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Study on varability between dehusked coconuts using principal component analysis

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■ **ABSTRACT :** Marketing of coconuts differs from that of other fresh fruits due to natural durability of coconuts, which are sold as fresh tender nuts as well as matured water nuts and dry nuts. Most widely indirect mode of disposal of coconuts is adopted by coconut farmers. In India mostly coconuts are segregated by manual inspection. This research concerns about grades of dehusked coconut. Principal component analysis was done to find the principal components in the different grades of dehusked coconut. The result indicate that weight of nut, weight of fresh kernel and the major diameter of the coconut are principal components needed to grade the dehusked coconut.

■ **KEY WORDS :** Varability, Dehusked, Principal component analysis

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Fruit commercialization is the main purpose of grading. Fruit in the same tree differ in quality such as feature, flavour because their growth was effected by many environmental factors. Especially, fruit from different orchards differ significantly in size and quality. Grading may not only standardize fruit product but also promote management of the fruit tree in orchard and product quality (Haisheng Gao *et al.*, 2010). Fruit and vegetable are very difficult to grade exactly and rapidly because of their significant difference in feature such as size, shape and colour as a result of changeable conditions of nature environment and manual factors.

Coconuts are one of the most valuable crops of the wet tropics and are considered to be among the 20 most important crop plants in the world. It is widely acclaimed as *Kalpavriksha* or tree of heaven.

The fruit is a fibrous drupe. It consists of, from the outside in a thin hard skin (exocarp), a thicker layer of fibrous mesocarp (husk), the hard endocarp (shell), the white endosperm (kernel) and a large cavity filled with liquid (water). When immature, the exocarp is usually green, sometimes bronze. Wide variation in fruit shape and size exist within types and populations. Fruit shapes vary from elongated to almost spherical and weigh between 850 and 3700 g (1.9–8.1 lb) when mature (Chan and Elevitch, 2006).

It is grown in more than 86 countries worldwide, with a total production of 54 billion nuts per annum. In world scenario, Indonesia occupies 29.59 per cent wold area; Philippines occupies 28.71 per cent world area and India occupies 17.58 per cent world area in coconut production. However, overtaking Indonesia and the Philippines, India occupies the premier position in the world with an annual production of 13 billion nuts. It is

reported that in India, the area and production of coconut are in increasing trend.

In Tamil Nadu fresh coconuts were exported by the dealers on the basis of count per sack and a minimum average net weight per sack. The average net weight of dehusked coconut may vary from 500 to 650 g. The most common size (circumference) of dehusked coconut packed varies from 12 to 14 inches. As a rule, the dealers expect the size to be fairly uniform for each count and sometimes complain for irregularity in size.

From this it is clear that exporters use size, weight and colour as the parameters for grading dehusked coconut. Keeping the above points in view, the present investigation has been undertaken to study variability of dehusked coconut.

METHODOLOGY

Coconuts were obtained from Sungaramudaku village, near Pollachi, Coimbatore, Tamil Nadu. It was harvested from trees bearing 12-13 months old fruits which was identified and harvested with the help of well experienced farmers. In order to determine the variability of dehusked coconut, randomly 100 nuts were taken. Variability in dehusked coconut was studied based on principal component analysis (PCA).

For each fruit, the three principle dimensions, namely length (L), width (W) and thickness (T) were measured using a digital verniercaliper, which had an accuracy 0.05mm. The width and thickness are perpendicular to each other. To obtain the mass, each fruit was weighed (w_1) with an electronic balance of 0.01g accuracy.

Fruits were carefully opened to avoid damage to the flesh and shell. The coconut water was drained off and again the weight was measured (w_2). By subtracting w_1 and w_2 the amount of coconut water present in each fruit was measured. The wet flesh of coconut was sun dried to determine the dry flesh weight (w_4). In sun drying, cups were spread over an open surface in a single layer directly facing the sun. During non-sunshine periods and nights, cups were covered by polyethylene sheet to avoid desorption of moisture. After second day, cups were removed from shells manually and dried for another five days to obtain constant weight of 8 per cent moisture content wet basis. The weight of shell of each fruit was measured (w_3). Wet flesh weight (w_5) was calculated by subtracting w_2 and w_3. Thickness of the shell was determined using screw gauge. The percentage shell weight, wet and dry flesh weight was calculated using w_3/w_1, w_5/w_1 and w_4/w_1, respectively.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Fruit character correlation :

Full weight of nut and major diameter indicated strong positive relationships with wet flesh weight, indicating that larger fruit were heavier and had greater total fresh kernel weight. Shell weight was highly correlated with full weight of nut. Weight of mature coconut water also showed strong positive association with full weight of nut. In contrast, the fruit length was poorly correlated with the weight of copra, shell weight, shell thickness, weight of mature coconut water and wet flesh weight. Likewise, the shell thickness was also poorly correlated with all fruit characteristics, indicating that heavier and bigger coconut were not influenced by shell thickness.

Principal component analysis (PCA) :

It could be observed that all the measured variables were correlated each other. Hence PCA would be best suitable for further analysis. The major concern to use PCA is to reduce dimensionality and to achieve the least possible number of components which governs original variation of original multivariate data. From the PCA results, two plots *viz.*, score plot and loading plot were obtained.

In Fig. 1 the score plot clearly revealed the variation obtained between the different size and weight of dehusked coconut in to groups. It is evident that the coconuts with same size vary with weight. It was observed that PC1, PC2 and PC3 revealed 40.1, 25.0 and 12.7 per cent variation, respectively. From the PCA loading graph (Fig. 2) it was analysed that spoke length of full wt of nut was longest among all the characteristic of dehusked coconut and therefore, proved as a most interactive character of dehusked coconut. Major diameter and minor diameter had similar interactive character as it have small angle within them. Similarly weight of fresh kernel and full weight of nut had similar interactive character. Whereas minor diameter, weight of water, thickness of kernel, weight of copra, length

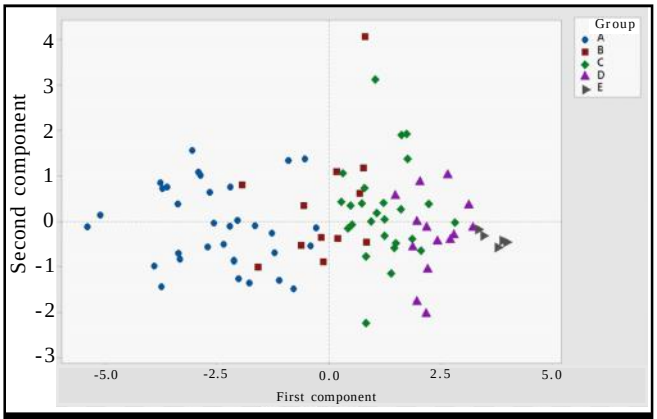

Fig. 1 : Score plot for dehusked coconuts [Group A: Size 80-90 mm(300-400 g);Group B: 80-90 mm(400-500 g); Group C: 91-100mm(400-500g); Group D: 91-100 mm (500-600 g)

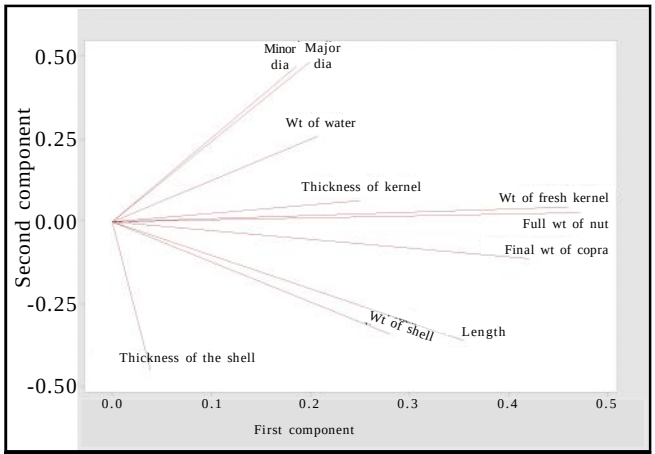

Fig. 2 : Loading plot for dehusked coconut

and thickness of shell have different interactive characters due to high angle between them. Similar analysis was done for the evaluation of quality of broiler chicken by Tiina *et al.* (2006).

Conclusion :

PC1 (Principal component) explains more about full weight of nut, weight of copra, weight of fresh kernel and length. Whereas PC2 explains about major diameter and minor diameter of dehusked coconut. From these PCA results, it could be concluded that two principal component (PC1 and PC2) were sufficient to explain the total variation of dehusked coconut.

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