

EQUILIBRIUM RELATIVE HUMIDITY (ERH) RELATIONSHIPS OF PROCESSED ARECANUT AND WHOLE DRIED RIPE NUTS

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The annual production of arecanut, the popular masticatory is of the order of a million quintals valued at about Rs 50 crores¹. It is consumed in different forms. A third (33 per cent) of the total production, is consumed as fresh or stored ripe nuts while the rest are consumed as whole or split dried ripe nut (25 per cent) or cut, boiled and dried green mature nuts (42 per cent). The production of these latter types is confined to the growing regions *viz.* Kerala, Mysore, Maharashtra, West Bengal and Assam, while the retailing and consumption is spread over the whole country. It has been estimated² that 85—95 per cent of the production is marketed outside the producing States. In many of these regions, monsoon interferes with the proper processing and storage of the finished products so that it has to be shifted to distant places for safe storage. The present paper reports on the results obtained in respect of the equilibrium relative humidity (ERH) relationship of four types of arecanuts used by the trade.

Measurement of ERH is of importance in packaging studies for the safe transport, storage and marketing of products. This value is mainly influenced by the original moisture content of the samples. The moisture equilibrium curve depicts the equilibrium relationship between the moisture content of the sample and the relative humidity of the atmospheres surrounding it.

Various methods could be employed for measuring the ERH such as direct measurement of water vapour pressure by manometric techniques; direct measurement by the use of electric hygrometer; by the graphical interpolation method³ and by Wink's weight equilibrium method⁴. Of these, the last two are simple and elegant and were therefore chosen for these investigation.

Experimental

Samples of *Chali* I and *Chali* II were obtained from fresh ripe arecanuts (8-9 months old) which were then dried in a through flow drier in the

laboratory. A market sample *Batlu adeke* was obtained. *Choor* made from mature green areca fruits (6-7 months old), cut into 8-12 pieces longitudinally, boiled, coated with *Kali* and then dried, was used. Scented *supari* I and II batches (made from *Batlu adeke*) were obtained from the market. Scented *supari* II had some white leguminous seeds.

Saturated solutions of salts in well sealed glass containers were used to obtain atmospheres of different relative humidities⁴.

Known weights of the samples were exposed to atmospheres of different relative humidities ranging from 40 per cent to 100 per cent. These were weighed once in two days and loss or gain in weight recorded. Adverse effects such as loss of crispness and mould growth were noted. When there was no further change in weight, the equilibrium moisture content of the samples was determined after powdering to a suitable mesh and drying a known weight (4-5 g.) in aluminium dishes to a constant weight at 105°C. The percentage loss or gain in weight of the samples after different periods of storage under different humidities was then calculated. Since the rate of moisture absorption by the hard dried materials, is rather low, the absorption at the end of 48 hours was taken for the analysis by the graphical interpolation method.

The initial, critical and permissible moisture contents for the samples were determined from the relation of equilibrium moisture content and relative humidity. The initial level represents the moisture content and the ERH of the original product and the critical level is the stage at which the products get infected or become organoleptically unacceptable. The level which corresponds to a 5 per cent lower R.H. is designated as permissible moisture content. The range between this level and the critical point may be considered as safety range and hence it is important that the packaging material selected should not permit the product to absorb moisture above the permissible moisture content.

Results and Discussion

With the processed mature green arecanut samples, equilibrium was obtained in 4-6 days while with the ripe dry whole nut, the *Chali* type,

the equilibrium was reached in 8-10 days. This may be due to the larger surface of the cut nuts being exposed to relative humidities as compared to that of the hard whole *chali* nuts. The percentage loss or gain in weight of the samples stored at different relative humidities in the first 48 hours plotted against R.H. is shown in Fig. 1, from which the ERH is determined. The equilibrium humidity moisture relationship is shown in Fig. 2, from which also the ERH has been determined.

The data relating to ERH and equilibrium moisture content (EMC) at the different humidities, are given in Table I.

As seen from Table I, the ERH of most of the samples are around 45-50 per cent except for the samples with the higher moisture contents, the ERH values for which are around 70 per cent. The two methods studied give closely agreeing values for the ERH of the samples.

The varieties cut into thinner sections and bits tend to become soft when moisture reached around 10 per cent. Samples at 90 per cent and 100 per cent R.H. were infected in 3-6 days. At 80 per cent R.H., *Batlu adeke*, *Choor* and scented *supari*, were infected between 20-28 days' of storage while *Chali* and scented *supari*-II got infected earlier at 14 and 8 days of storage respectively. All the samples at 70 per cent except the *Choor* and scented *supari* II were in good condition during the full period of the experiment, while the *Choor* and scented *supari* II got infected at 70 per cent after 26 and 38 days respectively. Scented *supari* II had white seeds. These seeds got infected first and even though they were removed and the storage continued, later on the sample itself was infected. These seeds act as the focal point of early infection.

Data regarding initial, critical and permissible moisture levels for the different types are given in Table II.

The permissible level of moisture for safe storage is between 10 per cent and 12 per cent with the processed mature green nuts while the *Chali* type is between 13 per cent and 14 per cent. With scented *supari* other factors such as loss of crispness and added flavours influence the storage conditions and time. As

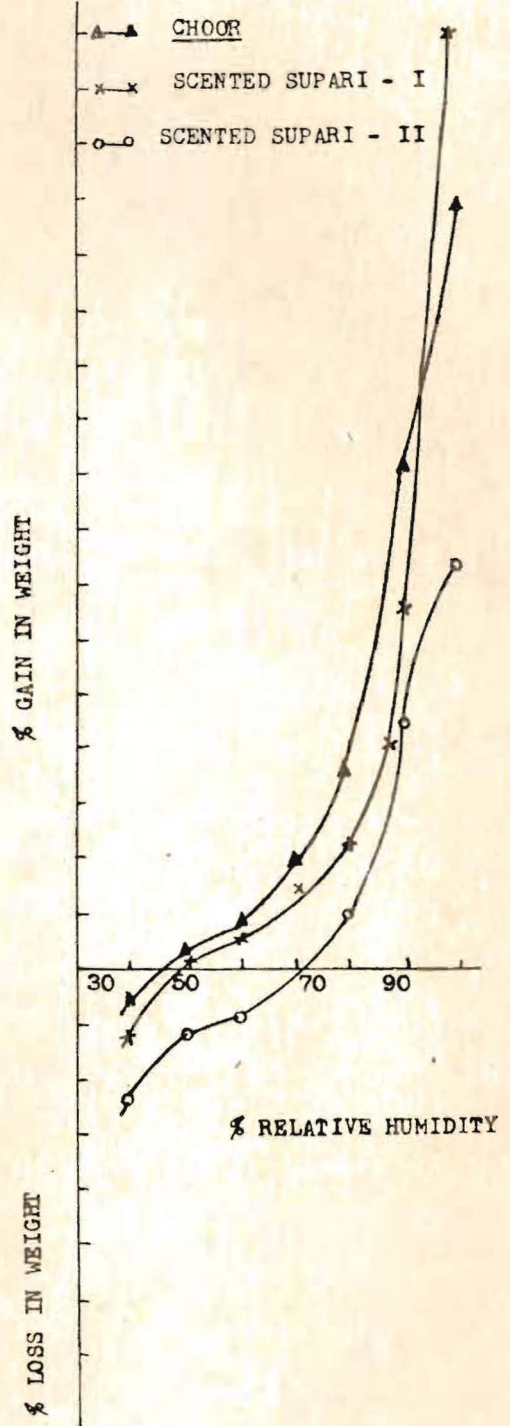
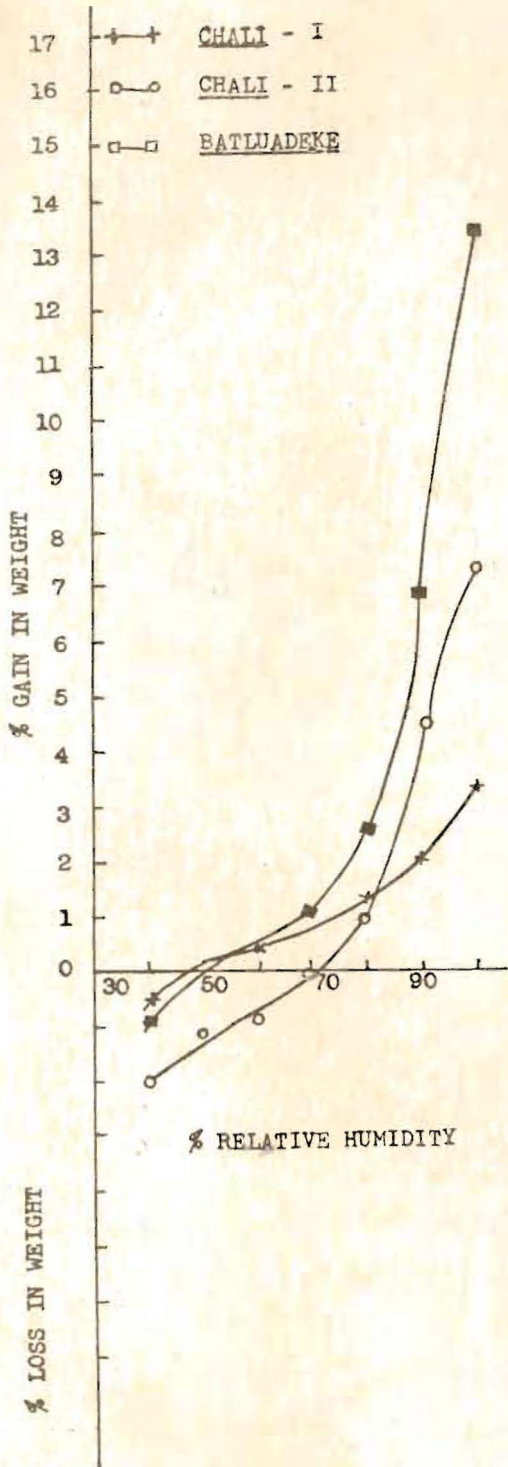


Fig. 1. Graphical interpolation curves.

48 hrs. storage at $26^{\circ} \pm 1^{\circ} \text{C}$

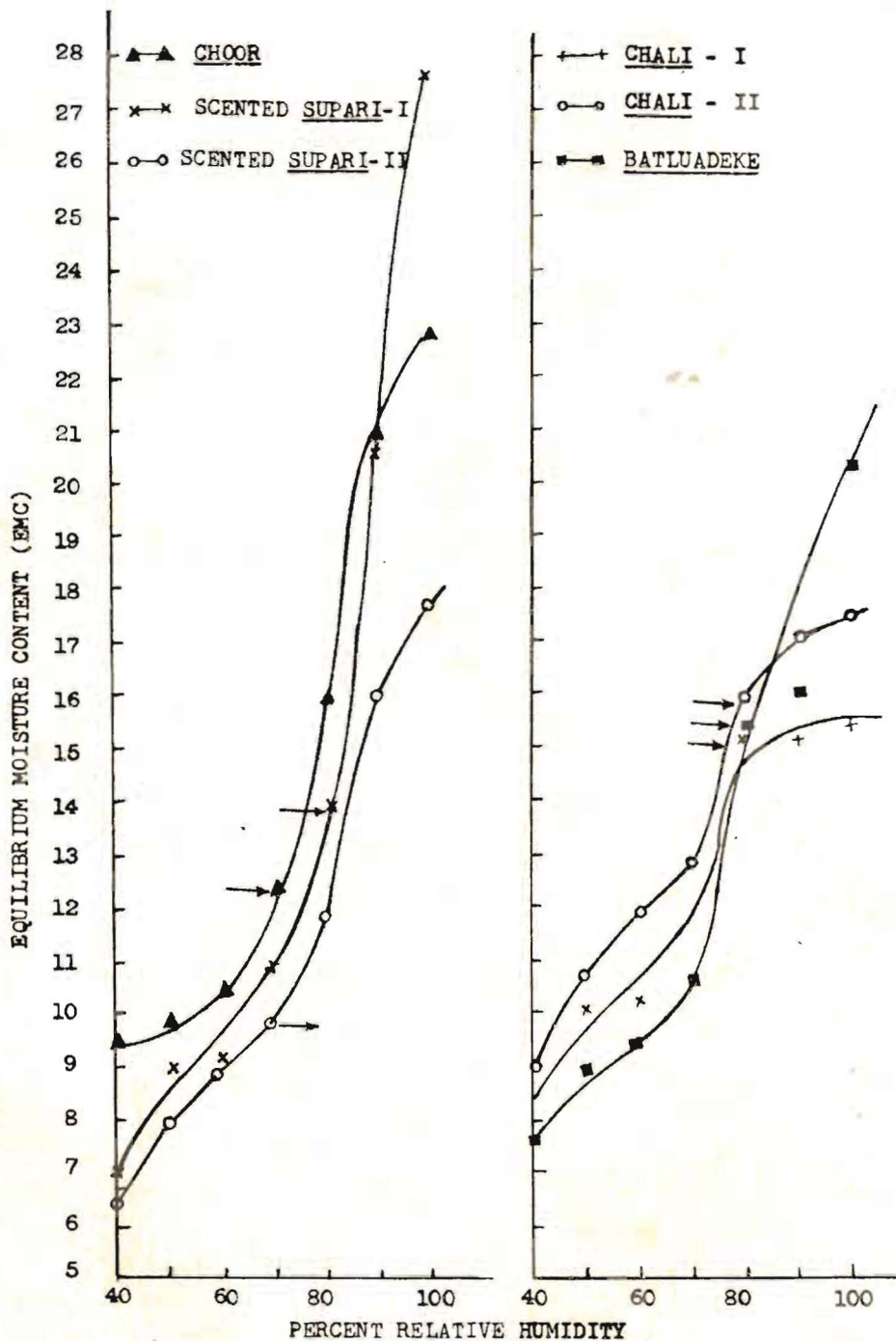


Fig. 2. Equilibrium humidity-moisture curves. Storage at $26^{\circ} \pm 1^{\circ} \text{C}$; \rightarrow indicates mould growth.

shown in one of the samples, substances other than arecanut bits such as leguminous seeds, coconut gratings etc. further reduce the per-

missible moisture levels, to between 9 and 10 per cent.

The moisture content of the processed green

TABLE I. EMC-Humidity relationship and ERH

Sample	Initial moisture %	ERH for sample from		EMC at different relative humidities							
		Fig. 1	Fig. 2	40%	50%	60%	70%	80%	90%†	100%†	
				Chali I	...	9.20	46	45	8.29	10.04	10.26
Chali II	...	12.50	71	68	8.90	10.66	11.91	12.81	15.80*	17.00	17.42
Batlu adeke	...	8.52	49	48	7.62	8.91	9.42	10.65	15.43*	16.02	20.36
Choor	...	9.53	46	47	9.36	9.77	10.42	12.32*	15.92	20.92	22.86
Scented supari I	...	8.25	48	48	6.56	8.93	9.15	10.95	13.85*	20.51	27.73
Scented supari II	...	10.38	72	73	6.32	7.96	8.80	9.80*	11.79	16.00	17.62

† At these levels the moisture content given is at the onset of infection and not EMC.

* Samples at this moisture and corresponding R.H. and higher levels got infected.

TABLE II. Initial, critical, and permissible moisture content of samples

Samples	Initial		Permissible		Critical		
	Moisture %	R.H. %	Moisture %	R.H. %	Moisture %	R.H. %	
							Chali I
Chali II	...	12.50	68	14.00	75	15.80	80
Batlu adeke	...	8.52	48	12.20	75	15.43	80
Choor	...	9.53	47	11.00	65	12.32	70
Scented supari I	...	8.25	48	11.90	75	13.85	80
Scented supari II	...	10.38	73	9.40	65	9.80	70

mature nuts is generally around 8 per cent and of *Chali* type around 10–12 per cent at the end of processing. These, however, will pick up moisture in the course of 4–8 days under high humidity conditions prevailing in the west coast and Assam and become fungus infected unless suitably protected with moisture barrier films and stored in properly constructed go-

downs. These aspects will be presented in subsequent papers.

Summary

Data on ERH, EMC and critical and permissible levels of moisture for three types of processed mature green arecanuts and whole dried ripe arecanut, have been determined.

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