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ACCOUNTING FOR THE ABSENCE OF ADVERSE REACTIONS DUE TO THE PRESENCE OF PROTEINS AND HIGH POTASSIUM FOLLOWING TENDER COCONUT WATER INTRAVENOUS INFUSION: A NON-CLINICAL STUDY

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ABSTRACT

The absence of hypersensitivity reactions during intravenous administration of tender coconut water due to the presence of proteins and the absence of hyperkalaemia symptoms due to high potassium concentration were investigated. It also covered many physicochemical properties of tender coconut water of five different coconut varieties grown in Sri Lanka. Samples were analysed for metal ions, glucose, protein, pH, conductivity and sterility. The molecular weight of proteins was determined by the Sodium Dodecyl Sulphate Polyacrylamide Gel Electrophoresis method. The lowering of plasma potassium concentration by 6-9 times following intravenous infusion of coconut water was determined mathematically. The King Coconut exhibited higher levels of metal ions ([K+] = 51.76±3.58 mmol/L, [Mg2+] = 5.27±0.74 mmol/L, [Ca2+] = 12.56±0.05 mmol/L) and glucose (221.581±1.096 mg/dL). Protein concentration of all varieties was low at 0.02% – 0.08% and consisted of low molecular weight peptides, 1 kDa to 13 kDa. The pH across all five varieties ranged from 4 to 7. All samples were found to be sterile. Low concentration of proteins and their low molecular weights less than 10kDa are insufficient to qualify them as antigens. Further, the presence of hyperkalaemia antidotes calcium, magnesium and glucose may be the reason for the absence of hyperkalaemia reactions. The study eliminates two parameters that led to reluctance by healthcare personnel in the clinical use of tender coconut water for intravenous infusion therapy.

KEYWORDS: Intravenous infusion, Tender coconut water, Tracer proteins, SDS – PAGE, *Rosette Alba*, Direct tapping fluid.

INTRODUCTION

In many regions of the world, it is a common practice to use tender coconut water (TCW) for oral rehydration and treatment of infantile symptoms like dysentery and cholera. It has favourable health effects like anti-ageing because of its antioxidant properties, benefits in cancer and cardiovascular events. TCW was used as a short-term intravenous (IV) hydration and as a resuscitation fluid for children and adults in many parts of the world during the Second World War.[1] Clinically based research has shown that TCW can be administered intravenously without frequent or serious evidence of adverse reactions. Additionally, it is sterile, eliminating the need for pre-treatment with antibiotics or heat sterilization.[2] Another study has discovered that coconut water is an effective IV hydration solution in the form of small volumes over short periods. Thereby, it was considered as an alternative to standard IV fluids in rural areas where the availability of modern dosages is limited and coconuts are abundant and inexpensive.[3]

It can be considered as a reliable alternative to standard intravenous fluid in remote areas where a lack of supplies and an availability of abundance of inexpensive natural gifts, "coconuts" exist.[3] In an animal model, it has been demonstrated that oral coconut water treatment in Wistar albino rats exhibited the systemic replenishing effect of coconut water, validating its use as an infusion

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fluid, although preservation and stability of nutrients should be further studied.[4]

However, there are limited studies on the analysis of minerals, protein, glucose, molecular weights of proteins (MW), and physicochemical profiles of Sri Lankan coconut varieties. Therefore, this study was undertaken to account for the absence of proteins induced adverse drug reactions during IV administration of TCW and the absence of high potassium induced hyperkalaemia via investigation of the above-mentioned parameters in TCW from five different Sri Lankan varieties. These include Green/Brown Tall variety (*Cocos nucifera var. typica*), King Coconut (*Cocos nucifera var. aurantiaca*), Golden King Coconut (*Cocos nucifera var. aurantiaca*), Dull King Coconut (*Cocos nucifera var. aurantiaca*), and Green Dwarf variety (*Cocos nucifera var. nana*) grown in a similar geographic location. By comparing varieties within the same environmental conditions, geographical locality, soil, climate, and farming practice, it eliminates the external variables that might affect the characteristics of TCW. It would be possible to identify the differences in mineral ion, protein and sugar content of each variety by analysing TCW on the plants from the same geographical location. Identification of proteins and protein concentration with the Bradford Test and the molecular mass of the proteins was determined with the Sodium Dodecyl Sulphate Polyacrylamide Gel Electrophoresis method (SDS-PAGE).

Therefore, the present study was undertaken as an extension of a previous study on the suitability of TCW as an intravenous infusion.[5] The study analysed five varieties of coconuts in Sri Lanka, focusing on the comparative composition of the fluid of five months maturity nuts identified with the *Rosette Alba* surrounding perianth (Fig. 1). At present, research on the subject focuses more on physicochemical analysis. None of the analytical results points to any parameter that prevents the employment of TCW as an IV infusion fluid. Despite favourable findings over the years, clinical trials have nearly totally disappeared, including animal trials. Renewed efforts are necessary, backed up by clinical trials, to establish TCW as an IV infusion fluid for regular human and veterinary use.

MATERIALS AND METHODS

Identification of five coconut varieties

The five coconut varieties were identified using the morphological characteristics of the coconuts, as given in the morphological chart and following the knowledge of the home gardeners.[6]

Sri Lankan Tall variety, the typical Green/Brown (*Cocos nucifera var. typica*), was identified with specific morphological and reproductive features. The tall stature and naturally outbreeding, allogamous, heterogeneous, form flowers in 6 – 7 years and produce flowers continuously, with medium-sized nuts, 20 – 25 nuts per bunch and 60 – 80 nuts per palm per year. King Coconut (*Cocos nucifera var. aurantiaca*) with specific morphological and reproductive features like intermediate in stature, autogamous, homogenous, flowers in 6 – 7 years, seasonal flower production, medium-sized nuts with bright orange epicarp, sweet nut water and 20 – 50 nuts per bunch. Golden King Coconut is a form of the variety *Aurantiaca*. It is similar to king coconut, with the characteristic feature of a pink coloured mesocarp and a pink whorl under the perianth (Fig. 2). Dull King Coconut is like the Sri Lankan tall variety. The ivory coloured epicarp of the nuts, petioles and inflorescences. Green Dwarf Coconut (Nana/Green dwarf or pumila) with specific morphological and reproductive features like stature, autogamous, homogeneous, flowers early in about 3 – 4 years, small-sized nuts with green epicarp, low copra content, 80 – 150 nuts per palm per year.

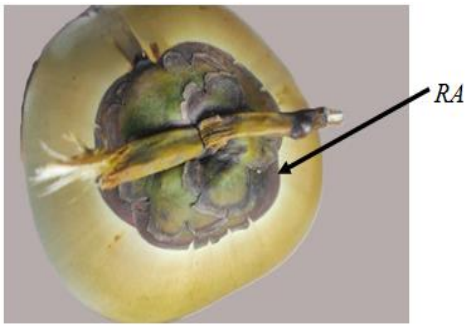

Fig. 1: Whitish 2-3 mm thick *Rosette Alba* lining surrounds the perianth in 5-6 months mature nut in Green/Brown tall variety – *RA: Rosette Alba.*

Fig. 2: The process of removing the pink mesocarp at stalk end, Golden King Coconut – *PM: Pink Mesocarp.*

Collection of tender coconut water samples for analysis

Tender coconuts of 5 – 6 months maturity were identified by the sharp whitish lining *Rosette Alba*, of about 2 – 3 mm thick surrounding the perianth (Fig. 1), were used for the analysis.[5] From different varieties, nuts were collected from the same geographical location, No. 625, Arakawilla Grama Niladhari Division, Kalutara District, Sri Lanka.

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In all cases, the young coconuts free of any excessive scar tissue and visible damage were freshly harvested. TCW samples were analysed within 48 hours, after the coconuts were washed with a mild detergent, followed by purified water and wiped with 70% ethyl alcohol. Coconut husks were removed from the stalk end of the fruit using a sterilized stainless steel sharp knife by making a circular cut around the stalk end 3-4 cm away from the circumference of the perianth (Fig. 2). The coconut water was drawn by inserting the needle of a disposable syringe. Three coconuts from each of the five varieties were used for each analysis.

Determination of the mineral ion concentrations in TCW

TCW from each variety were analysed in triplicate for potassium, magnesium and calcium content using a Flame Atomic Absorption Spectrometer (AAS Flame, iCE 3000, Germany), manufactured by Thermo Fisher Scientific GmbH, Dreieich, Germany. Chemical reference substances KCl, $MgCl_2$ and $CaCO_3$ of analytical grade were used for the serial dilutions for the standard curves of the above ions. Standard curve and the TCW mineral ion concentration for potassium is shown in the fig. 3.[7] Standard curves for Mg and Ca were similarly constructed. Using the absorbance, concentrations of K, Mg and Ca in the test samples were determined with appropriate calculations. Results are shown in table 1.

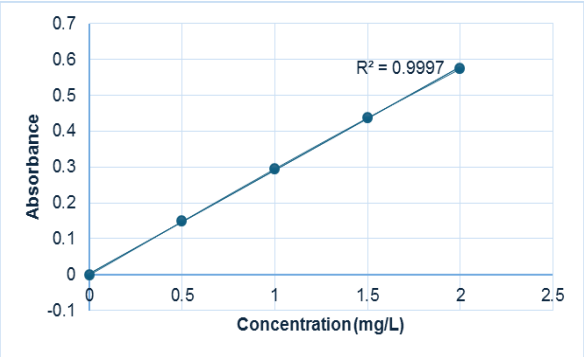

Fig. 3: Standard Curve of Potassium in Flame Atomic Absorption Photometric Analysis.

Determination of the glucose concentration of tender coconut water by Glucose Oxidase-Peroxidase assay (GOD-POD assay)

A blank of 10 µL of distilled water, a standard 10 µL of 100 mg/L glucose solution and test samples of 10 µL of 1:10 diluted TCW samples were taken and each was mixed with 1 mL of GOD-POD reagent in Khan tubes. After incubation at 37 °C for 10 minutes, absorbances were measured at 510 nm using UV Spectrophotometer (YOKE, V-1200, China), manufacturer: YOKE INSTRUMENTS CO.LTD. China. Glucose concentrations of samples were calculated appropriately using the absorbance values of the blank, the standard and the samples as per the equation below.[8]

The absorbance of the sample (X) and the standard (Y) against the reagent blank was taken.

$$Glucose\ Concentration\ of\ TCW = \frac{X}{Y} \times 100\ mg/L \times 10$$

Isolation of TCW proteins using the acetone precipitation method

To a volume of 10 ml of TCW, 40 ml of cold acetone (2 – 8)°C was added and the samples were incubated for 60 minutes at -20 °C. The resulted mixture was centrifuged at 4°C for 10 minutes at 10,000 rpm. The supernatant was discarded and the acetone was allowed to evaporate at room temperature for 30 minutes. The protein pellets were obtained at the bottom of the centrifuge tubes. The pellets were dissolved in 1 mL of fresh distilled water to yield a ten times stronger solution and the extracted protein in solution form was stored at -20 °C until analysed.[5]

Determination of the concentration of proteins in TCW

The Bradford Assay was performed to determine the protein concentration. Bovine Serum Albumin (BSA) stock solution was prepared from which BSA standard dilution series was made. Absorbance of standard dilution series and the TCW samples were measured at 595 nm using a microplate spectrophotometer (BIO-RAD Benchmark Plus, USA), manufacturer: BIO-RAD Laboratories, Inc., 1000 Alfred Nobel Drive, Hercules, CA 94547, USA, with the blank as compensation liquid.[5,9] Under the above section on "Isolation of proteins using acetone precipitation method", 50µL was pipetted out from 1mL protein solution and was used for the analysis of each variety of coconut in triplicate. Using the standard curve, concentrations of proteins in the TCW samples were determined.

Determination of the molecular weight of peptides in TCW using SDS PAGE (Sodium Dodecyl Sulphate Polyacrylamide Gel Electrophoresis method)

The resolving gel (15%), stacking gel (15%), buffers and samples were prepared according to the procedure of the Department of Chemistry, University of Colombo. After the preparation of the gels, TCW protein samples and the molecular weight marker (Opti-Protein Ultra Marker – consists of 10 pre-stained proteins that resolve into sharp, tight bands covering a wide range of molecular weights from 6.5 kDa to 270 kDa) were loaded and then the gel was run at 150 V for about 1 hour in the SDS-PAGE Apparatus (BIO-RAD, USA), manufacturer: BIO-RAD Laboratories, Inc., 1000 Alfred Nobel Drive, Hercules, CA 94547, USA. After staining and destaining the gel, the molecular weights of the unknown protein samples were determined with calculations and standard curve graph plotting.[10,11]

Physico-chemical tests

Three nuts from each variety were tested for pH, using a pH Meter (EUTECH Instruments, pH 700, Singapore),

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manufacturer: EUTECH INSTRUMENTS PTE LTD, 1 Yishun Industrial Street 1, #06-03/09 A'Posh Bizhub, Singapore. The conductivity was tested by using a Conductivity Meter (DDSJ-308A, China), manufacturer: Shanghai Precision & Scientific Instrument Co.Ltd, Shanghai, China. The pH meter was validated with standard buffer solutions (pH 4.0, 7.0 and 10.0) and the conductivity meter was validated by standard conductivity solutions (KCl solutions of known conductivity) before testing the TCW samples in triplicate.

Sterility Test

The young coconuts were cleaned for sampling by washing with mild detergent, freshly boiled portable water and wiping with 70% ethyl alcohol. The test was conducted within 48 hours of plucking using Mueller-Hinton Agar media. Husk was removed from the stalk end together with the perianth as described previously (Fig. 2). Samples were drawn aseptically with a disposable syringe inside a clean bench and spread plates were prepared. All five varieties were tested in triplicate.

Results of the analysis of TCW of the five coconut varieties are given in table 1 together with the normal plasma and intracellular fluid values for comparison.

Technique of direct tapping of the nut

A fresh coconut fruit was taken, washed with a mild detergent, potable water and then with 70% ethyl alcohol. Using a sterile stainless steel sharp knife, a circular cut was made around the stalk end 3-4cm away from the circumference of the perianth by ensuring sufficient soft husk meat remains between the cut surface and the fluid cavity. Saw-like or hammer-like cutting motions were avoided when cutting, to minimize particle generation. The cut surface is rinsed with freshly boiled potable water to remove any particles generated on the surface while cutting.

Then the IV administration set was taken and the spike was inserted into the cut surface with a gentle push until the base of the spike was firmly gripped. The air vent of the spike was opened. Part of the husk in one of the three outer ridges at the opposite end of the nut was cut off using the same technique. When the fluid flow is too slow, a sterile injection needle [gauge no 18] was inserted at this point (A), as shown in fig. 4. This procedure promotes free flow of the fluid through the IV giving set. (I.V. Administration Set - Infusion Set KU000461, Yangzhou Golden Well Medical Devices Factory, P. R. China). The flow rate was adjusted by manipulating the air vent and flow control on the IV set. At this point, the needle can be inserted into the patient's vein.

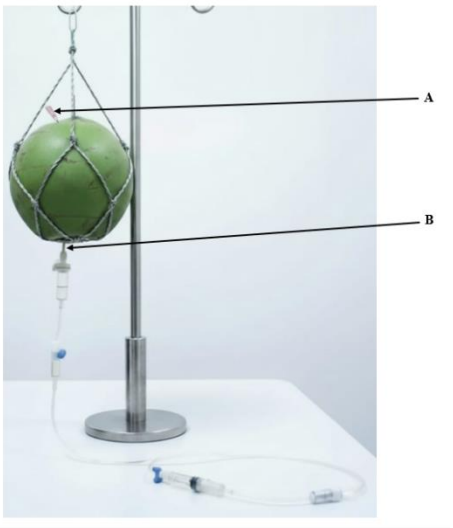

Fig. 4: Illustration of the insertion of IV administration spike into tender coconut fruit, together with an injection needle at the top of the coconut nut. Tapping points in the nut digitally edited for demonstration purpose using Adobe Illustrator.

A - The injection needle at the top of the nut. B – Inserted spike of the IV administration set with tubing).

Model calculations of the resulting serum [K^+] following IV administration of 200 mL of tender coconut water

To evaluate the potential rise in serum potassium concentration [K^+] following intravenous administration of TCW, calculations were performed using two assumptions. Firstly, assuming no renal excretion or intracellular distribution during the assessment period. The potassium content of TCW was taken as 52 mEq/L (Table 1). Given the atomic weight and equivalent weight of potassium as 39.1 g/mol, the amount of potassium in 52 mEq/L equates to 2.0332g/L. Thus, 200 mL of TCW would deliver approximately 0.407 g of potassium.

The average [K^+] in human serum is approximately 4.25 mEq/L (range: 3.5 – 5.0 mEq/L), translating to 0.166 g/L. Assuming an average serum volume of 2.5 L, the

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total potassium content in serum would be 0.166 × 2.5 = 0.415 g. Following IV infusion of 200 mL TCW, the total potassium content in the expanded volume (0.2 + 2.5 = 2.7 L) would be 0.407 + 0.415 = 0.822 g, resulting in a serum [K^+] of 0.822 g / 2.7 = 0.304 g/L. This corresponds to 7.785 mEq/L, indicating a potentially life-threatening hyperkalaemia.

If 50% of the TCW infused potassium shifts intracellularly, only 0.204 g remains in the serum. The new total serum potassium would be 0.415 + 0.204 = 0.619 g/L, equivalent to 5.86 mEq/L. This indicates that serum [K^+] stabilizes at approximately 6 to 9 times lower than the concentration present in TCW, assuming partial intracellular buffering. In practice, IV fluids are administered at a much slower drop wise rate so that 200 ml TCW considered infused all at once for the calculation is an exaggerated value.

RESULTS AND DISCUSSION

Test results of five coconut varieties and two body fluids are displayed in table 1.

Table 1: Comparative analytical results of TCW from five coconut varieties together with plasma and intracellular fluid values.

Test Para-meter	Normal plasma values	Green/ Brown coconut	King coconut	Golden King coconut	Dull King coconut	Green Dwarf	Intrace-llular fluid
[K^+] mmol/L	3.5-5.0 (5)	49.69 ±0.98	51.76 ±3.58	36.93 ±0.30	36.01 ±2.09	32.19 ±0.84	140
[Mg^{2+}]mmol/L	0.70-1.5	3.27 ±0.12	5.27 ±0.74	2.50 ±0.13	4.97 ±1.31	2.59 ±0.08	58
[Ca^{2+}] mmol/L	2.2-2.6	5.11 ±0.29	12.56 ±0.05	4.98 ±0.06	6.43 ±0.06	6.56 ±0.58	<0.0001
Glucose mg/dL	70.26-105.29	170.720±5.315	221.581 ±1.096	208.207 ±2.984	218.338± 4.743	182.067± 6.696	0-20
Protein g/L	60-80	0.263 ±0.001	0.321 ±0.001	0.323 ±0.001	0.819 ±0.002	0.615 ±0.002	40-50
MW of proteins kDa	Varies	1.274± 0.238	3.887± 2.552	1.512± 0.01	12.535± 1.183	N/A	Varies
pH	7.35-7.45	6.13 ±0.02	5.14 ±0.02	4.79 ±0.07	5.06 ±0.01	4.93 ±0.01	7-7.2
Conductivity mS/cm	Varies	6.82 ±0.13	6.28 ±0.02	5.69 ±0.04	5.19 ±0.02	6.78 ±0.02	Varies

The table summarizes the mean values of the respective parameters in triplicate. TCW [Na^+] that ranges from (0.8-3.0) mmol/L was not tested as it has little relevance.[5]

The potassium concentration in TCW was found to be relatively higher in the King coconut variety, 51.76±3.58 mEq/L and relatively lower in the Green Dwarf variety, 32.19±0.84 mEq/L. These findings align with previous research data.[3] These higher potassium concentrations initially raise concerns regarding the potential risk of hyperkalaemia and its associated cardiovascular complications. However, according to model calculations, if 200 mL of a TCW containing 52 mEq/L of potassium is administered all at once intravenously, it will result in a reduction of the actual potassium concentration of TCW by 6-9 times, 7.785 mEq/L - 5.86 mEq/L.

The normal plasma potassium concentration range is (3.5-5.0) mEq/L. Potassium levels above 5.5 mEq/L can lead to arrhythmia and other life-threatening conditions. The presence of high concentrations of magnesium, calcium and glucose in TCW relative to normal plasma values may tend to antidote the effects of increased potassium concentrations and it has been mentioned that calcium gluconate and glucose as standard treatments for hyperkalaemia.[12] The magnesium concentration in TCW was found to be relatively higher in the King coconut variety, 5.27±0.74 mEq/L and relatively lower in the Golden King coconut variety, 2.50±0.13 mEq/L. The calcium concentration in TCW was found to be relatively higher in the King coconut variety, 12.56±0.05 mEq/L and relatively lower in the Golden King coconut variety, 4.98±0.06 mEq/L. There is a higher glucose concentration in the King coconut variety, 221.6 ± 1.1 mg/dL, and the lowest glucose concentration is in the Green/brown tall variety, 170.7±5.3 mg/dL. It can be noted that Mg^{2+}, Ca^{2+} and glucose concentration in TCW are approximately three times that of plasma.

The molecular weights of the proteins in tender coconut water were analysed to determine their suitability for intravenous administration. Molecular weight marker (Opti Protein Ultra Marker) with bands ranging from 6.5kDa- 270kDa was run together with TCW protein samples for comparison of the resulting bands from protein samples. When running the SDS-PAGE apparatus, only faint and smaller protein bands were observed, as shown in fig. 5. This may be due to the low concentration of proteins, incomplete protein

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denaturation or else due to ineffective SDS binding. However, complete denaturation of proteins was achieved by high temperature treatment at 98 °C for 10 minutes, a standard method to ensure full denaturation of proteins by disrupting their secondary and tertiary structures through the thermal energy.[13] Thereby, this procedure ensures that proteins are adequately unfolded and linearized, which may aid in the good separation of proteins. Furthermore, for the electrophoresis, a 15 % acrylamide gel, which is commonly employed for the separation of smaller proteins, may have contributed to the clearer separation of smaller protein fragments.[14] A low concentration of proteins in the sample can result in faint bands, as there is less concentration to visualize. According to one argument, inadequate protein loading on the gel often leads to weak band intensities.[13]

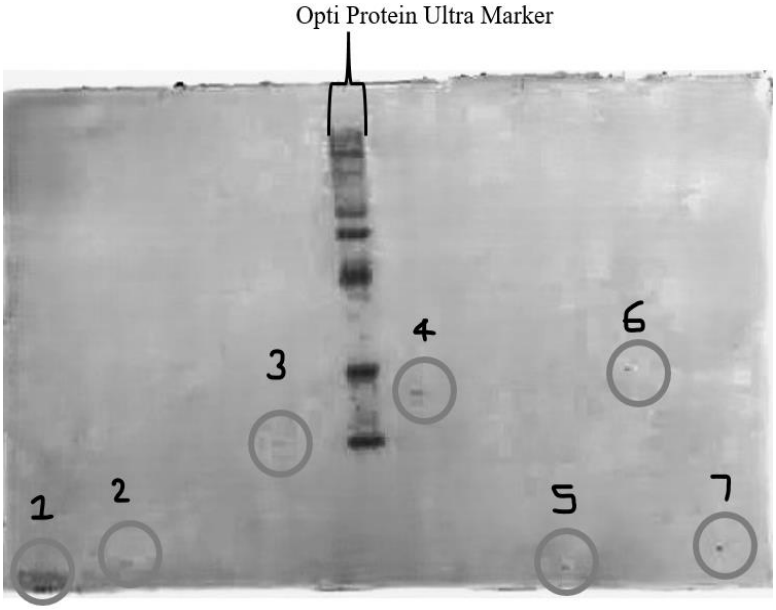

Fig. 5: SDS-PAGE image of peptide bands of tender coconut water, bands 1 and 2 for green/brown tall variety, 3 and 5 for King coconut variety, 4 and 6 for Dull king coconut variety and band 7 for Golden king coconut variety.

In this study, the molecular weights of observed bands (Fig. 5) were determined using the standard protein marker. The results indicated that precipitated proteins of TCW have molecular weights ranging between 1-13 kDa. The common Green/Brown Tall variety has the lowest molecular weight of 1.036 kDa, and Dull King Coconut showed the highest molecular weight of 12.535 kDa. The results indicate that TCW contains low molecular weight proteins, which is a crucial factor in assessing potential hypersensitivity reactions. It states that molecules greater than 10kDa are more likely to be immunogenic.[15] Therefore, when considering IV administration of protein-containing solutions like tender coconut water, the relatively low molecular weights of its proteins suggest a reduced likelihood of inducing allergic reactions. A very low concentration of 0.02- 0.08% proteins in TCW compared to 7.0% in normal plasma also does not favour the occurrence of hypersensitivity reactions. Thus, the reasons for the absence of hypersensitivity reactions in IV infusion of TCW are confirmed.

The physicochemical parameters, like pH and conductivity, are crucial in assessing the suitability of an IV fluid. These values are matched with the previously published data.[3] The low pH of TCW theoretically worsens an already present metabolic acidosis common in many disease processes requiring IV fluids. However, studies have shown no change in pH measured within 24 hours after infusion of as much as 3000 mL of TCW. It appears that the buffering system of the body can neutralize the acidity of the coconut fluid.[3] This study indicated that the TCW of all 5 varieties are sterile.

Due to the presence of comparatively high potassium, calcium and magnesium content in TCW, the patient's urine output, renal output, renal function and cardiac status should be closely monitored. It has been mentioned that it would be contraindicated to use coconut water for patients with hyperkalaemia from acute renal injury, rhabdomyolysis or severe burns.[2]

This study provides valuable insights into the biochemical composition and the potential intravenous infusion suitability of different TCW varieties. The Green Dwarf variety was excluded from protein concentration and molecular weight determinations. Normal plasma values and intracellular fluid values are provided in table 1 for comparison with those of TCW.[16]

Direct tapping of the coconut fluid is of great advantage. However, very often, the fluid resists flowing through the tube due to clogging of soft husk pieces in the narrow

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ducts of the spike. It can be suggested that a smooth, sterile stainless steel ~2 mm diameter probe, 2" in length, tapering to a pointed tip, be used initially to bore into the point of attaching the spike of the IV administration set. The clogging issue must be solved for the success of direct tapping.

CONCLUSION

The study successfully investigated the biochemical composition of five different Sri Lankan coconut varieties and the reasons for the safety of IV administration of tender coconut water. This was of particular interest considering the historical absence of adverse reactions due to the presence of proteins and high potassium ion concentration in TCW.

Among the varieties tested, King Coconut water showed the highest potassium concentration, approximately 52 mEq/L. It may still be compatible with intravenous administration when considering the reduction of potassium ion content in plasma, 6-9 times less than the concentration present in TCW. This assumes an ideal pharmacokinetic scenario where potassium excretion is either negligible or controlled and 200 ml TCW is administered at once.

Furthermore, the presence of comparatively high concentrations of magnesium, calcium and glucose in all varieties may offer an additional therapeutic benefit, specifically in potassium antagonism, as these are the standard antidotes for the treatment of hyperkalaemia.[12]

Additionally, the low protein content of 0.02- 0.08% with molecular weights below 10 kDa, (except for the Green Dwarf variety), suggests a reduced likelihood of inducing allergic reactions following intravenous administration of TCW. These are peptides rather than proteins. Intravenous administration of TCW offers a promising alternative to conventional parenteral fluids, bypassing the immunogenic subcutaneous route, thus avoiding sensitisation. Importantly, the presence of essential electrolytes such as calcium (Ca^{2+}), magnesium (Mg^{2+}), and also glucose in comparatively high concentrations contributes to mitigating the risks of hyperkalaemia, as these components act as natural antidotes. The high potassium concentration gets drastically reduced following IV infusion to safe levels near normal physiological values.

TCW also stands out for its absence of artificial chemicals and synthetic by-products. Given the composition, TCW can be classified as a fluid, electrolyte and energy replacement large volume IV infusion. Also, TCW of the five varieties of coconuts may be interchanged.

Pharmaceutical concerns that have historically discouraged the use of TCW for IV administration were not substantiated upon thorough evaluation against compendial standards. With the availability of modern IV sets equipped with particle and bacteria-proof filters and air vents facilitating suction of air into the nut cavity neutralizing the creation of a vacuum, the safety profile of TCW as a parenteral fluid is further enhanced.

Nevertheless, several limitations remain. The liquid content inside the nut cannot be visually inspected before drawing out the fluid. Cutting the nut may generate unwanted fine particles. It has been determined that the shelf life of tender coconuts is limited to five days after plucking.[5] Although the King Coconut variety demonstrates potential for IV use, its suitability requires further validation through osmolality testing, haemolysis studies, and particle count analysis, particularly when using direct tapping methods. It is noteworthy that the pyrogen test is not applicable to fresh TCW in the manner in which they are to be used.[5]

Additionally, limitations in sample size and sampling diversity may affect the reliability and generalizability of the current findings. Future studies should expand the sample size across all coconut varieties and broaden the sampling process to ensure more representative and robust conclusions. Visual inspection of the fluid, though not possible through the nut, can be facilitated by collecting 30–50 mL into a clean glass vessel prior to administration.

Since coconut trees are widely distributed, covering most remote areas in all tropical countries, tender coconuts are a ready source of inexpensive, absolutely pure IV infusion fluids free of every trace of artificial chemicals. Further research, including clinical studies, is essential to evaluate long-term effects and establish definitive clinical safety parameters for the use of TCW as a parenteral fluid.

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REFERENCES

1. Yong JWH, Ge L, Ng YF, Tan SN. The chemical composition and biological properties of coconut (Cocos Nucifera L.) water. Molecules, 2009; 14: 5144-5164. doi: 10.3390/molecules14125144.
2. Eiseman B, E Lozano DR, Hager Louis TS, Barnes AD. Clinical Experience In Intravenous Administration Of Coconut Water. AMA Arch Surg, Jul. 1954; 69(1): 87-93. PMID: 13170928.

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3. Campbell-Falck, D., T. Thomas, T. M. Falck, N. Tutuo, and K. Clem. The intravenous use of coconut water. Am. J. Emerg. Med., 2000; 18(1): 108–11.
4. Igbokwe, G.E., Ikwuka, D.C., Okpala, C.O., Ezugwu, U.M., Chibeze, U.S., Ugwu, P., and Nworgu, C.C. Biochemical Indices on Coconut Water for Packaging as Infusion Fluid and its Effect on Kidney Function of Fasted Wister Rats. Journal of EC Endocrinology and Metabolic Research. 2020; 5(10): 03-08.
5. Pathirana W, Karunaratne N. Consolidating tender coconuts as a source of safe natural large volume parenteral fluid under regulatory oversight. Pharmaceutical Journal of Sri Lanka, Nov. 16, 2018; 8(1): 38.
6. Ekanayake GK, Perera SACN, Dassanayake PN, Everard JMDT. Varietal Classification of New Coconut (Cocos nucifera L.) Forms Identified from Southern Sri Lanka. COCOS, Oct, 15, 2012; 19(1): 41–50.
7. Chuku, L.C.; Kalagbor, G.I. Protein and Mineral Element Content of Coconut (Cocos Nucifera) Water from Different Species. Open Journal of Advanced Drug Delivery, 2014; 2: 451–453.
8. Jakobsen LK. Quantitative determination of urinary glucose using glucose oxidase and peroxidase. Scand J Clin Lab Invest, 1961; 13(3): 374–6.
9. Kielkopf CL, Bauer W, Urbatsch IL. Bradford assay for determining protein concentration. Cold Spring Harb Protoc, Apr. 1, 2020; 2020(4): 136–8.
10. Gallagher, S.R. SDS-polyacrylamide gel electrophoresis (SDS-PAGE). Curr. Protoc. Essent. Lab. Tech., 2012; 6: 7–10.
11. Brunelle JL, Green R. One-dimensional SDS-polyacrylamide gel electrophoresis (1D SDS-PAGE). In: Methods in Enzymology. Academic Press Inc., 2014; 151–9.
12. British National Formulary (BNF). British National Formulary 84. London: BMJ Group and Pharmaceutical Press, 2022.
13. LAEMMLI, U. Cleavage of Structural Proteins during the Assembly of the Head of Bacteriophage T4. Nature, 1970; 227: 680–685. https://doi.org/10.1038/227680a0
14. Hames, B.D. (1998) Gel Electrophoresis of Proteins: A Practical Approach. Oxford University Press, New York.
15. Abbas A.K, Lichtman A.H, Pillai S. Basic Immunology: Functions and Disorders of the Immune System. Philadelphia, PA: Elsevier Health Sciences; 6th ed. Elsevier, 2021.
16. Hall JE. Guyton and Hall textbook of medical physiology. 12th ed. Philadelphia: Saunders Elsevier, 2011; 45: 400.

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