Effect of pectin coating on colour and quality of dehydrated pineapple during storage

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ABSTRACT
The effect of storage on the colour and quality parameters of uncoated and pectin coated dehydrated pineapple samples were studied during storage. The dehydrated pineapple samples were packed in aluminium foil pouches and stored at 30 ± 1°C and 75% RH. The colour change was determined using \( L^* \), \( a^* \), \( b^* \), hue, total colour difference and browning index values. The kinetics of changes in colour parameters was determined using zero-order and first-order reaction kinetics. Non-linear regression of experimental data was done to obtain the reaction rate constants. \( L^* \), \( b^* \), and hue values decreased, while \( a^* \), total colour difference and browning index increased during storage in both coated and uncoated samples. Both the models were found to describe the data of colour parameters adequately. The correlation coefficient value of most of the colour parameters was more than 0.95 indicating good agreement between experimental and model predicted values. The browning was more observed in uncoated samples than coated samples, which increased in the later stages of storage. Rehydration ratio decreased, while moisture content increased with storage. The sensory evaluation scores of coated samples remained acceptable for longer period than uncoated samples.

Key words: Coating, Colour kinetics, Pectin, Pineapple, Storage.

INTRODUCTION
Pineapple, of the family Bromeliaceae, is the third most important produced tropical fruit after banana and citrus (Rohrbach et al., 2003). The fruit is very rich in some vitamins (C and B\(_6\) as well as smaller amounts of B\(_3\), B\(_5\), B\(_8\) and B\(_9\)) and many other food micronutrients (manganese, copper, magnesium, potassium, beta-carotene, folic acid and dietary fibre. The bromelain enzyme helps in balancing and neutralizing the pH of human body fluids and further stimulates pancreatic hormonal secretions that aid digestion (Lotz-Winter, 1990).

The fruit which is easy to process, is mostly marketed as canned slices, chunks, concentrated and fresh juice. These products however have a limited shelf life (1-3 weeks) except when frozen. The chilled freshly-cut product addresses consumer demand for ready-to-eat foods that do not require any further preparation. The air dried pineapple after osmotic dehydration could be stored for several months.

Edible coatings are thin layers of edible material applied directly and formed on the surface of lightly processed fruits and vegetables (by immersing, spraying or wrapping) to provide a selective mechanical barrier against transmission of gases, vapours and solutes (Gennadios and Weller, 1990; Singh et al., 2010) and as such improve their shelf- life and sensory properties.

Colour measurements are simpler and faster substitutes to chemical analysis for the estimation of changes in foods. The change of product colour is caused by the activation of reactive components in foods. Storage studies have been conducted on a vast number of different products with the most recent being on dried mango (Pott et al., 2005), dried kiwifruit (Maskan, 2001), and dried banana (Demirel and Thuran, 2003), all in a bid to maintain their colours throughout storage until eventual consumption. Hunter colour parameters \( (L^*, a^*, b^*, h^o, \Delta E, \text{and browning index}) \) have previously been proven to be valuable in describing visual colour deterioration and providing useful information for quality control in mango (Kienzle et al., 2011) and vegetables (Manninen et al., 2015). The knowledge of kinetics of colour degradation in fruits has contributed to minimizing undesirable colour changes and maximizing colour retention (Kessler and Fink, 1986; Lund, 1975; Rhim et al., 1989; Wells and Singh, 1988). Dehydrated products are usually rehydrated prior to their use and rehydration ratio is also a very important quality parameter.

It is a complex concept that is dependent on the nature of food product under consideration, the preservation technologies applied, and the environmental conditions to which the food product is exposed. Krokida and Marinos-Kouris (2003) examined the rehydration capacity of dehydrated apple, potato, carrot, banana, pepper, garlic,

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mushroom and tomato. Moisture of the product has a critical influence on its storage stability and moisture migration from the environment. The change in sensory quality was evaluated during storage in dehydrated ripe mango slices (Sagar et al., 1998), dried mango slices (Kesarwani et al., 2000), and guava fruit bar (Vijayanand et al., 2000), respectively. In order to minimize colour deterioration, suitable designs are needed for manufacturing of processed fruit products (Maskan, 2001). But if fruits are coated with edible coatings, then osmotically dehydrated and finally air-dried, then this combined processes will help to maintain the colour of the fruits during storage.

In the past, various studies have been conducted on the kinetics of colour changes in fruits, but no work has been conducted on the kinetic studies related with colour change during storage of coated and dehydrated pineapple fruit. Although, research work on shelf life evaluation of different types of processed pineapple products is already undertaken by various authors e.g. fresh cut pineapples, air-dried pineapples, and frozen pineapples, but the shelf life evaluation of pineapple samples which are osmotically dehydrated with edible coatings and then further convective dehydrated is not reported by any author. Therefore, the present work was undertaken to study the effect of pectin coating on the kinetics of changes in colour parameters and in various quality and sensory parameters of dehydrated pineapple samples during storage in laminates in order to evaluate the commercial shelf life of the product.

MATERIALS AND METHODS

Pineapples were procured from the local market, Sangrur. Sucrose was used as an osmotic agent for osmotic dehydration process and pectin (Sisco Research Laboratories Private Limited, Mumbai) was used for coating the samples prior to osmotic dehydration. Pectin was used as a coating agent because of its high performance ratio demonstrated in screening experiments. Calcium chloride (Sisco Research Laboratories Private Limited, Mumbai) was used as a cross linking agent for coating.

Coating prior to osmotic dehydration: Pineapples were peeled, cut into cuboids (2 cm x 2 cm x 0.75 cm), weighed and dipped into pectin solutions (coating agent) of different concentrations (0.5%, 1%, 2%, 3%, 4% and 5%, w/v) for 60 s and 120 s, retrieved, drained for 30 s and dipped into CaCl$_2$ solution (2% w/v) for 30 s for cross-linking, retrieved again and dried in a hot-air oven (1.5 m/s air velocity) at 50°C to fix the layer of coating followed by osmotic dehydration. Drying was done separately for 10 and 40 min.

Osmotic dehydration (OD): In the screening experiments, by using different levels of processing parameters in central composite rotatable design (CCRD), the conditions of OD were optimized. The processing parameters optimized were sucrose concentration of the osmotic solution, temperature during OD, time and fruit-solution ratio, whereas the response variables kept were water loss, solid gain and ratio of water loss to solid gain (WL/SG) with desired conditions of maximum water loss, minimum solid gain and maximum WL/SG ratio during the OD. The optimized conditions obtained after the experiment were: 62°Brix sucrose concentration, temperature of 30°C for 6 hours using 1:6 fruit-solution ratio (Singh et al., 2008). After OD, samples were taken out of the osmotic medium, drained, gently blotted with filter paper to remove adhering solution and weighed. Uncoated samples were also dehydrated osmotically by using sucrose solution for comparison of the mass transfer in coated samples to that in uncoated samples.

Mass transfer studies: The evaluation of mass exchange was done at above optimized conditions of OD. Solution-to-sample mass exchange was done under optimized OD conditions and the performance ratio (PR) estimated as ratio of water loss (WL) to solid gain (SG).

\[
PR = \frac{WL}{SG}
\]

After carrying out mass transfer study, the coated sample with highest performance ratio (PR) was selected. The sample dipped in 1% pectin solution for 120 s and oven dried for 40 min was found to have highest PR. Therefore, pineapple samples were dipped in it for 120 s followed by dipping in 2% calcium chloride solution for 30 s and finally dried in hot-air oven for 40 min to fix the coating. The highest value of PR means maximum WL and minimum SG. Therefore, further convective dehydration study was carried out only in this sample along with uncoated sample. All the experiments were carried out in triplicates and the average value was taken for calculations. Completely randomized design (CRD) was employed to find out differences between coated and uncoated samples. Factorial experiment in completely randomized design (CRD) was used to find out differences among the different coated samples.

Convective dehydration: The pineapple samples after coating and OD were dehydrated at 55°C temperature with an air velocity of 1.5 m/s in a tray drier along with uncoated sample. The uncoated sample was taken as a control sample in which OD without coating was performed. The weight of the samples during drying was monitored at different time intervals by a precision balance. The experiments were conducted in triplicate. The dried samples were cooled for 15 min and then packed in laminated pouches for further analysis.

Packaging and storage of dehydrated samples: The coated and uncoated dehydrated pineapple samples were packed in laminated pouches of 30 μm thickness. The material of pouches consisted of aluminium foil laminated with colourless low density polyethylene (LDPE). Unit pouches of the packaging material measuring 18 x 14 cm$^2$ were made for holding 200 g of dehydrated pineapple samples, and were sealed with heat sealing machine. A saturated salt solution of sodium chloride was prepared to
obtain the required relative humidity. Desiccators were
prepared using saturated salt solution. The sealed pouches
were placed inside the airtight desiccators. The desiccators
were then placed inside the incubator maintained
thermostatically at 30 ± 1°C to maintain relative humidity at
75%. Evaluation of Hunter colour parameters, rehydration
ratio, moisture content and sensory evaluation for both coated
and uncoated samples was carried out after one month
each. Each determination was replicated thrice and the
data presented are averages of the three measurements.
After sampling, the pouches were resealed and stored for
subsequent sampling.

**Colour measurement:** The colour parameters (“L*”, “a*”,
and “b*”) of dehydrated samples were measured using a
 calibrated (against a white standard) Gretag Macbeth Colour
 is Spectrophotometer. Measurements were separately taken
 for five fresh (reference), uncoated and coated samples and
 the average recorded.

Total colour difference (ΔE) was calculated according to
Hunter (1975) as:

\[ \Delta E = \left( \Delta L^* \right)^2 + \left( \Delta a^* \right)^2 + \left( \Delta b^* \right)^2 \]  

(2)

The hue angle (hº) is extensively used to
colour in food products such as green vegetables,
fruits and meats (Barreiro *et al*., 1997; Lopez *et al*., 1997).

An angle of 0º or 360º represents red hue, while angles of
90º, 180º and 270º represent yellow, green and blue hue,
respectively. hº was calculated using the following equation:

\[ hº = \tan^{-1} \left( \frac{b^*/a^*}{} \right) \]  

(3)

Browning index (BI) was estimated according to the
following equation:

\[ BI = \frac{[100(x - 0.31)]}{0.17} \]  

(4)

where

\[ x = \frac{(a^*+1.75 L^*)}{(5.645 L^*+ a^*-3.012 b^*)} \]  

(5)

In the above equation, L*, a* and b* are the
respective colour values of both coated and uncoated samples
(Maskan, 2001).

**Kinetics of colour change during storage:** The change in
food colour was studied by zero-order (Eq. 6) and first order
(Eq. 7) degradation reaction kinetics

\[ C = C_o \pm k_o t \]  

(6)

\[ C = C_o \exp \left( \pm k_i t \right) \]  

(7)

where, \( k_i \) is the reaction rate constant for the zero order model
\( k_i \) is the reaction rate constant for the first order model
\( C \) is the measured colour scale value at time \( t \)
\( C_o \) is the initial colour scale value

The symbols, (+) and (-) indicated formation and
degradation of quality parameters, respectively (Pua *et al*.,
2008; Chutintrasri and Noomhorm, 2007; Maskan, 2001).

Experimental data of colour parameters were fitted
to kinetic models. Non-linear regression analysis was applied
for the kinetics equations of zero-order and first-order. From
the analysis, the best fit was selected and rate constants were
determined for each model.

**Rehydration ratio:** The rehydration ratio (RR) was used to
express ability of the dried material to absorb water. To
determine the rehydration ratio, a 10 g sample of dried
material was rehydrated by immersing in 150 ml of distilled
water (in a 500 ml beaker), boiled for 5 min, retrieved and
weighed again. The rehydration ratio was estimated as the
ratio of the rehydrated weight to the initial weight (Prakash
*et al*., 2004).

**Moisture content:** This parameter was determined by using
the oven-drying method (AOAC, 1990). Samples were
weighed, placed in an oven set at 70°C, dried to a constant
weight, retrieved, cooled down to room temperature in
dessicators, and re-weighed. The moisture content of fresh
pineapple samples, calculated as the percentage ratio of the
sample weight before and after drying varied from 89% to
93% (w.b.).

**Sensory evaluation:** The sensory attributes of rehydrated
samples were evaluated at one month interval in terms of
colour, flavour, texture and overall acceptability. The
rehydrated samples were presented to trained panellists, who
evaluated the sensory characteristics of the samples on a
nine point Hedonic scale (Ranganna, 1997a). Numerical
values were assigned to each point on the scale. The rating
was done on the following scale

1= dislike extremely, 2 = dislike very much, 3 = dislike
moderately, 4 = dislike slightly, 5 = neither like nor dislike,
6 = like slightly, 7 = like moderately, 8 = like very much
9 = like extremely

Samples were presented with code markings to
obscure the identity of the sample. The order of presentation
was randomized within each test session. Ten panellists were
used for one sample. The scores received by each sample
were then averaged.

**Statistical analysis:** t-test was used to assess whether
difference in colour parameters, moisture content, rehydration
ratio and sensory characteristics between coated
and uncoated samples was significant or not, at all the months
of storage (Ranganna, 1997b). Each determination was
replicated thrice and data presented are average of three
measurements.

**RESULTS AND DISCUSSION**

**Colour parameters:** Although both the coated and uncoated
samples darkened and their “L*” values decreased during
the 18 months of storage (Fig.1a), the coated ones were
relatively lighter (69-54) than the uncoated ones (60-43) and
remained correspondingly higher throughout the storage. The
coated samples were having higher “L*” value as compared
to uncoated sample at the beginning of storage study and this phenomenon was observed throughout the storage period. The higher "L*" values in the coated samples indicated the development of light coloured samples by the process of coating. The variation in the lightness of the dried samples can be taken as a measurement of browning (Avila and Silva, 1999; Ibarz et al., 1999). The development of discoloration of samples may be related to pigment destruction, ascorbic acid browning and non-enzymatic Maillard browning (Abers and Wrolstad, 1979; Skrede, 1985). As both coated and uncoated samples were subjected to osmosis, the infusion of sucrose into the pineapple cuboids also caused relative colour stability. The sucrose may have deactivated enzyme-induced browning through a decrease in their water activity. The outer pectin layer prevents direct contact of pineapple cuboids with atmospheric oxygen, required for the oxidation of polyphenols. All these resulted in light coloured pineapple samples with higher "L*" in coated samples. The uncoated samples showed 27.72% decrease in "L*" values, whereas the coated samples showed 22.81% decrease in "L*" values from the beginning of storage till the end of 18 months storage. There was significant difference (p≤0.05) in the "L*" values between coated and uncoated samples.

In an inverse manner, the "a*" value of coated and uncoated pineapple increased during storage (Fig. 1b), indicating an increase in the intensity of redness and eventual browning reactions, probably due to the decomposition of chlorophyll and carotenoid pigments (Kostaropoulos and Saravacos, 1995; Lee and Coates, 1999; Weemaes et al., 1999) and formation of brown pigments (Rhim et al., 1989; Lopez et al., 1997; Maskan, 2000). The "a*" value of uncoated samples was significantly higher (p≤0.05) than that of coated samples throughout. These results are similar to those obtained elsewhere on garlic slices (Prachayawarakorn et al., 2004), jackfruit bulbs (Saxena et al., 2008), and jackfruit powder (Pua et al., 2008). The "a*" value of uncoated sample was higher than the coated samples from the beginning till the end of the storage period, which indicated more redness in the uncoated sample than coated sample. The "a*" value of 4.23 in uncoated sample was observed at the beginning of the storage period, which later on increased to 14.47 at the end of storage period, whereas, the "a*" value of coated sample increased from 2.02 at the start to 10.93 at the end of storage study. The increase in "a*" value with time is supported by various authors in the previous studies in garlic slices (Prachayawarakorn et al., 2004), jackfruit bulbs (Saxena et al., 2008), jackfruit powder (Pua et al., 2008). There was significant difference (p≤0.05) in the "a*" values between coated and uncoated samples throughout the storage study.

The "b*" values of both the coated and uncoated pineapple samples decreased, unlike "a*" value, with increase in storage time (Fig. 1c). The "b*" value at the beginning of the storage was 31.47 and 28.33 for uncoated and coated samples, which decreased to 26.25 and 24.44 after 18 months of storage, respectively. The "b*" values decreased by 16.58% and 13.73% in uncoated and coated samples from the beginning till the end of storage study. The difference in "b*" values between coated and uncoated samples was found to be significant (p ≤0.05).

The "h°" values of both coated and uncoated samples decreased with increase in the storage time (Fig. 1d). At the beginning, "h°" values of uncoated and coated samples were 82.34 and 85.92, which subsequently decreased to 61.13 and 65.90 after 18 months of storage. "h°" values in uncoated and coated samples decreased by 25.75% and 23.30% from the beginning till the end of storage study. "h°" values of coated samples were higher than the uncoated samples during the entire storage study. High values of hue angle indicate less browning (Hawlader et al., 2006). Therefore, higher "h°" values of coated samples indicated lesser browning than uncoated ones.

The total colour difference (ΔE), which is a combination of parameters "L*", "a*" and "b*" values, is a colorimetric parameter used to characterize the variation of colour in foods during processing. "E" values of both coated and uncoated samples increased with increase in storage time (Fig. 1e). ΔE values of uncoated and coated samples were 19.16 and 12.68 in the beginning, which subsequently increased to 32.26 and 21.57, respectively. There was 68.37% and 70.11% increase in the ΔE value of uncoated and coated samples, respectively. ΔE value of coated samples was lesser than uncoated samples throughout the storage study. The increase in ΔE value with increase in the storage period was also observed by Pua et al. (2008) in jackfruit powder.

Browning index (BI) is considered as an important parameter in those food processes where enzymatic and non-enzymatic browning take place (Palou et al., 1999). At the beginning of storage, BI values of uncoated and coated samples were 76.54 and 52.91, which later on increased to 112.55 and 73.66, respectively (Fig. 1f). BI values of uncoated samples were higher than coated samples during the entire storage period indicating more browning in uncoated samples. Therefore, coating the pineapple samples with pectin helped to maintain the colour of dried pineapple close to the fresh fruit with minimum browning. There was significant difference (p ≤0.05) between coated and uncoated values of "h°", ΔE and BI. Kinetics of colour change during storage: Table 1 shows the results of non-linear regression analysis of colour parameters from zero-order and first-order reaction kinetics in uncoated and pectin coated samples. The analysis revealed that both zero-order and first-order reaction kinetics models can be used adequately for both uncoated and coated...
FIG 1: Kinetics of change of Hunter colour parameters (a) L* (b) a* (c) b* (d) h° (e) ΔE (f) BI as a function of time during storage (30 ± 1°C, 75% RH) of uncoated and pectin coated dehydrated pineapple samples (n=5)

h° hue; ΔE Total Colour Difference; BI Browning Index

- Δ experimental uncoated; - - - - zero order uncoated; + first order uncoated;

x experimental coated; — zero order coated; • first order coated
samples. The coefficient of determination ($R^2$) values for zero-order model varied from 0.973 to 0.993 in uncoated samples and 0.938 to 0.984 in coated samples, whereas, the $R^2$ values varied from 0.922 to 0.993 in uncoated samples and 0.948 to 0.977 in coated samples for first-order model. There was not much difference in the $R^2$ values of colour parameters for the two models. Therefore, both the models fitted well with the data of colour parameters in both coated and uncoated samples. The regression explained more than 95% of the variation in all the colour parameters except few cases. The “$b^*$” and $\Delta E$ value in coated sample in zero-order model explained 94% and 93% variation in the colour value, respectively. The “$a^*$” value of uncoated sample explained 92% variation, whereas, “$b^*$” value of coated sample explained 94% variation for first-order model by regression analysis. The $R^2$ value of colour parameters, which was more than 0.95 indicated that there was good agreement between the model predicted values and experimental values. Overall, both the zero-order and first-order model described adequately the change in colour parameters over the entire storage period.

Maskan (2001) reported that both zero-order and first-order reaction kinetic models can be used adequately to describe the colour changes in kiwifruits. Pua et al. (2008) observed that the treatments at various storage conditions followed the zero-order reaction, whereas Avila and Silva (1999) and Ibarz et al. (1999) have observed that first-order kinetic model fitted well for “$L^*$” and “$b^*$” values of peach puree and pear puree. The kinetic rate constants of all the colour parameters were more in zero-order model as compared to first-order model for uncoated samples (Table 1). The coated samples also demonstrated same behaviour. The value of zero-order kinetic model constants for “$L^*$”, “$a^*$” and “$b^*$” of uncoated samples was found to be 0.9961, 0.5651 and 0.2841 day$^{-1}$, whereas the values for coated samples were 0.9623, 0.5517 and 0.2265 day$^{-1}$, respectively.

Similarly, the value of first-order kinetic model constants for “$L^*$”, “$a^*$” and “$b^*$” of uncoated samples was 0.0186, 0.0994 and 0.0099 day$^{-1}$ and the values for coated samples were 0.0161, 0.0448 and 0.0085 day$^{-1}$, respectively. Within both the models, the kinetic rate constants of all the colour parameters were more in uncoated samples as compared to coated samples. The evident higher values of kinetic constants in uncoated samples validated that browning is more in uncoated samples than coated samples.

**Rehydration ratio and moisture content**: The effect of storage on the rehydration ratio and moisture content of uncoated and pectin coated dehydrated pineapple samples are shown in Fig. 2 and 3. Rehydration ratio decreased with increase in storage time and this phenomenon was observed in both coated and uncoated samples. This may be due to the fact that the dehydrated pineapple samples may have absorbed some amount of moisture from the atmosphere during the storage. Rehydration ratio of coated samples was more than uncoated samples during the entire storage period. This might be due to the coating layer formed outside the coated samples didn’t allow the moisture gain into the cuboid. As a result, the internal structure of the coated sample was not as modified as compared to uncoated sample, where the intake of moisture was more due to the absence of coating layer. Prakash et al. (2004) also observed the decrease in rehydration ratio with increase in storage time in dried carrots.

The moisture content increased with increase in storage time in both coated and uncoated samples (Fig. 3). Moisture content increased by 11.53% and 8.27% in uncoated and coated samples from the beginning up to end of storage study. The uncoated samples recorded higher percentage increase which may be due to more absorptivity of moisture from the surroundings, while it was not possible in samples coated with pectin. There was significant

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Table 1: Non-linear regression analysis results of colour parameters from zero and first-order reaction kinetics in samples coated with pectin

<table>
<thead>
<tr>
<th>Sample</th>
<th>Parameter</th>
<th>Zero-order model</th>
<th></th>
<th>First-order model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$k_0$ (day$^{-1}$)</td>
<td>$C_o$</td>
<td>$R^2$</td>
</tr>
<tr>
<td>Uncoated</td>
<td>$L^*$</td>
<td>0.996</td>
<td>78.455</td>
<td>0.991</td>
</tr>
<tr>
<td></td>
<td>$a^*$</td>
<td>0.565</td>
<td>4.872</td>
<td>0.973</td>
</tr>
<tr>
<td></td>
<td>$b^*$</td>
<td>0.284</td>
<td>31.277</td>
<td>0.976</td>
</tr>
<tr>
<td></td>
<td>$h^*$</td>
<td>1.273</td>
<td>95.097</td>
<td>0.979</td>
</tr>
<tr>
<td></td>
<td>$\Delta E$</td>
<td>0.864</td>
<td>18.346</td>
<td>0.993</td>
</tr>
<tr>
<td></td>
<td>BI</td>
<td>2.094</td>
<td>75.278</td>
<td>0.990</td>
</tr>
<tr>
<td>Coated</td>
<td>$L^*$</td>
<td>0.962</td>
<td>70.046</td>
<td>0.969</td>
</tr>
<tr>
<td></td>
<td>$a^*$</td>
<td>0.551</td>
<td>3.262</td>
<td>0.982</td>
</tr>
<tr>
<td></td>
<td>$b^*$</td>
<td>0.226</td>
<td>28.150</td>
<td>0.948</td>
</tr>
<tr>
<td></td>
<td>$h^*$</td>
<td>1.223</td>
<td>82.277</td>
<td>0.984</td>
</tr>
<tr>
<td></td>
<td>$\Delta E$</td>
<td>0.578</td>
<td>11.562</td>
<td>0.938</td>
</tr>
<tr>
<td></td>
<td>BI</td>
<td>1.278</td>
<td>49.978</td>
<td>0.963</td>
</tr>
</tbody>
</table>

$h^*$ hue; $\Delta E$ Total Colour Difference; BI Browning Index (n=5)
Fig 2: Effect of storage time on the rehydration ratio of uncoated and pectin coated dehydrated pineapple samples

difference ($p \leq 0.05$) in the rehydration ratio and moisture content values between coated and uncoated samples.

**Sensory quality during storage:** Shelf life refers to the end of consumer quality, and is the time at which a percentage of consumers are displeased with the product (Labuza and Schmidl, 1985). Fig. 4 shows the overall acceptability scores of both pectin coated and uncoated samples as a function of storage period. A uniform decrease in the colour, flavour, texture and overall acceptability scores during storage was
Fig 4: Effect of storage time on the overall acceptability values of uncoated and pectin coated dehydrated pineapple samples

observed. There was significant difference ($p \leq 0.05$) between sensory evaluation scores of coated and uncoated samples, which substantiated the fact that coating influenced the variation in sensory quality. The uncoated samples were rated 8.3 for overall acceptability at the beginning, which subsequently decreased to 4.1 at the end of storage study, whereas the coated samples were rated 8.6 at the start and later on decreased to 5.8 at the end of storage period. The sensory evaluation scores of coated samples were more than the uncoated samples during the whole storage period. The sensory evaluation scores of coated samples were more than 5 ($5 = \text{neither like nor dislike}$) even after passage of 18 months. The flavour of uncoated sample was acceptable up to 12 months, whereas the colour and texture was acceptable only up to 10 months. Therefore, it was concluded that the coated samples remained stable and acceptable up to 18 months, whereas the uncoated samples were acceptable for only 10 months. Pua et al., (2008) in jackfruit powder and Lee and Resurreccion (2006) in roasted peanuts also predicted the shelf life with consumer acceptance of more than 5.0 for sensory attributes.

CONCLUSION

It was observed that the coating treatment with pectin had significant effect on all the colour parameters, rehydration ratio and moisture content. Browning effect was more observed in uncoated pineapple samples, while less browning was observed in coated samples. The colour parameters $L^*$, $b^*$, and $h^\circ$ decreased, while $a^*$, $\Delta E$ and BI increased during storage in both coated and uncoated samples. Colour change reactions followed both zero-order and first-order reaction kinetics. In both the models, kinetic rate constants of colour parameters were more in uncoated samples than coated samples. The regression explained more than 95% of the variation in most of the colour parameters. Rehydration ratio decreased while moisture content increased with increase in storage time in both coated and uncoated samples. The sensory quality of coated samples was better than the uncoated samples from the beginning up to the end of storage period. The coated samples remained stable and acceptable for a more prolonged period (18 months) than the uncoated samples (10 months).

REFERENCES


