# Packaging Requirements of Ready-to-Serve-Instant Tea-Mix in Relation to Moisture Equilibrium

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The initial (I), critical (C) and Danger (D) points for Ready-To-Serve Instant-Tea-mix are 3.0 per cent, 13.80 per cent and 6.2 per cent of equilibrium moisture content (EMC) respectively. Product stores well when the relative humidity of the storage atmosphere is upto about 22.0 per cent and it is thus quite hygroscopic in the real sense. It, therefore, requires stringent packaging conditions in regards to moisture pick up.

## INTRODUCTION

Ready-To-Serve-Instant-Tea-Mix is a dehydrated blend of milk, sugar and tea extracts. Dehydrated foods are usually very hygroscopic and each food has important product characteristics (Elder, 1949), which determine the nature, type and design of its package. In selecting a right type of package, factors like the initial moisture content and the E.R.H. value are the most important.

The measurement of equilibrium relative humidity is of value in studying the performance of hygroscopic foods for packaging (Elder, 1949; Landrock and Proctor, 1951 ; Wink, 1947). The products having Equilibrium Relative Humidity (E.R.H.) less than 50 per cent are usually considered as "Hygroscopic", whereas those having (E.R.H.) above 50 per cent are termed as "hygroemissive" (Pruthi *et al.*, 1959).

Although much data on the Equilibrium Relative Humidity relationships of many dehydrated foods have been published (Elder, 1949 ; Makower and Dehority, 1943. Siddappa and Nanjundaswamy, 1960 ; Stitt, 1958), information on the (E.R.H.) of Ready-To-Serve-Instant-Tea-Mix are absolutely lacking. This paper reports the results of a study on this subject.

Several methods have been reported in literature for the determination of Equilibrium Relative Humidity and no attempt will be made to mention each of them.

Wink's Weight Equilibrium method and Graphical Interpolation methods (Pruthi *et al.*, 1959; Wink, 1946) are generally used for the measure-

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ment of (E.R.H.) of foods but Pruthi *et al.* (1959) and Siddapp a and Nanjundaswamy (1960) have recommended the usefulness of the former method over the latter and as such Wink's method only was employed in these investigations.

## MATERIALS AND METHODS

The Ready-To-Serve-Instant-Tea-Mix employed in these studies was prepared by spraydrying a mixture of tea extract, skim milk and cane sugar according to a process developed in our Laboratories (Bhatti *et al.*, 1964). The Instant-Tea-Mix was hygroscopic and was, therefore, packed in airtight and moisture proof glass jars soon after preparation and used in the subsequent experiments. The proximate composition of black tea leave, tea extracts, feed mixture (extract+skimmilk+cane/sugar) and the final powder are given in Table I. Moisture ash, soluble ash, insoluble ash, alkalinity of soluble ash and alkalinity of insoluble ash, nitrogen, protein, caffein, caffein nitrogen, sugars and tannins were analysed according to A.O.A.C. methods (1955).

TABLE 1. *Proximate composition of tea leaves, extract, tea feed and tea powder mixture*

(Result on as such basis)

| Sr. No. | Determination made | | Tea leaves | Tea extract | Tea mixture | Whole tea mix |
|---|---|---|---|---|---|---|
| 1. | Moisture | .. | 8.53 | 86.70 | 71.75 | 3.9 |
| 2. | Total solid | .. | 91.47 | 14.30 | 28.25 | 96.1 |
| 3. | Ash total | .. | 5.11 | 1.35 | 1.083 | 3.27 |
| 4. | Soluble ash | .. | 56.6 | 15.5 | 33.25 | 30.35 |
| 5. | Alkalinity of soluble as Hcl./100 gm. | .. | 23.20 | 30.31 | 0.5 | 1.2 |
| 6. | Alkalinity of insol. ash as HCL/100 gm. | .. | 19.60 | 4.60 | 4.86 | 13.60 |
| 7. | Sugar total | .. | 11.9 | 1.25 | 17.857 | 67.6 |
| 8. | Reducing sugar | .. | 6.6 | 0.6 | 4.116 | 7.25 |
| 9. | Non-reducing sugar | .. | 5.035 | 0.617 | 13.00 | 57.332 |
| 10. | Water extract | .. | 27.69 | 8.40 | 30.68 | 96.60 |
| 11. | Caffein | .. | 3.33 | 0.70 | 0.2170 | 0.224 |
| 12. | Caffein nitrogen | .. | 0.5656 | 0.095 | 0.0328 | 0.0560 |
| 13. | Total nitrogen | .. | 1.4 | 0.12 | 0.157 | 0.239 |
| 14. | Crude protein | .. | 8.75 | 0.7500 | 0.98 | 1.494 |
| 15. | Caffein protein | .. | 2.25 | 0.3766 | 0.13 | 0.222 |
| 16. | Tannins | .. | 13.9 | 2.37 | 0.72 | 0.631 |
| | Dispersibility | .. | — | — | — | 50 seconds |
| | Bulk Density gms/ml | .. | — | — | — | 0.91 gm/ml. |

Dispersibility of the powder was determined by a previously described method. Bulk density was ascertained by taking a weighed sample in a graduated cylinder, closing its open end with a rubber bung, tilting it to horizontal position, rolling it against any plain surface vertically and horizontally and finally noting the weight in grams per ml.

## EQUILIBRIUM RELATIVE HUMIDITY VALUE

This was determined by Wink's weight equilibrium method (Wink, 1946) as described by Siddappa *et al.* (1960), with minor alternations to secure more precise as well as more detailed data. Five grams lots of the powder were weighed into petri dishes, spread uniformly and exposed to different relative humidities ranging from 11.0 to 92.0 per cent at room temperature (28°C. to 32°C.) inside desiccators containing saturated solutions of different salts having definite relative humidities at an average room temperature (30°C.). The gain or loss in weight of the samples was determined at the end of 1, 3, 7, 13, 21, 33, 57, 81, 105, 129, 153, 177 hours and thereafter at intervals of one week up to 767 hours with a view to determine the moisture equilibrium of the product at 30°C. In the course of the experiment, apart from the uptake or loss of moisture, any adverse change such as discolouration, loss of texture, appearance of mould growth were also recorded. Equilibrium moisture content of the product was calculated, from the data when there was practically insignificant gain or loss in the weight of the sample.

## RESULTS AND DISCUSSION

The loss or gain in moisture of the product at 30°C. over the entire period of 767 hours has been shown graphically in Fig. 1. It will be seen that the curves become parallel to the X-axis only in case of first six lots, while lots Nos. 7 and 8 show indefinite capacity for moisture gain and their curves show steady rise upto the entire period of 767 hours. The moisture equilibrium curve is shown in Fig. 2. while the detailed data regarding the E.R.H. of the product and its conditions are given in Table 2. On the curve, the initial point (I), the danger point (D) and the critical point (C) are marked. I represents the moisture content and E.R.H. of the product as prepared, C, the stage just prior to which the product becomes mouldy and D is the point which is 5 per cent lower in relative humidity than C. The portion of the curve between C and D has been arbitrarily defined as the safety range (S.R.). The package designed for the Tea-Mix should be the one that will not permit the product to reach this danger point so that there may still be a sufficient margin of safety.

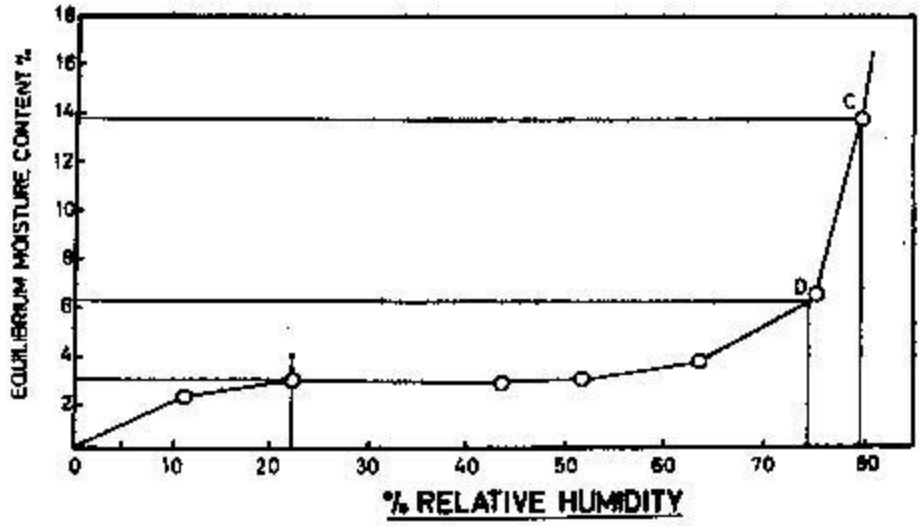


Fig. 1. Humidity Equilibrium Curve for Instant Tea Mix at 30°C (R.I.) as obtained by Wink's Method

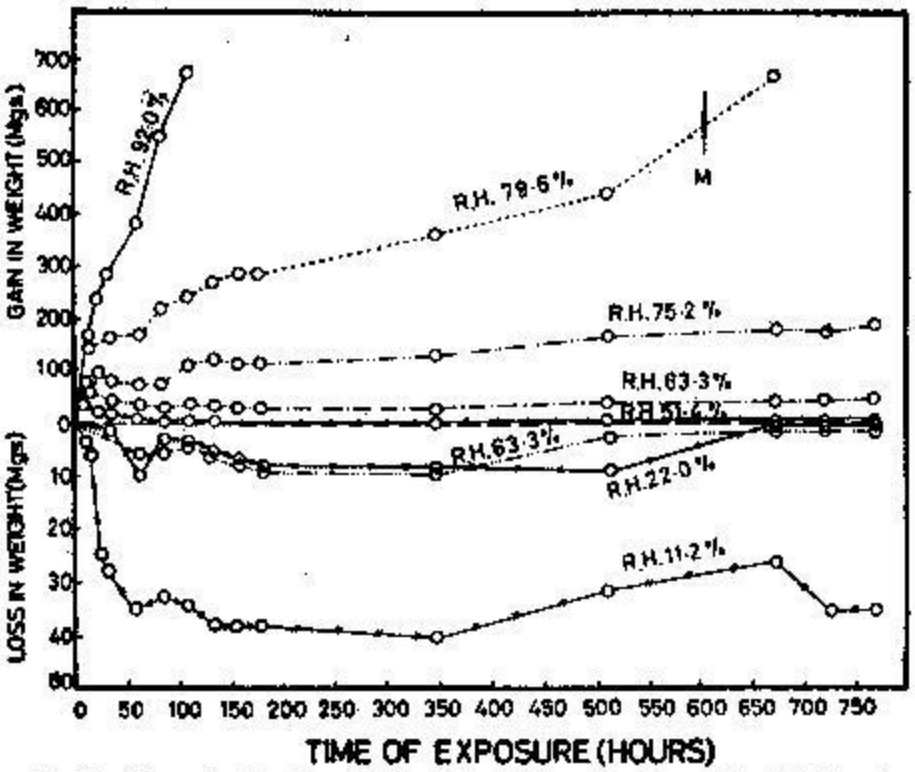


Fig. 2. Change in Moisture Content of ready-to-serve-Instant Tea-Mix Stored at room Temperature under different Relative Humidities

TABLE 2. *Equilibrium Moisture Content of Instant-Tea-Mix at Different Relative Humidities of Storage Atmosphere*

| Sr. No. | Name of salt solution | Relative humidities of salt soln. % | Equilibrium Moisture at R. T. (30°C) | | | Remarks |
|---|---|---|---|---|---|---|
| | | | 177 hrs. | Hrs. to each equilibrium | E.M.C. % | |
| 1. | Control | 65.2 | 3.00 | — | 3.00 | Straw colour, free flowing, no caking, typical ten odour, palatable. |
| 2. | Lithium chloride | 11.2 | 2.24 | 719 | 2.30 | No colour change, no caking, no mould growth, not lumpy, no, change in flavour slight loss of free flowing texture, product palatable. |
| 3. | Potassium acetate. | 22.0 | 2.64 | 671 | 2.99 | No marked flavour or texture change no caking, no marked change in colour, no mold growth, palatable. |
| 4. | Potassium carbonate | 43.5 | 2.83 | 671 | 2.97 | Same as in No. 3 but slight changes in flavour, texture and colour. |
| 5. | Magnesium nitrate. | 51.4 | 3.02 | 671 | 3.09 | Slight change in colour, remaining as in 4. |
| 6. | Sodium nitrate | 63.3 | 3.66 | 671 | 3.78 | Browning in colour slight off flavour remaining characterisation as in 4. |
| 7. | Sodium chloride | 75.2 | 5.35 | 719 | 6.38 | Same as in 6. |
| 8. | Ammonium sulphate | 79.6 | 8.63 | 600 | 13.83 | Product became pasty, dark brown, mold growth, visible moisture on the surface and sweating of product unpalatable. |
| 9. | Ammonium phosphate | 92.0 | 24.06 | 767 | 57.10 | Blakish colour, powder turned into liquid, looking like honey in texture, the powder lost all the original characteristics of texture, colour, flavour and palatability. |

The data in Table 2 show that there is only slight difference in the equilibrium moisture contents of the product after 177 hours and 671 hours of storage at room temperature. It may, however, be pointed out that at 79.6 and 92.0 per cent relative humidities, the product continued to gain moisture from 671 hours to 767 hours or up. The product stored at 79.6 R.H. became mouldy at 600 hours of storage period.

Considering the over-all quality of Instant-Tea-Mix in relation to colour, texture, and organoleptic quality, relative humidity of 22.0 per cent or below during storage would be the optimum. At 11.0 per cent R.H., the product remains quite good, while at higher R.H., the product undergoes undesirable changes as darkening, caking and mould growth and as such could not be stored at these relative humidities.

On the basis of data presented here, it is concluded that the Instant-Tea-Mix is very hygroscopic and needs stringent packaging conditions as for other hygroscopic foods. The humidity moisture equilibrium curves fall in between the trends shown by Elder (1949) for (sucrose+10 per cent glucose) on the higher side and (dried whey + L lactose) on the lower side. This confirms partly the theory enunciated by Stitt (1958) that sorption Isotherms for any product is expected to be a weighted average of the isotherms of its constituents.

Owing to hermetic sealing properties, flexible packages using metal foil laminated to cellophane or glassine laminated to cellophane would be the best packaging materials for moisture proof, airtight and odor impermeable properties. Glass jars fitted with rubber or plastic lined lids or all metal cans closed in vacuum or in an insert gas atmosphere might be suitable for packaging Ready-To-Serve-Instant-Tea-Mix. This however, requires further investigations.

## LITERATURE CITED

A. O. A. C., 1955. Official and Tentative Methods of Analysis, Washington D. C.

Bhatti, M. B., M. R. Chaudhry, and A. Sattar. 1964. A Process For The Preparation of Ready To Serve Instant-Tea-Mix. Patent Application Dated 2-7-64. P.C.S.I.R. Pat. Office, Karachi.

Elder, L. W. 1949. Functional Package Design. *Chem. and Eng. News.* **27** : 2682.

Landrock, A. H., and B. E. Proctor. 1951. Measuring Humidity—Equilibria. *Modern Pak.* **24** : 123.

Landrock, A. H., and B. E. Proctor. 1951. A Graphical Interpolation Method For Obtaining Humidity Equilibria Data With Special Reference To Its Role In Food Packaging Studies. *Food Technol.* **5** : 332.

Makower, B., and G. L. Dehority. 1943. Equilibrium Moisture Content of Dehydrated Vegetables. *Ind. and Eng. Chem.* **35** : 193.

Pruthi, J. S., and L. J. Singh, and G. Lal. 1959. The Equilibrium Relative Humidity Of Garlic Powder. *Jour. Sci. Food Agri.* **359** : 361.

Siddappa, G. S., and A. M. Nanjundaswamy. 1960. Equilibrium Relative Humidity Relationship (E.R.H) Of Fruit Juices And Custard Powders. *Food Technol.* **14** : 533-537.

Stitt, F. 1958. Moisture Equilibrium and The Determination Of Water Content Of Dehydrated Foods. *Fundamental Aspects of Dehyd. Of Food Stuffs.* 67-88.

Wink, W. A. 1947. Moisture Equilibrium *Modern Pack.* **20** : 135.

Wink, W. A. 1946. Determining The Moisture Equilibrium Curves of Hygroscopic Materials. *Ind.* and *Eng. Chem. Anal. Ed.* **18** : 251.