Selection of Suitable Packing Material for Hygroscopic Food Products

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Introduction

In modern age, food packaging has become very important because of protection of the product from contamination by macro and micro-organisms and their filth, prevention from loss or gain of moisture, shielding the product from oxygen and to facilitate handling. The hygroscopic food products are easily subjected to moisture adsorption or desorption from the environment. The major undesirable change in food is the absorption of moisture as a consequence of an inadequate barrier provided by the package, resulting in caking. Control of moisture exchange is necessary to prevent microbiological or enzymic spoilage, drying out or softening of the food, condensation on the inside of packages and resulting mould growth. This can occur either as a result of poor selection of packaging material in the first place, or failure of the package integrity during storage (Robertson and Dekker, 1993).

In tropical climates like Sri Lanka, maintaining the shelf-life of flour and flour based products is a serious problem and due to prevailing weather conditions, it is a must to explore proper packaging materials to overcome existing dilemma. Presently, packaging materials being used in Sri Lanka for noodles and pasta products are polypropylene and double laminate packaging materials.

The present research was designed to evaluate four different packaging materials for their ability to maintain a favourable storage environment within the package and to extend the shelf-life of red rice noodles, which is a hygroscopic food product which made mainly of rice and water with or without the incorporation of other flour. Accordingly, the main objective of the study is to select the suitable packing material for hygroscopic food products.

Methodology

The initial moisture content of Harischandra red rice noodles was determined by using oven dry method. Then, the red rice noodles (5 g) containing 6.5 – 7.5 % moisture content were sealed in bags (5.5 cm × 6 cm) of the low density polyethylene (250 µm), oriented Polypropylene (240 µm), double laminate (320 µm) and triple laminate (280 µm) packaging materials. Moisture stability of the packed red rice noodles was carried out by exposing the packed food product to four relative humidity environments (55%, 70%, 76% and 86%) at an ambient temperature of 25^{0}C. The relative humidity environments were obtained by preparing four saturated salt solutions, which represent environments with different relative humidities. The humidity chambers containing the saturated salt solutions 1M KCl (86% RH), K_2CrO_4 (76% RH, NaCl, (70% RH) and Ca $(NO_3)_2.4H_2O$ (55% RH) were used in the experiment.

The packed samples were weighed at 7 day intervals during the period of 75 days. All experiments were done in three replicates.

Results and Discussion

At 70%, 76% and 86% RH conditions, moisture adsorption of all packaging materials were higher than 55% RH condition (Figure 1 to 4). Of the packaging materials tested, double laminate and triple laminate materials permitted minimum moisture movement across them at all RH levels.

In the red rice noodles, 12% of moisture is accepted as the critical level (CMC) and 10% as safe moisture level (SMC). With the LDPE packaging material, the adsorption of moisture by red rice noodles to reach the critical moisture level was observed only at 76% and 86% RH levels. Other three packaging materials, even at higher RH levels were not exceeded the critical moisture level at 75 days of storage.

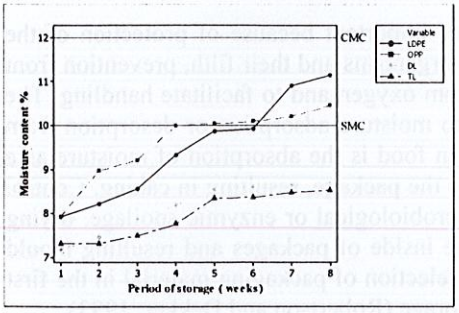

Figure 1: Moisture adsorption at 55% RH

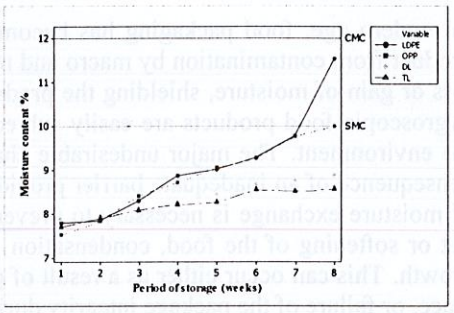

Figure 2: Moisture adsorption 70% RH

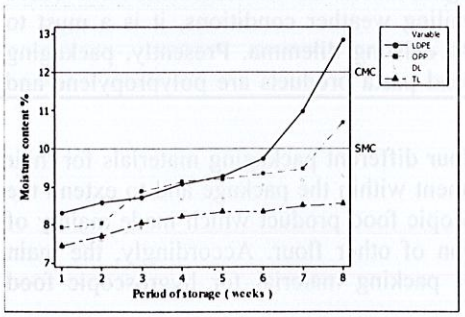

Figure 3: Moisture adsorption 76% RH

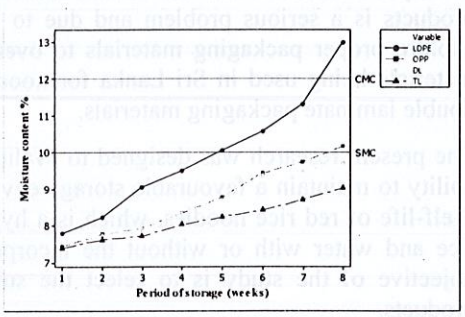

Figure 4: Moisture adsorption 86% RH

The data presented in Table 1 showed that the lowest Water Vapor Transmission Ratio (WVTR) was recorded in Triple laminate packaging material at all considered RH conditions. Further, the study has shown that TL and DL packaging materials performed as well as moisture barriers. One of the most obvious finding emerged from the mean comparison using Tukey test was that there were no significance difference in the moisture absorption between DL and TL packaging materials. The second major finding was that TL and DL packaging materials has the lowest moisture vapor transmission rates. It was also shown that, the cheapest packaging material was LDPE and the Triple Laminate packaging materials was costly.

Table1. Water Vapor Transmission Ratio of four packaging materials

Packaging material	Water Vapor Transmission Ratio (WVTR) g m^2 hr			
	55%	70%	76%	86%
Low Density Polyethylene	1.9518	2.0660	1.5760	2.3300
Oriented Polypropylene	1.6486	1.6782	1.5539	1.8707
Double Laminate	1.4829	1.5042	1.4859	1.6391
Triple Laminate	1.4029	1.4420	1.4324	1.5482

Conclusions

Technically, the Double Laminate and Triple Laminate packaging materials are the most suitable for packaging red rice noodles at all considered RH levels. Considering the cost factor into account, the use of Double laminate packaging material is safe and economical in packing hygroscopic food products as Red Rice Noodles.

Reference

Robertson, G.L., and Dekker, M. 1993. Food Packaging- principles and practice, New York.