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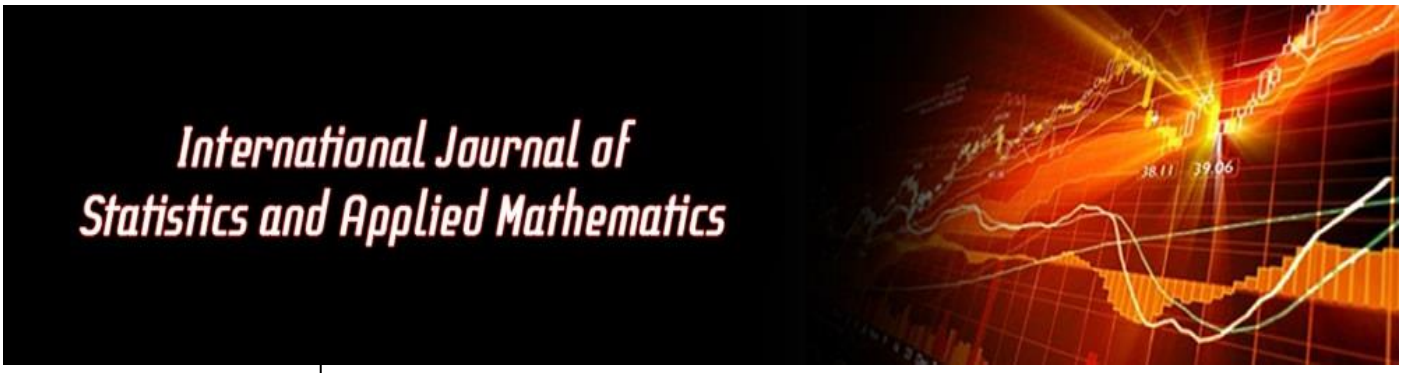

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Varietal evaluation in Coconut

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Abstract
Coconut (*Cocos nucifera* L.), often referred to as the "Tree of Heaven," is a member of the Arecaceae family and the sole species in the genus Cocos. This review explores the botanical, historical, and cultural significance of coconut, emphasizing its role as a versatile and economically important palm in tropical regions worldwide. Known as "Kalpavriksha," every part of the coconut palm holds utility, providing sustenance, shelter, and economic resources throughout an individual's life. The cultivation of coconut spans centuries, with references dating back to ancient texts like the 'Ramayana.' Originating from disputed locations, coconut cultivation has spread across various regions in India, notably in states like Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, Odisha, Gujarat, Maharashtra, Bihar, Assam, Chhattisgarh, and Tripura. The coconut's economic importance is evident in its contribution to the livelihoods of farmers, generating income through a diverse range of value-added products. The review also addresses the physical attributes of tender coconuts, exploring variations in weight, size, and water content across different cultivars. From a nutritional perspective, coconut emerges as a rich source of water, proteins, fats, amino acids, and total soluble solids (TSS). The potential health benefits, including anti-cancer properties attributed to specific cytokines found in coconut water, open avenues for further research and exploration. The comprehensive evaluation of coconut hybrids for organoleptic qualities emphasizes the suitability of specific varieties for tender nut purposes. The findings of this review contribute to a deeper understanding of coconut, shedding light on its cultural, agricultural, and economic significance, thereby fostering continued research and sustainable practices in coconut cultivation.

Keywords: Organoleptic**,** inflorescence, Kalpavriksha, tree of heaven

Introduction
Coconut (*Cocos nucifera* L.) is considered as a “Tree of Heaven” belongs to the family Arecaceae and only species of the genus *Cocos*. The term coconut can refer to the whole coconut palm or the seed, or the fruit, which, botanically, is a drupe, not a nut. The spelling coconut is an archaic form of the world. The term is derived from the 16th century Portuguese and spenish word *coco* meaning “head” or “skull”. Form the tree indentations on the coconut shell that resemble facial features. It is also well known as a “*Kalpavriksha*” because each and every part of the palm may be useful to mankind as a number of ways, right from birth to death. The importance of palm lies in the fact that not only does it supply, food, drink and shelter, but it also provides raw domestics as well as economic life. The wide range of value added products available in coconut generate additional income to the farmers and provides employment opportunities for many people. Coconut is a very versatile and an important commercial palm in the tropics of the world. It is being cultivated since time immemorial, as references are available in various literatures including 'Ramayana'. There are various disputes about its origin. According to some report coconut had been cultivated in many parts of India and the climatic and geographical changes in due course might have caused the confinement of coconut to coastal tracts in the country.
Coconut or Kalpavriksha (*Cocos nucifera* L.) is one of the commercially important plantation crops extensively grown throughout the country for its nutritive value and medicinal properties. The palm produces both the female and male flowers on the same 2 inflorescence; thus, the palm is monoecious. Other sources use the term polygamomonoecious. The female flower is much larger than the male flower.

Coconut palms are belived to be largely cross pollinated, although some dwarf varieties are self- pollinating. Coconut palms grown in the country Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, Odisha, Gujarat, Maharashtra, Bihar, Assam, Chhattisgarh, Tripura, Nagaland particularly. It is grown in almost all the districts of the Gujarat state. The major growing area of Gujarat is confined to Junagadh, Bhavnagar, Valsad, Kutch, Porbandar, Jamnagar, Surat, Navsari, Amreli, Vadodara, Anand districts. In the country, coconut occupies the prime place among various plantation crops which are popular. In India, share area of coconut is 2088.47 thousand hectares with production of 22167.45 thousand MT. In Gujarat, share area of coconut is 22.81 thousand hectares with production of 312.68 thousand tonnes.

Coconut is usually grown commercial crop. Moreover, it can also be grown in any type of soil mostly Red Sandy loam, laterite and alluvial soils having good drainage system. From nutritional point of view, Coconut can be considered as nutrition rich plantation crop. It contains considerable amount of water (154-385 ml), Proteins (0.03-0.51 g), Fats (0.14-0.74 g), Amino acids (1.30-2.21 mg), TSS (4.5-7.0) (A. Prases *et al.*, 2011) [13]. Coconut water is rich in vitamins, minerals, amino acids and phytohormones. The potential anti-cancer properties of specific cytokines could bring encouraging and novel prospective in finding cures for the different types of cancer (Reddy and Lakshmi, 2014, Malam *et al.*, 2022) [12, 9]. Coconut nut is a fibrous drupe but with a smooth outside skin (exocarp), which may vary from green to red brown or even ivory. The coat (mesocarp) in the young coconut is white and firm. On the other hand, the ripe nut has a fibrous mass, the husk, from which coir is obtained. Within this fibrous mass is the nut with a hard shell (endocarp) enclosing the kernel (endosperm). Between the shell and the kernel is a thin brown seed coat (testa). It adheres firmly to the kernel which is the white flesh, about 12 mm thick lining the central cavity containing the nut water. Towards the end of maturation, the volume of water in the cavity decreases considerably which may be due to absorption by the endosperm tissue or to evaporation. Matured nuts have a sloshing sound of water inside when shaken. Yield is usually estimated in terms of the number of nuts produced per palm or unit area and weight of equivalent copra.

Physical characters of coconut palm

Ghosh *et al.* (2015) [8] reported that, the length of petiole was recorded maximum 195 cm in Philipines Ordinary compared to 148 and 146 cm WCT x COD and S. S. Green. The leaf length recorded maximum (564 cm) compared with 249 cm in Laccadive Ordinary. The Number of leaflets varies between 112 to 242 cm among different varieties and hybrids. The length of leaflets was maximum in Local Tall (127 cm) followed by Laccadive Ordinary (121 cm) and WCT x COD (117 cm) compared with 96 cm in MYD x WCT. The bunch production was maximum in hybrid COD x WCT (9.4 palm-1) followed by Philipines Ordinary (8.4 palm-1). S. S. Green produced minimum number of bunches (6.1 palm-1). The yield nut per palm was recorded maximum (105.2 palm-1) in Laccadive micro followed by 92.6 palm-1in COD x WCT while it was lowest in S. S. Green (57.6 palm-1). Dare *et al.* (2010) [7] observed that the nut colour of different varieties of coconut at immature stage was recorded in SGD x VTT, MYD x VTT, VTT, WAT (Green, Red, Bronze) and SGD (Green) respectively. The Nut size was recorded at mature stage in SGD x VTT, MYD x VTT, VTT, WAT (Small, Medium, and Large) and SGD (Medium), respectively. observed that the plant height was maximum recorded in 'Java Giant' (10.30 m) followed by 'Federated Malayan States' (9.48 m) and minimum height of palm was recorded in 'East coast Tall' (3.67 m). The number of functional leaves maximum in 'Kanyakumari Green' (41.5) followed by 'Philipines Ordinary' (39.8) and minimum recorded in „Ayiramkachi" (26.7). The girth of collar region was maximum recorded in „Andaman Giant" (96.2 m) followed by 'Andaman Ordinary' (82.3 m) and minimum was recorded in 'Kanyakumari Red' (61.6 m). The length of leaflet bearing portion recorded maximum was found in 'Andaman Giant' (4.98 m) followed by 'Federated Malyayan States (3.90 m) and minimum was recorded in; Kanyakumari Red' (0.97 m). The number of leaflets on one side recorded was maximum in 'Siam' (117) followed by 4 'Andaman Red' (116) and minimum was recorded in 'Kanyakumari Yellow' and 'Kanyakumari Red' (88).

Physical character of inflorescence

Reported that the length of spadix is 1 to 2 m long and about 15 cm diameter and consist of a central axis or rachis, with 30 or more lateral branches and each about 30-55 cm long and bearing 200-300 male flower from the top down and some rachillae have one or more female flowers at their base. The total number of female flowers in an inflorescence is depending on genetic and environmental factor and varies from o to few 100. The normal inflorescence has several thousand male flowers but, in contrast, the spicata inflorescence is very few. The male flowers are borne singly or in two's or three's on each rachilla. They are sessile, 0.7-1.3 x 0.5-0.7 cm, usually pale yellow colour. The female flower are 2-3 cm diameter and have a calyx consists of six thick, imbricate perianth lobes in two whorls which are tightly folded over the pistil when young. Varkey and Davis (1960) reported that the, each anther contains 1,11,000 and 2,21,000 pollen grains. Aldaba *et al.* (1921) [1] reported that each inflorescence produce approximately 272 million pollen grains in an inflorescence reported that coconut pollen grains are spherical (50 µm) when fresh but shirnk rapidly after shedding and become ellipsoidal (65-69 µm in length and 28-30 µm in diameter) with a longitudinal suture. When placed in water, the pollen grain immediately gets hydrated regaininig its spherical shape and the suture disappears. The pollen has been reported to remain viable for 2-8 days.

Physical character of tender coconut

Attri *et al.* (1999) [5] evaluated different cultivars of coconut (*Cocos nucifera* L.) at tender nut stage and found that at 7-8 months maturity, the weight of nut varied from 1.315 kg in MOD (Malayan Orange Dwarf) to 2.815 kg in AT (Andaman Tall). Length and breadth of nuts exhibited significant differences among different cultivars studied. The maximum length 21.02 cm) was recorded in D x T, whereas the breadth was maximum (16.34 cm) in AT (Andaman Tall). The volume of water varied significantly and was maximum in D x T cultivar (649.0 ml) observed that, the weight of nut increased steadily from sixth month onwards upto nine months. This increase in weight appeared to be fairly linear during the first three stages (i.e. 6, 7 and 8 months) and it tapered off as the last stage was reached. Further, they observed that, the weight of nut at six months age was O.98 kg, which reached to 1.38 kg, 1.85 kg and 2.05 kg at seven, eight and nine months age. The weight of nut kernel exhibited a gradual increase with maturity. There was a doubling of kernel weight between III (8 months) and IV stage (9 months)

of maturation. This increase in kernel weight was result of kernel formation from six months onwards. The kernel weight was found to be increased from 15 g (six months) to 183.6 g (nine months). Cv. 'Arsikere'.

Ghosh *et al.* (2015) [8] reported that, the average nut weight was recorded maximum in S. S. Green (1882 g) followed by Andaman Ordinary (1855 g). The minimum nut weight was observed in Laccadive Micro (1265 g). The average nut weight showed variation among different cultivars and hybrids was recorded maximum in S. S. Green (1882 g) followed by Andaman Ordinary (1885 g). The minimum nut weight was observed in Laccadive Micro (1265 g). The copra yield was highest in Philipines Ordinary (9.4 kg palm-1 yr-1) followed by COD x WCT (9.3 kg) and Laccadive Ordinary (9.2 kg) as compared to (6.2 kg) in ECT. The oil yield was recorded maximum in Philipines ordinary (6.3 kg palm-1) followed by COD x WCT (5.8 kg) as compared to (4.2 kg) in ECT. The maximum volume of water was observed in case of Philipines Ordinary (305.2 ml) followed by COD x WCT (268.2 ml). Mali *et al.* (2004) [10] observed that the length of tender nut recorded an increasing trend with the maturity. The maximum length was recorded in 'Fiji' at six (20.20 cm) and seven (21.85 cm) months maturity, respectively and in 'San Ramon' (24.27 cm) at eight month maturity. The minimum nut length was recorded in „BYL" (13.27 cm) at six month maturity and in „Pratap" at seven (14.98 cm) and eight (16.03 cm) months maturity, respectively observed that the Dehusked nut weight recorded was maximum in 'Fedrated Malyayan States' (902 g) followed by 'Cochin China' (900 g) and minimum was recorded in 'Ayiramkachi' (220 g). The kernel thickness was maximum recorded in 'Lakshadweep Small', 'Straits Settlements Green', 'Philipines Ordinary' 'Java Giant' (1.5 cm) and minimum was recorded in 'Ayiramkachi' (1.1 cm). The weight of kernel was maximum recorded in 'Philipines Ordinary' (388.3 g) followed by „Siam" (375 g) and minimum was recorded in 'Ayiramkachi' (128 g) respectively. Perera *et al.* (2014) [11] observed that the weight of different fruit components in each coconut genotype, the husked nut weight was maximum recorded in 'Kamandala' (952.8 g) followed by 'Ran Thembili' (826.4 g) and minimum was recorded in 'Porapol' (446.1 g). The split nut weight was recorded maximum in 'Kamandala' (695.2 g) followed by 'Ran Thembili' (596.4 g) and minimum was recorded in 'Red Dwarf' (358.5). The shell weight was maximum recorded in 'Kamandala' (244 g) followed by 'Ran Thembili' (234.5 g) and minimum was recorded in 'Red Dwarf' (122.8 g). The dry weight of nut was maximum recorded in 'Kamandala' (224.8 g) followed by 'Ran Thembili' (193.4 g) and minimum was recorded in "Red Dwarf" (110.9 g), respectively.

Chemical composition of tender nut water

Ghosh *et al.* (2015) [8] reported that, the Maximum pH (5.10) of tender nut water was also observed in COD x WCT followed by WCT x COD (4.58). The tender nut water of Philipines Ordinary exhibited the highest TSS (6.2 obrix) followed by S. S. Green (5.7o brix), respectively.

Organoleptic evalution

Evalution of coconut hybrids for sutability as tender nut was taken by Apshara *et al.* (2007) reported that the organoleptic evalution showed that the hybrids Chandrasankara and Chandralaksha were the best for tender nut purpose as both them ranked good for taste of water and meat at the age of 7 month during summer season.

Conclusion

In conclusion, this comprehensive review unfolds the multifaceted tapestry of the coconut palm, revered as the "Tree of Heaven." From its botanical intricacies to its historical and cultural significance as a Kalpavriksha, every facet of the coconut palm emerges as a crucial thread in the fabric of human life. The palm's exceptional versatility extends beyond mere sustenance, providing food, drink, shelter, raw materials, and economic opportunities that weave into the very essence of daily existence. Vast expanse of coconut cultivation in diverse regions of India, particularly in Gujarat, it underscores the pivotal role of this commercially significant plantation crop. The nutritional richness of coconut, encapsulated in its water, proteins, fats, amino acids, and total soluble solids, emphasizes its standing as a nutritionally potent crop with potential health benefits, including anti-cancer properties. Delving into the physical characteristics of coconut palms, inflorescences, and tender coconuts, the review encapsulates a wealth of knowledge. Insights into the variations among different cultivars, their yield, and organoleptic qualities contribute to a deeper understanding of coconut's diverse offerings. From the majestic height of palms to the intricate details of inflorescences and the chemical composition of tender nut water, each revelation adds a layer to the rich narrative of coconut cultivation. The conclusive evaluation of coconut hybrids for tender nut suitability, with hybrids like Chandrasankara and Chandralaksha standing out, further solidifies the practical applications of this research. The findings not only contribute to the scientific understanding of coconut but also have tangible implications for agricultural practices and the development of coconut-based industries. As we unravel the coconut's story, from its origins in ancient texts to its present-day cultivation and applications, it becomes clear that the coconut palm is not merely a botanical entity but a lifeline intricately woven into the socio-economic fabric. This review, therefore, serves as a valuable resource for researchers, agriculturists, and policymakers alike, paving the way for informed decisions and sustainable practices in the cultivation and utilization of this remarkable "Tree of Heaven."

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