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ASSESSMENT OF PHYSICAL AND NUTRITIONAL CHARACTERISTICS OF TENDER COCONUT (*Cocos nucifera* L.) COLLECTED FROM DIFFERENT LOCATIONS OF BASTAR CHHATTISGARH INDIA

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ABSTRACT

Tender Coconut (*Cocos nucifera* L.) water is a natural refreshing beverage widely appreciated for its pleasant test, excellent hydration properties and rich nutritional composition. The Bastar Plateau of Chhattisgarh possesses considerable diversity in coconut germplasm. However, limit information on the physical and nutritional characteristics of tender coconut collected from different locations is available of Bastar region. Therefore, the present investigation was conducted to evaluate the physical and nutritional potential of tender coconut collected from seven locations of the Bastar region namely Dantewada, Tudparas, Purantarayi, Gadiras, Kondagaon, Kanker and Bakawand, along with two check varieties, Kera Bastar and Gautami Ganga. The experiment was carried out during 2025–26 at the Department of Plantation, Spices, Medicinal and Aromatic Crops, K. D. College of Horticulture and Research Station, Jagdalpur, Bastar, Chhattisgarh. Physical parameters including nut shape, colour, weight, length, diameter, husk weight, water volume, kernel weight and shell thickness along with nutritional properties such as potassium, sodium, calcium, magnesium and phosphorus, were measured and analyzed using standard analytical procedures. Considerable variation was observed among the collected genotypes for all the studied traits, indicating substantial diversity in the Bastar region germplasm. The findings suggest that the identified superior genotypes can be utilized for quality improvement, conservation of valuable germplasm and utilization in future coconut breeding and crop improvement programmes.

Key word: Bastar region, *Cocos nucifera*, germplasm, Tender Coconut water, physical and nutritional properties.

Introduction

Coconut palm (*Cocos nucifera* L.) is an important economic plant species in fragile coastal and island ecosystems of the tropics. The palm is a multipurpose perennial crop whose diversity at spatial and trait levels has been exploited to improve yield, resistance to diseases and develop value-added products. Coconut is a member of the monocotyledonous family Arecaceae (Palmae) and the monospecific genus *Cocos*. It is a diploid with chromosome number of $2n = 32$ and is traditionally seed

propagated with slow growing habit (Navnath, 2019). Coconut occupies 2216 hectares with 14260 million tonnes production In India. India is the third largest coconut producer after Indonesia and Philippines and grown in states like Tamil Nadu, Kerala, Karnataka, Andhra Pradesh and Maharashtra (Anonymous, 2024-25). Coconut water refers to the liquid endosperm of a tender coconut at an age of approximately 7 months from time of pollination. “Tree of life” or “Tree of Heaven” or “Kalpavriksha”. Being an important member of

Monocotyledons, it serves the human life through varietal benefits from its leaves, spikelet, water, meat, sap, husks, shells, wood, etc. (Tamishra, 2023). Tender coconut water is a natural, nutritious, medicinal, mineral drink with well acceptable flavour and taste and consumed by all age groups (Rethinam and Nandakumar, 2001).

The main components of coconut milk are water (50%), fat and protein, whereas coconut water contains mainly water (94%) (Seow and Gwee, 1997). Coconut water is served directly as a beverage. It provides livelihood directly and indirectly for thousands of people in three sectors like production, processing and marketing. The quality and acceptability of the final product depend upon the initial quality of the tender nut water which is governed by the age of the nuts, variety, agro-climatic conditions and horticultural practices (Navnath, 2019).

Tender coconut water (TCW) refers to the clear, slightly sweet and aqueous component of an immature coconut. It contains about 95.5% water, 0.1% fat, 4% carbohydrate, 0.02% Calcium, 0.01% Phosphorus, 0.5% Iron and some amino acids, vitamin B complex, vitamin C and mineral salts. As the coconut fruit matures, the volume of coconut water decreases and its chemical composition undergoes changes: the total soluble solids (TSS), ash content, and mineral content decrease, whereas the fat and protein content increase (Shi *et al.*, 2025).

Genetic erosion is rampant in coconut due to biotic, abiotic and anthropogenic threats and expansion in area under high yielding selections and hybrids. Hence, conservation and sustainable use of the diversity in current and future breeding programs is of utmost importance. The present study aimed to address this gap by assessing

Table 1: Location details of various coconut genotypes selected for the present study.

Treat-ments	Districts	Villages	Notation
T ₁	Dantewada	Dantewada	MGDC
T ₂	Dantewada	Tudparas	MGTC
T ₃	Dantewada	Purantarayi	MGPC
T ₄	Sukma	Gadiras	MGGC
T ₅	Kondagaon	Kondagaon	MGKDC
T ₆	Kanker	Kanker	MGKC
T ₇	Bastar	Bakawand	MGBC
T ₈	Bastar	Jagdalpur	Kera Bastar (KB)
T ₉	Bastar	Jagdalpur	Gautami Ganga (GG)

the genetic diversity and trait associations among Coconut genotypes from the Bastar plateau zone of Chhattisgarh.

Material and Method

Experimental Details

The present investigation on tender coconut (*Cocos nucifera* L.) was conducted during the 2025–26 season at the Horticulture Research Laboratory, Krantikari Debridhar College of Horticulture and Research Station, Jagdalpur, Bastar, Chhattisgarh, India. The experiment was laid out in a Completely Randomized Design (CRD) comprising nine treatments with three replications. Tender coconuts were collected from nine locations representing different areas of the Bastar Plateau of Chhattisgarh. The treatments consisted of T₁ (MGDC), T₂ (MGTC), T₃ (MGPC), T₄ (MGGC), T₅ (MGKDC), T₆ (MGKC), T₇ (MGBC), T₈ (Kera Bastar) and T₉ (Gautami Ganga). Ten healthy, seven-month-old tender nuts were randomly selected from each replication and labelled for analysis. Fruit physical traits were observed as per the Guidelines for the Conduct of Test for Distinctiveness, Uniformity



Fig. 1: Chhattisgarh map.



Fig. 2: Bastar region map.

Table 2: Parameters of Coconut Genotypes Studied During the Experiment(DUS on Coconut by PPV&FRA, GoI, 2012).

Physical parameters	Nutritional parameters
Nut colour	Potassium (mg/100ml)
Nut shape	Sodium (mg/100ml)
Nut length (cm)	Calcium (mg/100ml)
Nut diameter (cm)	Magnesium (mg/100ml)
Nut weight (kg)	Phosphorus (mg/100ml)
Water volume (ml)	-
Husk weight (g)	-
Shell thickness (mm)	-

and Stability on Coconut by PPV&FRA, GoI (Thomas, 2012). The mean value of each treatment in every replication was calculated and subjected to analysis of variance (ANOVA) for statistical interpretation.

Result and Discussion

Nut colour

The colour of tender coconut showed noticeable variation among the genotypes collected from different locations of the Bastar region. Three distinct colour groups were observed, namely green, green-yellow and green-red (red-green). Among the nine genotypes, green colour was the most predominant and was recorded in T₂, T₄, T₇, T₈ and T₉. Green-red colour was observed in T₁ and T₅, while green-yellow colour was recorded in T₃ and T₆. The observed variation indicates the presence of considerable diversity among the collected coconut genotypes. Study on Coconut genotypes by Diwakar *et al.*, (2025) and Beura *et al.*, (2020) had shown similarity with the results of the present experiment.

Nut shape

Significant variation in nut shape was observed among the coconut genotypes collected from different locations.

Table-3: Physical Parameters of Tender Coconut

Treat-ment	Geno-type	Nut colour	Nut shape	Nut length (cm)	Nut diameter (cm)	Nut weight (kg)	Water volume (ml)	Husk weight (g)	Kernel weight (g)	Hard shell thickness (mm)
T ₁	MGDC	Green- Red	Oval	20.60	13.23	1.42	467.77	911.67	36.56	3.50
T ₂	MGTC	Green	Round	16.40	14.40	1.50	363.33	1071.67	63.00	2.70
T ₃	MGPC	Green- Yellow	Oblong	23.63	12.67	1.20	419.17	740.33	44.50	2.70
T ₄	MGGC	Green	Round	22.90	14.40	1.82	607.08	1094.00	122.92	3.00
T ₅	MGKDC	Red-green	Oval	21.33	12.97	1.14	438.25	651.30	53.45	2.50
T ₆	MGKC	Green- Yellow	Oval	24.17	13.30	1.67	419.83	1191.04	60.13	2.10
T ₇	MGBC	Green	Oval	22.27	12.43	1.09	500.75	530.33	53.92	3.30
T ₈	KB	Green	Round	21.33	13.73	1.52	365.67	1045.62	106.71	2.80
T ₉	GG	Green	Oblong	27.10	16.10	1.81	398.08	1277.23	133.69	3.00
CD (5%)				1.15	1.06	0.09	30.42	68.01	5.64	0.19
SEm(±)				0.38	0.35	0.03	10.16	22.71	1.89	0.06
CV (<5)				3.00	4.47	3.69	3.98	4.16	4.35	3.91

Three different nut shapes, namely oval, round and oblong, were identified. Oval shape was recorded in T₁, T₅, T₆ and T₇, round shape in T₂, T₄ and T₈, while oblong shape was observed in T₃ and T₉. The results indicate considerable morphological diversity among the collected coconut genotypes. Study on Coconut genotypes by Beura *et al.*, (2020) and Diwakar *et al.*, (2025) had shown similarity with the results of the present experiment.

Nut length (cm)

The highest nut length (27.10 cm) was recorded in T₉ (GG), followed by T₆ (24.17 cm) and T₃ (23.63 cm). However, the lowest nut length (16.40 cm) was observed in T₂ (MGTC). The variation in nut length among the collected genotypes may be attributed to genetic variability and environmental conditions prevailing at different collection sites.

The superior nut length observed in T₉ may be attributed to its favourable genetic potential and better adaptation to the local agro-climatic conditions. The variation in nut length among the genotypes reflects the influence of both genetic makeup and environmental factors. More and less Similar variation were reported by Ramanandam *et al.*, (2017) and Tripura *et al.*, (2018).

Nut diameter (cm)

The maximum nut diameter (16.10 cm) was recorded in T₉ (GG), followed by T₂ and T₄ (14.40 cm). The minimum nut diameter (12.43 cm) was observed in T₇ (MGBC). The variation in nut diameter indicated the influence of genetic makeup and growing environment on nut development.

The greater nut diameter in T₉ may be due to superior genetic characteristics and favourable environmental conditions that promoted better fruit development. The observed variability among genotypes indicates

Table 4: Nutritional Contents of Tender Coconut Water.

TR	GT	K	Na	Ca	Mg	P
T ₁	MGDC	284.10	42.70	43.10	13.40	8.50
T ₂	MGTC	279.00	43.40	46.70	10.60	9.00
T ₃	MGPC	287.10	45.30	47.80	13.00	7.30
T ₄	MGGC	290.10	49.80	50.30	14.60	9.10
T ₅	MGKDC	282.50	43.60	47.90	14.00	8.70
T ₆	MGKC	288.90	46.10	50.20	11.30	9.40
T ₇	MGBC	280.90	44.40	45.10	12.30	8.90
T ₈	KB	286.40	50.40	50.20	13.90	10.30
T ₉	GG	293.40	48.30	48.70	15.10	9.50
CD (5%)	4.29	3.39	1.91	1.05	0.69	
SEm(±)	1.43	1.13	0.64	0.35	0.23	
CV(<5)	0.87	4.26	2.31	4.63	4.42	

TR: Treatment; GT: Genotype; K: Potassium (mg/100ml);
Na: Sodium (mg/100ml); Ca: Calcium(mg/100ml);
Mg: Magnesium(mg/100ml); P: Phosphorus(mg/100ml)

considerable diversity in coconut germplasm of the Bastar Plateau region. Similar variation in diameter in coconut was observed by Hemavathy and Balaji (2008) and Ramanandam *et al.*, (2017).

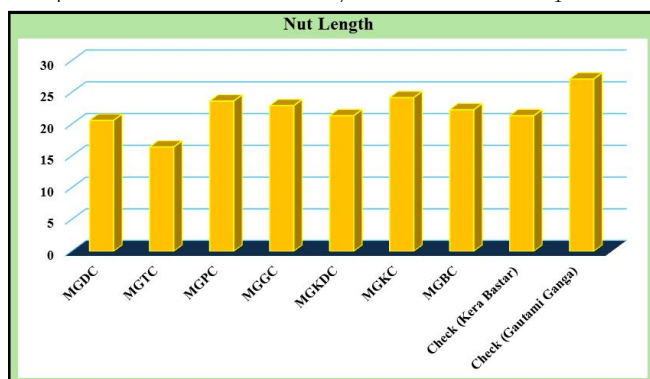
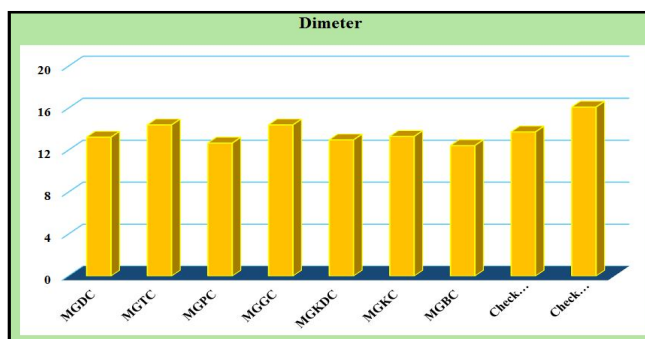
Nut weight (kg)

The highest whole nut weight (1.82 kg) was recorded in T₄ (MGGC), followed by T₉ (1.81 kg) and T₆ (1.67 kg). The lowest whole nut weight (1.09 kg) was recorded in T₇ (MGBC). The observed variation may be due to differences in genetic potential and environmental conditions prevailing at different locations.

The higher nut weight in T₄ may be attributed to favourable genetic characteristics and better dry matter accumulation under suitable environmental conditions. In contrast, the lower nut weight in T₇ might be associated with comparatively smaller nut size. Similar results were reported by Hemavathy and Balaji (2008), Ramanandam *et al.*, (2017) and Tripura *et al.*, (2018).

Water volume (ml)

The highest water weight (607.08 ml) was recorded in T₄ (MGGC), followed by T₇ (500.75 ml) and T₁ (467.77

**Fig. 1:** Graphical representation nut length of Tender Coconut.**Fig. 2:** Graphical representation nut diameter of Tender Coconut.

ml). The lowest water weight (363.33 ml) was observed in T₂ (MGTC). The variation in water weight may be attributed to genetic differences and the stage of nut development.

The higher water weight T₄ may be due to better moisture accumulation and favourable genetic potential of the genotype. The lower water weight in T₂ could be attributed to comparatively lower water accumulation during nut development. Similar findings have been reported by Jackson *et al.*, (2004), Poduval *et al.*, (1998) and Ratnambal *et al.*, (1999).

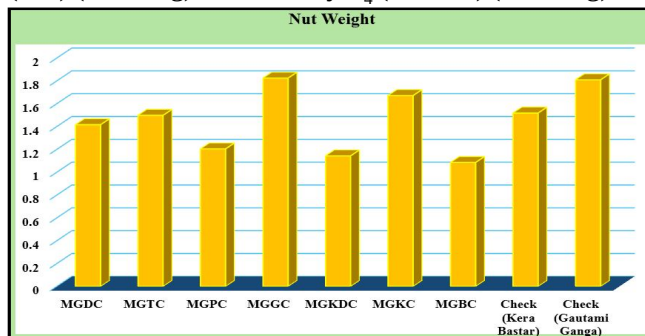
Husk weight (g)

The highest husk weight (1277.23 g) was recorded in T₉ (GG), followed by T₆ (1191.04 g) and T₄ (1094.00 g). The lowest husk weight (530.33 g) was observed in T₇ (MGBC). The differences in husk weight may be due to genetic variability and environmental influences.

The higher husk weight T₉ may be attributed to vigorous fruit growth and greater dry matter accumulation, while the lower husk weight could be associated with smaller fruit size. Similar observations have been reported by Tripura *et al.*, (2018) and Ramanandam *et al.*, (2017).

Kernel weight (g)

The kernel weight of tender coconut exhibited significant variation among the evaluated genotypes of the Bastar region. Kernel weight ranged from 36.56 g to 133.69 g. The highest kernel weight was recorded in T₉ (GG) (133.69 g), followed by T₄ (MGGC) (122.92 g) and

**Fig. 3:** Graphical representation nut weight of Tender Coconut.

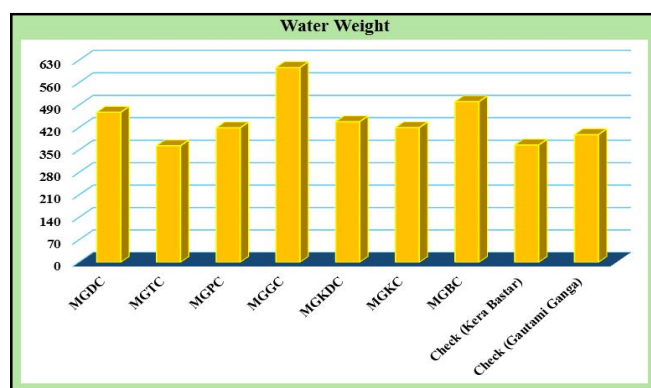


Fig. 4: Graphical representation water weight of Tender Coconut.

T_8 (KB) (106.71 g), whereas the lowest kernel weight was observed in T_1 (MGDC) (36.56 g).

The higher kernel weight in T_9 may be attributed to superior genetic potential and greater accumulation of endosperm during fruit development. In contrast, the lower kernel weight in T_1 could be due to comparatively reduced endosperm development. The findings previously presented by Ramanandam *et al.*, (2017), Hemavathy and Balaji (2008) and Tripura *et al.*, (2018).

Hard shell thickness (mm)

The maximum hard-shell thickness (3.50 cm) was recorded in T_1 (MGDC), followed by T_7 (3.30 cm) and T_4/T_9 (3.00 cm). The minimum hard-shell thickness (2.10 cm) was observed in T_6 (MGKC). The observed variation in shell thickness might be due to genetic differences among the genotypes and environmental conditions of the collection sites.

The variation in shell thickness may be attributed to genetic differences among the genotypes and environmental conditions prevailing at the collection sites. Similar observations have also been reported by Indires *et al.*, (1997) and Niral *et al.*, (2013).

Potassium (mg/100ml)

The potassium content varied significantly among the treatments and ranged from 279.10 to 293.40 mg. The

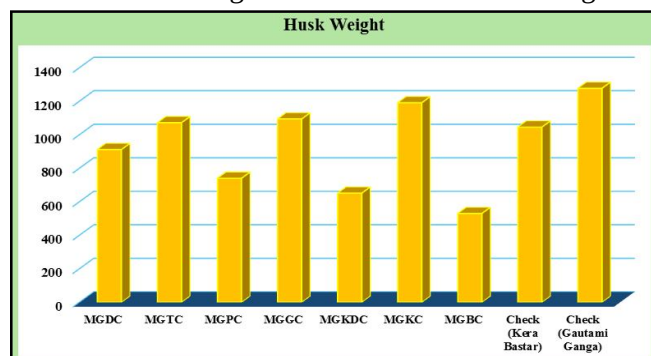


Fig. 5: Graphical representation husk weight of Tender Coconut.

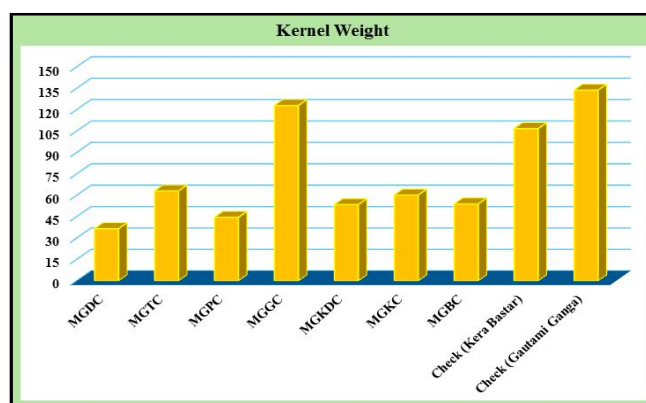


Fig. 6: Graphical representation kernel weight of Tender Coconut.

highest potassium content was recorded in T_9 (GG) with 293.40 mg, followed by T_4 (290.00 mg) and T_6 (288.90 mg), whereas the lowest value was observed in T_2 (MGTC) (279.10 mg).

The higher potassium content T_9 may be attributed to genetic variation and efficient mineral uptake among the genotypes. The observation is in conformity with the findings reported by Priya and Ramaswamy's (2014) and Appaiah *et al.*, (2015).

Sodium (mg/100ml)

The sodium content varied among the treatments and ranged from 42.70 to 50.40 mg. The highest sodium content was recorded in T_8 (KB) (50.40 mg), followed by T_4 (49.80 mg) and T_9 (48.30 mg), whereas the lowest value was observed in T_1 (MGDC) (42.70 mg).

The variation in sodium highest concentration T_8 may be due to differences in genotype and mineral absorption capacity under varying agro-climatic conditions. More and less Similar variation were reported by Ramanandam *et al.*, (2018) and Dhamodaran *et al.*, (2006).

Calcium (mg/100ml)

The calcium content varied among the treatments and ranged from 43.10 to 50.30 mg%. The highest calcium content was recorded in T_4 (MGCC) (50.30 mg), followed

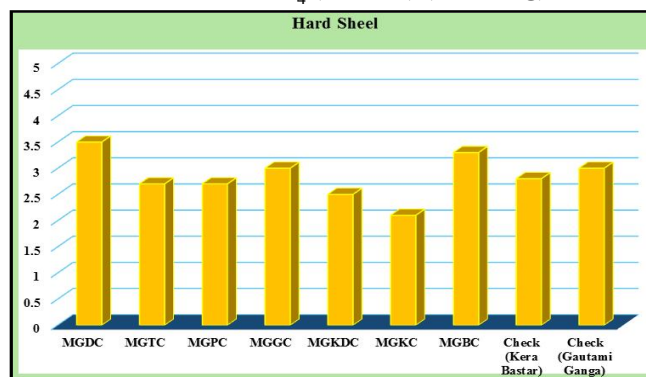


Fig. 7: Graphical representation hard shell thickness of Tender Coconut.

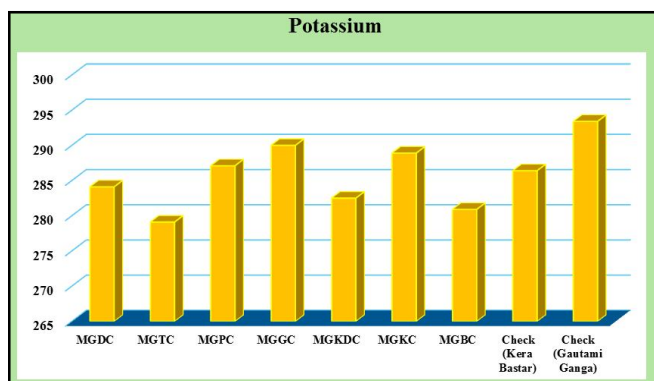


Fig. 8: Graphical representation potassium of Tender Coconut water.

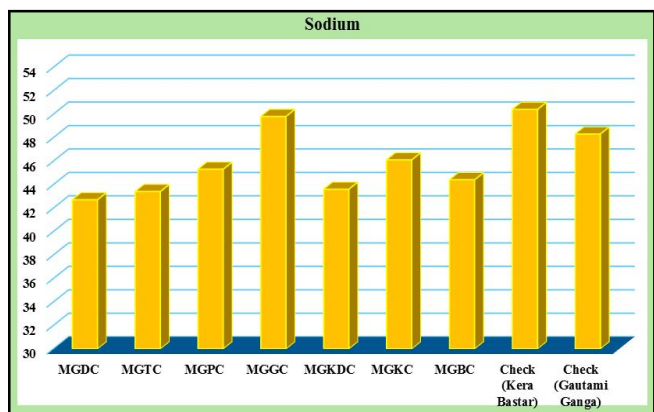


Fig. 9: Graphical representation sodium of Tender Coconut water.

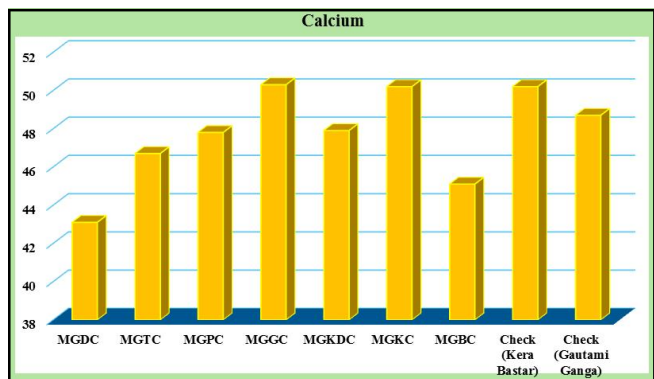


Fig. 10: Graphical representation calcium of Tender Coconut water.

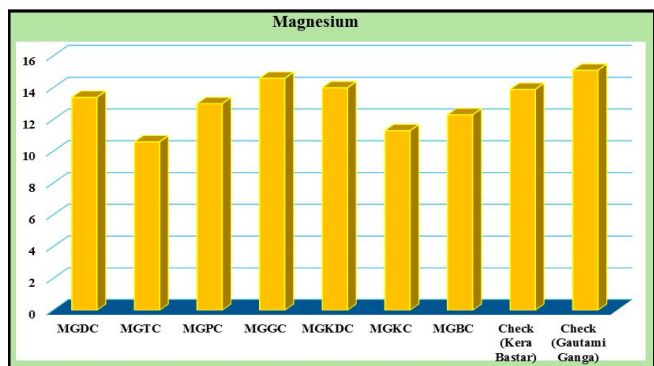


Fig. 11: Graphical representation magnesium of Tender Coconut water.

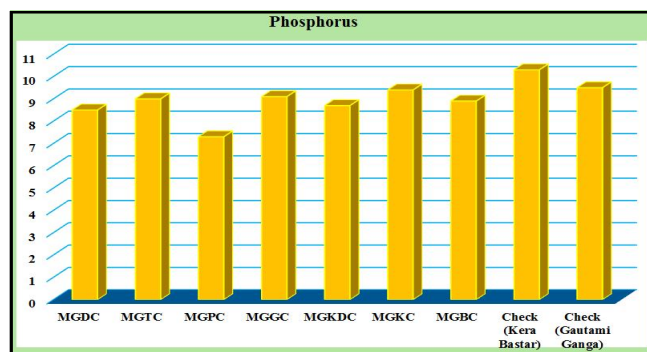


Fig. 12: Graphical representation phosphorus of Tender Coconut water.

by T_6 (50.20 mg) and T_8 (50.20 mg), whereas the lowest value was observed in T_1 (MGDC) (43.10 mg). The minimum value was observed in T_1 (MGDC). The observed variation may be associated with genetic characteristics and nutrient accumulation efficiency. Similar trends in calcium across different coconut are observed by Jackson *et al.*, (2004).

Magnesium (mg/100ml)

The magnesium content exhibited variation among the treatments, with values ranging from 10.60 to 15.10 mg. The maximum magnesium content was recorded in T_9 (GG) (15.10 mg), followed by T_4 (14.60 mg) and T_5 (14.00 mg), while the minimum magnesium content was observed in T_2 (MGTC) (10.60 mg).

Higher magnesium concentration T_9 (GG) indicates better mineral accumulation potential in these genotypes. These findings regarding ascorbic acid are in line with the study of Yong *et al.*, (2009).

Phosphorus (mg/100ml)

The phosphorus content exhibited considerable variation among the treatments, ranging from 7.30 to 10.30 mg. The highest phosphorus content was observed in T_8 (KB) (10.30 mg), followed by T_9 (9.50 mg) and T_6 (9.40 mg), while the lowest phosphorus content was recorded in T_3 (MGPC) (7.30 mg).

The differences in Highest phosphorus (T_8) content may be attributed to genetic variability and differential nutrient uptake among the evaluated genotypes. The findings previously presented by Jackson *et al.*, (2004) and Ramanandam *et al.*, (2017).

Conclusion

The present investigation demonstrated substantial in both the physical and nutritional properties of tender coconut genotypes collected from Bastar region Chhattisgarh. Significant differences were observed in nut colour, nut shape, nut length, nut diameter, nut weight, water volume, husk weight, kernel weight, and hard-shell thickening the existence of rich genetic diversity among

the evaluated genotypes. Genotypes GG (T₉) and MGGC (T₄) performed better for most physical traits, while KB (T₈) also showed superior performance for several parameters. The observed variability reflects the rich genetic diversity of the collected germplasm and highlights the potential of these genotypes for selection, varietal improvement, and conservation programmes.

The nutritional analysis of tender coconut water further revealed considerable variation in mineral composition. Potassium was the predominant mineral, with the highest concentration recorded in GG (T₉), KB (T₈) were observed in the highest sodium and phosphorus contents. The highest calcium content was observed in MGGC (T₄), whereas GG (T₉) recorded the maximum magnesium content. The observed diversity in both physical and nutritional attributes highlight the potential of these superior genotypes for varietal improvement, germplasm conservation and future coconut breeding programmes aimed at developing high yielding and nutrient rich cultivars suited to the Bastar region.

Authors Contribution

Author 2 (Ganesh Prasad Nag), 3 (Bhagwat Kumar) and 4 (Agniva Halder) conceptualized the study, designed the experiment and developed the methodology. Author 1 (Bhumika Netam), 5 (Manjari) and 6 (Chandni Shardul) Author conducted experiments and collected experimental data. Author 1(Bhumika Netam) and 2 (Ganesh Prasad Nag) performed data analysis and interpretation. Author 1(Bhumika Netam) and 2 (Ganesh Prasad Nag) and 4 (Agniva Halder) the original manuscript draft. All authors critically revised reviewed and approved the final version of the prepared manuscript.

Declaration: The authors declare no conflict of interest.

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