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Physico-chemical changes in tender coconut due to *Paradasynus rostratus* Dist. infestation

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Coconut (*Cocos nucifera* L.), an important ommercial palm of the tropics, is mainly grown for its uts. The tender stage of the nuts serves as a source of ater (liquid endosperm), which is delicious and rich in utrients (Jayalekshmi *et al.*, 1986). An average weighing nder nut may contain about 300 ml of water with 15 g ugar. In the natural state, it is sterile and used for general nd medicinal purposes.

The coreid bug (*Paradasynus rostratus* Dist.) has tained the status of a potential pest of coconut in Kerala recent years. The pest was first reported on coconut the seventies (Kurian *et al.*, 1972). The bio-ecology this pest has been extensively studied on the main ost, coconut and on collateral hosts like guava and marind (Kurian *et al.*, 1979). Both adults and nymphs the bug feed on developing buttons. When the adult ugs and nymphs infest buttons during early stages of eir growth, the entire bunch dries-up. However, when e buttons are damaged, after three months of evelopment they show further growth expressing festation symptoms of varying intensities in due course development. The buttons, which mature, show eding marks as permanent deep depression resulting eye-like crinkle surrounded by necrotic lesions.

Due to the feeding damages by the pest, the internal ntents of the nuts are also affected. The quantitative ss of physical characters and qualitative chemical anges in the oil from mature nuts had been reported rlier (Nair *et al.*, 1997; Mayilvaganan and Nair, 2002). owever, the information on the changes in chemical mposition of nut water due to feeding damage of the ugs is not available. Hence, the present investigation was carried out to study the changes in physical characteristics of tender nuts and chemical composition of nut water.

Twenty four pairs of seven month old nuts (uninfested and infested) were harvested from 18 tagged bunches of coconut palms (variety West Coast Tall) in Kayangulam (Alappuzha Dt.) and Chirayinkizh (Thiruvananthapuram Dt.) areas of Kerala. Each pair of uninfested and infested nuts was collected from the same bunch. In this investigation, nuts of seven months maturity were used for the study, as whole cavity of six to eight month aged nuts were found completely filled with water (Devi and Velayutham, 1972; Chikkasubbanna *et al.*, 1990). Severely infested nuts were not included in the study as the water content was minimal in such type of nuts. Nuts which were moderately infested with one or two feeding points developed into deep depression and had volume of nut with husk between 1150 and 1450 mm^3 were used for the study. Harvested nuts were studied for the physical characteristics *viz.*, precise area of damage on pericarp, total weight of nut, amount of water, weight of nut without water, weight of solid endosperm (kernel), weight of shell and husk. Nut water was collected in sterile flasks and analysed for chemical constituents immediately. Total solids, total lipids, pH and titratable acidity were determined according to AOAC methods (1984), total sugar and reducing sugar were estimated by the methods of Roe (1955) and Somogyi (1945) and the nonreducing sugar was computed from it. Protein estimation was done by Lowry *et al.* (1951) method and free amino acids by ninhydrin method (Moore and Stein, 1948).

The physical characteristics of tender nut are presented in Table 1, which give a clear picture of effect of feeding of the coreid bug. The mean area damaged on pericarp of bug-infested nuts was 1983 mm^2. This attribute of nut has direct relevance to the physical parameters of nut. The weight and volume of infested whole nuts had registered 34.0 and 30.3 per cent reduction from uninfested whole nuts. Similarly, the weight of infested nut without water showed 36.4 per cent reduction from uninfested nuts. The amount of nut water and weight of kernel showed 44.8 and 54.2 per cent reduction respectively in infested nuts. The weight of shell and husk of infested nuts showed 46.2 and 36.9 per cent reduction from uninfested nuts. Previous studies on physical characteristics on mature nuts indicated similar results (Nair *et al.*, 1997; Mayilvaganan and Nair, 2002). The quantitative loss may be due to the restricted water movement created by deep depression at the feeding points along with the crinkling and necrotic lesions on the nuts produced by the infestation of the coreid bug. Student's t-test performed between uninfested and infested nuts for each characteristic showed highly significant differences.

Table 1. Physical characteristics of tender nut infested by coreid bug (mean values with SD)

Characteristics	Uninfested	Infested	Per cent loss	t-value
Area of pericarp damaged (mm^2)	-	1983	-	-
Weight of whole nut (g)	1446±38	954±33	34.0	19.9**
Volume of whole nut (mm^3)	1853±76	1292±55	30.3	24.2**
Weight of nut without water (g)	1015±32	646±14	36.4	15.6**
Amount of nut water (ml)	420±24	232±19	44.8	11.5**
Weight of kernel (g)	72±4.2	33±2.8	54.2	15.3**
Weight of shell (g)	182±13	98±7	46.2	10.2**
Weight of husk (g)	936±29	591±22	36.9	9.4**

**Significant at 1% level

The results on the correlation studies between area damaged on pericarp and other physical characteristics are presented in Table 2. The results showed significant negative correlation between the area damaged and characteristics of weight and volume of whole nut, amount of water, weight of nut without water, weights of kernel, shell and husk.

Table 2. Correlation coefficient between the area of pericarp damaged (mm^2) and other physical characteristics of coreid bug infested tender nut

Characteristics x Area damaged (mm^2)	r-value	Inference
Weight of whole nut (g)	-0.47	*
Volume of whole nut (mm^3)	-0.56	**
Weight of nut without water (g)	-0.73	**
Amount of nut water (ml)	-0.92	**
Weight of kernel (g)	-0.79	**
Weight of shell (g)	-0.95	**
Weight of husk (g)	-0.63	**

**Significant at 1% level *Significant at 5% level

The influence of coreid bug infestation on the chemical constituents of nut water is presented in Table 3. The pH and titratable acidity of the water did not show any significant variation between infested and uninfested nuts. The total soluble solid was found to be lower (about 0.14 g /100 ml water) in infested nut water compared to uninfested nuts. However, the total sugar content in infested nuts was higher (3.89 g/100 ml) than in uninfested nuts (3.46 g/100 ml), which are statistically not significant. The results of sugar content are in broad agreement with the earlier studies (Devi and Velayutham, 1972; Jayalekshmy *et al.*, 1986; Chikkasubbanna *et al.*, 1990).

Table 3. Percentage chemical composition of tender nut water (mean value)

Chemical composition	Uninfested	Infested	Mean change	t-vlaue
pH	4.76	4.79	0.03	-
Acidity (mg KOH/100 ml)	81.16	78.51	2.65	1.85^{NS}
Total soluble solids (g/100 ml)	5.98	5.84	0.14	0.53^{NS}
Total sugar (g/100 ml)	3.46	3.89	0.43	-1.30^{NS}
Reducing sugar (g/100 ml)	2.16 (62.4%)	2.44 (62.6%)	0.28	-0.31^{NS}
Soluble protein (mg/100 ml)	7.28	6.56	0.72	2.57*
Free amino acids (mg/100 ml)	2.08	1.86	0.22	1.73^{NS}
Ether extractable lipid (mg/100 ml)	4.13	4.02	0.11	1.03^{NS}

Figures in parenthesis are percentage of reducing content out of total sugar
*Significant at 5% level NS – Not significant

Total soluble protein in nut water of coreid bug infested nuts was significantly lower (6.56 mg/ 100 ml) as compared with water of uninfested nuts (7.28 mg/ 100ml). The changed chemical composition in water of infested nuts substantiates the possibility of impairment of metabolic activity due to toxaemia and feeding damage caused on the pericarp by the bugs. The mean ether

ractable lipid was slightly less in infested nuts (4.02 /100 ml) than in water of uninfested nuts (4.13 mg/ ml). Probably, due to the disturbance of metabolic ivity, the synthesis of these primary metabolites in nut is affected in the initial stage of nut development. milarly the content of the free amino acids in water of ested nut was found low compared to uninfested nuts, no significant reduction was noticed.

Student's t-test performed between uninfested and ested nut for each chemical constituent on percentage sis showed only significant difference in protein ntent. Other chemical parameters between uninfested d infested nuts were found statistically nonsignificant.

In Table 4, the results of correlation coefficient tween amount of water and chemical composition of ter from infested nuts are presented. On percentage sis, significant positive correlation was found only tween amount of water (ml) and total protein (mg) in ter of infested nut.

ble 4. Correlation coefficient between the amount of water (ml) and chemical composition of water from infested nut

emical components	r-value (per 100 ml)	Inference
dity (mg KOH)	0.21	NS
l soluble solids (g)	-0.19	NS
l sugar (g)	0.40	NS
ducing sugar (g)	0.39	NS
uble protein (mg)	0.48	*
e amino acids (mg)	0.41	NS
l lipids (mg)	-0.11	NS

gnificant at 5% level NS – Not significant

It is evident from the results that the chemical mposition has not been substantially altered alitatively due to coreid bug damage. However, the antitative changes in chemical composition were seen ainly due to reduction in amount of water in infested ts attributed to necrosis and warting on pericarp. rther, the infestation of coreid bug on young veloping buttons of coconut caused substantial loss of water and consequently resulted in quantitative loss of nutrients. As a result of reduced amount of water in infested nuts, the quantity of kernel is reduced during further development of nut.

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