SHELF-LIFE OF PRE-COOKED RICE ORAL REHYDRATION SALT PACKETS

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Abstract. The shelf-life of pre-cooked rice oral rehydration salts (ORS) at the household level was studied in urban Dhaka. To prepare the packets, cooked rice was dried and ground to fine powder and the salt ingredients were mixed according to the World Health Organization formulation. For each half liter packet, 10 g glucose was replaced by 25 g of instant cooked rice powder. The packets were kept in different environments for three months among 30 households of varying socioeconomic status. At monthly intervals, two packets from each family were collected for laboratory tests.

Physical characteristics of ORS such as color and dispersibility remained the same throughout the three month study period. However, in the third month flavor changed slightly. The electrolyte concentration of the prepared solution remained the same at the end of the first, second and third months. However, progressive but minimal increase in moisture content of the packets was noted over the allotted time period. This increase in moisture was less when the mixture was packed in double thin layer polythene bags as opposed to the single layer bags. In conclusion, the shelf-life of pre-cooked rice ORS remains stable at least up to three months when stored at the household level. Therefore, pre-cooked rice ORS can be kept at households for future use in the event of diarrheal episodes.

INTRODUCTION

Hand packaged ORS is routinely used at a large diarrhea hospital in Dhaka, Bangladesh, which annually treats about 120,000 patients with diarrhea and dysentery. About twenty years ago a hand mixed and packaged sucrose ORS was standardized and used for several years (Ali and Wahed, 1984). More recently, the employees' cooperative society at this treatment center has maintained in-house production of rice ORS and provided it routinely to more than 600,000 patients over the last nine years (Islam *et al*, 1994). Apart from the meeting of in-house needs, patients are also sent home with the ORS packets for use at the household level. One disadvantage of this ORS packet is that it needs to be cooked prior to use. In addition, this ORS does not remain stable over long periods of time, and its flavor changes during storage at home. Considering this problem and in view of the demonstrated superiority of rice-based ORS (Gore *et al*, 1992), it was felt that locally produced pre-cooked rice ORS packets with a shelf-life of several months would be very useful for treating diarrhea patients attending many treatment centers. These ORS packets were produced and used at the Dhaka Hospital and found to be acceptable by the patients.

This study was conducted to evaluate the shelf-life of these pre-cooked ORS packets up to 3 months on the ground that a longer shelf-life of these ORS packets would be very useful for home use. This ready-to-use ORS does not require cooking and is suitable for distribution to the remote areas.

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MATERIALS AND METHODS

The instant rice powder was prepared from par-boiled milled rice. The rice was washed with water and cooked for 20-25 minutes. To facilitate drying, the cooked rice was spread on a metallic tray and dried in an oven for 4-5 hours at 100°C. The dried rice was then ground to a fine powder using a grinder. The flour was sieved through a local seiving device. To prepare ORS packets (half liter), the WHO-recommended formula was followed, except that 25g of instant rice powder was substituted for 10g of glucose. The salt ingredients were mixed thoroughly with the rice powder by hand in a large bowl, until a homogeneous mixture resulted. To ensure a minimum moisture content, the mixture

was dried again in an oven for half an hour to one hour at 100°C.

The contents were subsequently packed in either a single or double layer thin polythene bags. These bags were chosen because they are easily available and inexpensive. From each lot of 30 ORS packets, two to three were tested for their physical properties including color, flavor, dispersibility, and moisture content. Concentration of the electrolytes Na^+, K^+ and Cl^- were also measured by an Ion Selective Electrode (Beckman system E4A TM) Electrolyte Analyzer.

The shelf-life of 180 packets of pre-cooked rice ORS was tested. Ninety packets were packed in thin layer single polythene bags and the rest were packed in double layer polythene bags. The packets were kept in different environments in different types of households for 3 months. A set of 30 households was non-randomly selected. Six packets (3 single layer packed and 3 double layer packed) were left with each family to be kept in the bedroom. At the time of distribution, the field workers noted whether any container was used by the households for storage. They also noted the location within the bedroom where the packets were kept for storage. The field workers visited the households once a week for the first month and once a fortnight for the following two months. They documented any change in the containers or the location of storage during the observation period. At monthly intervals, one single-packed and one double-packed ORS packets was collected from each household for the laboratory tests. Physical tests for color, flavor, dispersibility and moisture content were administered on each of the packets at the Biochemistry and Nutrition Laboratory of ICDDR, B. A sensory test was run by a group of laboratory personnel. This same group tested the visual change in color of the ORS, while dispersibility and moisture content were determined using standard laboratory tests. Some of the packets, either single or double packed, were randomly tested for electrolyte concentration. Moisture content of the ORS was determined by weighing a portion of ORS (W_1) which was kept at 105°C in an oven. Weight was taken every hour until the constant weight (W_2) was achieved. Percent of moisture was calculated from the difference between W_1 and W_2. The study was carried out during the premonsoon period (March to May, 1994).

Statistical analysis

Statistical analyses were performed by entering all data into a personal computer using StatPack Gold. Mean ± SD were calculated using different equations and a student's *t*-test was used. Differences were considered significant if $p < 0.05$.

RESULTS

Among the 30 households, ten did not use any container for storing the ORS packets. They left the packets inside, on the shelf or in the almirah. Only 2 households changed the location of storage of the ORS packets.

During the first month of storage, two packets (one single and one double layer packed) were damaged by cockroaches or other insects within the same household. Although the packets were damaged, physical and chemical tests were performed on those two packets. In the second month none of the packets were damaged. In the third month two of the packets (single and double layer packed) from the same households were damaged and some black particles were visible inside the packets.

Physical characteristics like color and dispensibility remained the same throughout the whole period. In the third month, flavor became musty. Electrolyte concentrations of the pre-cooked rice ORS packets remained the same as the WHO standard ORS. At different time intervals the moisture content of ORS packets (single and double layer packed) increased from the initial level. In the second and third months, moisture content of the ORS packets increased progressively. At the end of the third month, though, it was observed that the moisture content of the double layer packed ORS packet was less than that of the single layer one. The difference in moisture content between these two packets, however, was not statistically significant ($p = 0.16$).

DISCUSSION

The pre-cooked rice ORS packets can be prepared at a mini cottage industry level. These packets have the advantage that the contents can be mixed with water prior to use and they do not

Table 1

Percentage of moisture content of pre-cooked rice ORS at different time intervals.

ORS packets	Initial moisture content	Moisture content after 1 month N = 30	Moisture content after 2 months N = 30	Moisture content after 3 months N = 30
Single layer packet	4.7 ± .082	6.53 ± 0.89	6.95 ± 0.62	7.32 ± 1.1[x]
Double layer packet	4.7 ± .083	5.82 ± 1.1	6.47 ± 0.91	6.89 ± 1.2[y]

x *vs* y, p = 0.16 by Student's *t*-test,
Values are in mean ± SD.

require any cooking. Its ease of preparation will increase its use at household levels. Although the production cost of precooked rice ORS (US$0.13 for half liter packet) is higher than the cooked one (US$0.12 for one liter packet), the precooked one will be more acceptable because it is very convenient to prepare. In a three month study period these packets remained stable in terms of their physical characteristics and electrolyte content. Physical characteristics including color, flavor and dispersibility remained almost the same throughout the whole study period. Moisture content increased progressively, suggesting that shelf-life cannot be improved further using this type of packaging. The moisture content can be reduced by drying the powder for several hours at 100°C; however, this will increase the cost and time of preparing the packets. Electrolyte concentration of precooked rice ORS remained the same at the end of the first, second and third months. The osmolarlity of the ORS solution was also stable throughout the three month period.

It can be concluded that in a three month time period, the shelf-life of pre-cooked rice ORS remains stable in terms of its potency in single layer as well as in double layer polythene bags. It can therefore be stored and used within this period at the household level.

However, the shelf-life of three months for ORS packets is too short. Further study is needed to determine the shelf-life of these pre-cooked ORS packets in different seasons, under varying conditions of temperature and humidity. An improved packaging material which is less porous than polythene should be sought. Longer shelf-life of the preparation will be more cost-effective and will make it suitable for distribution to the remote areas.

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