyphenol oxidase and peroxidase from coconut water obtained from immature and mature coconuts. Food Chemistry,2014:142:121–128.
29. Tangsuphoom N, Coupland JN. Effect of surface-active stabilizers on the microstructure and stability of coconut milk emulsions. Food Hydrocolloids,2008:22(7):1233–1242.

30. Thanatrungrueang N, Harnsilawat T. Effect of sucrose ester and carboxymethyl cellulose on physical properties of coconut milk. Journal of Food Science and Technology,2018:56(2):607–613.
31. Tulashie K, Samuel I, Amenakpor J, Atisey S, Odai R, Akpari E. Production of coconut milk, A sustainable alternative plant-based milk. Case Studies in Chemical and Environmental Engineering,2022:6:100206.
32. Wang HX, Ng TB. An antifungal peptide from the coconut. Peptides,2005:26(12):2392–2396.