SHELF-LIFE STUDIES

The shelf-life studies were carried out at accelerated conditions of 38 ± 1ºC and 90 ± 2% R.H. and at standard conditions of 27 ± 2ºC and 65 ± 2% R.H+ for the period of 4 months and 12 months respectively for all the three selected products in different packaging materials. Ordinary as well as gas flushing are also considered.

A) SELECTION OF PACKAGING MATERIALS :

Based on the commercial availability of packaging materials, a number of flexible packaging materials, some of which were considered suitable for gas flushing were identified and procured. The selected materials were assessed in the laboratory or basic significant physical, mechanical and physico-chemical properties. The tests conducted are with respect to the following properties :

1) Total Thickness
2) Heat Seal Strength
3) Tensile Strength
4) Percentage Elongation
5) Water Vapour Transmission Rate
6) Oxygen Transmission Rate

The results of the tests conducted on the packaging materials to assess the above properties are given in Annexure-I.

The following flexible packaging materials were selected for shelf-life studies of the specific products, depending upon the product characteristics.

(a) Dehydrated Onion Flakes

i. 12 micron PET/9 micron Al.foil/37.5 micron LDPE
ii. 12 micron MET.PET/37.5 micron LDPE
iii. 12 micron PET/30 micron LDPE/HDPE
iv. 20 micron BOPP/12 micron PET/37.5 micron LDPE
v. LDPE-TIE-NYLON-TIE-LDPE (70 micron)
vi. 125 micron HDPE

(b) Dehydrated Garlic Powder

i. 12 micron PET/9 micron Al.foil/37.5 micron LDPE
ii. 12 micron MET.PET/37.5 micron LDPE
iii. 12 micron PET/30 micron LDPE/HDPE
iv. 20 micron BOPP/12 micron PET/37.5 micron LDPE
v. LDPE-TIE-NYLON-TIE-LDPE (70 micron)
vi. 250 micron HDPE

(c) Accelerated Freeze-dried Corn

i. 12 micron PET/9micron Al.foil/37.5 micron LDPE
ii. 12 micron MET.PET/37.5 micron LDPE
iii. 20 micron BOPP/12 micron PET/37.5 micron LDPE
iv. LDPE-TIE-NYLON-TIE-LDPE (70 micron)
v. 20 micron BOPP/37.5 micron LDPE

LDPE - Low Density Polythylene
MET - Metallised
PET - Polyester
BOPP - Biaxially oriented polypropylene
HDPE - High Density Polyethylene
TIE - Bonding Agent

B) SAMPLE DETAILS :

Dehydrated Onion Flakes and Garlic Powder were procured from one of the exporters in Mahuva near Bhavnagar and AFD Corn was procured from AFD products exporter in Baroda in a fresh condition. The samples of packaging materials were procured by the Institute and these material were converted into pouches to hold about 100 grams of the product. The pouches were packed by two different packaging systems viz. :

1) Ordinarily packed - heat sealed
2) Gas flushed - heat sealed

All the above three products were packed into the pouches by both the methods viz. ordinary and gas flushing.

B) PRODUCT PARAMETERS :

The basic product parameters were evaluated in the laboratory on the fresh products.

1) Initial Moisture Content (IMC)

The initial moisture content of the product is the level of moisture content when the product is manufactured and packed. Samples of dehydrated Onion flakes, dehydrated garlic powder and accelerated freeze-dried corn when received in the laboratory for studies, were checked for initial moisture content by toluene distillation method for first two products and by over-drying method for third product. The initial moisture content for each selected product is given below :

Product Initial Moisture Content (IMC)
%

Dehydrated Onion Flakes : 6.60
Dehydrated Garlic Powder : 2.12
Accelerated Freeze-dried Corn : 4.20

2) Critical Moisture Content (CMC)

The critical moisture content of a product is the level of moisture content when the product just begin to deteriorate. The critical moisture content for each selected product was determined in the laboratory, is as given below :

Product Critical Moisture Content (CMC)
%

Dehydrated Onion Flakes : 8.00
Dehydrated Garlic Powder : 5.00
Accelerated Freeze-dried Corn : 6.00

3) Sorption Isotherm

The sorption Isotherm of the product indicates the behaviour of the product at different levels of relative humidity. For determining the sorption isotherm of selected products, the range of relative humidity conditions were built up in the desiccators. Each desiccator therefore shows one relative humidity ranging from 11% to 96%. Pre-weighed samples of the products were exposed to each of these relative humidity conditions. The temperature of 28 ± 2ºC was mentioned constant throughout the experiment.

The exposed product samples were weighed every 2/3 days and the change in moisture content (gain/loss) was noted. This was continued till the product achieved an equilibrium with the condition at which it was exposed. A graph of relative humidity v/s : moisture content was plotted. The ERH (Equilibrium Relative Humidity) of all 3 selected products at IMC and CMC were determined from the graph. The graphs are given in the drawing Nos. (1) – (3). The ERH for all the 3 selected products at IMC and CMC are given as below :

Product ERH at IMC ERH at CMC
% %

Dehydrated Onion Flakes : 33.0 39.5
Dehydrated Garlic Powder : 8.10 23.2
Accelerated Freeze-dried Corn : 13.0 35.0

This indicates that the dehydrated onion flakes would pick up the moisture when exposed to relative humidity beyond 33% and the moisture pick up would be very rapid beyond 39.5% RH. In the case of dehydrated garlic powder, it would pick up the moisture when exposed to relative humidity beyond 8.1% and the moisture pick up would be very rapid beyond 23.2% RH. Similarly the product AFD corn would pick up the moisture beyond 13.0% RH and the moisture pick up would be very rapid beyond 35% RH.

D) STORAGE STUDIES :

The shelf-life/storage studies were conducted on all the selected packaging materials. About 100 grams of the product was packed. The pouches were closed by heat sealing. Adequate number of filled pouches of all the selected materials were exposed to accelerated conditions of 38 ± 1ºC and 90 ± 2% R.H. and standard conditions of 27 ± 2ºC and 65 ± 2% R.H. for a period 4 months and 12 months respectively. During the exposure period, samples were drawn periodically from both the conditions.

The packed product from these pouches was assessed in the laboratory for its keeping quality.

The parameters determined were :

1) Moisture Content
2) Texture
3) Odour/Aroma (Organoleptically)

Besides assessing the product quality, the packaging materials were also observed for any changes like retention/leakage of gas from the nitrogen flushed pouches. Packaging materials were also observed visually for any changes like delamination etc.

The samples which showed deterioration earlier, were withdrawn and studies on that particular material were discontinued.

The results of the tests conducted on samples of 3 selected products viz. dehydrated Onion flakes, dehydrated Garlic powder and accelerated freeze-dried Corn from accelerated and standard conditions are tabulated in Annexure-II A to VII E. Annexure-VIII, IX and X indicates shelf-life (in days) at accelerated and standard conditions based on the storage studies in all the selected packaging materials for dehydrated Onion flakes, dehydrated Garlic powder and accelerated freeze-dried corn respectively.