INTRODUCTION

India is a country with diverse cultures, traditions and hundreds of varieties of traditional foods. Among these food items, jalebi is one such product prepared and consumed with much interest. Khoa jalebi is a khoa based product with a coiled structure and a brown crust and light brown interior. It has a soft and chewy body and texture with a sweet, nutty flavour (Pagote and Jayaraj Rao, 2011). It is mainly prepared by halwais and packaged in thin polyethylene pouches or paper boxes or plastic boxes and sold in retail market. Since dairy is looking for new products, khoa jalebi can be one product with a commercial potential. The method of manufacture has been standardised by Pratik (2010). It has a shelf life of about 10 days at room temperature. The product needs to have a longer shelf life if it is to be adopted by the industry. Hence, in this study shelf life enhancement trials were carried out using potassium sorbate which is a common preservative used in processed foods. In khoa based sweets it is permitted up to 1000 ppm (FSSA, 2006). It acts against bacteria, yeasts and molds by alteration of cell membranes, inhibition of transport systems and key enzymes, creation of a proton flux into the cell, or more than one of these actions (Sofos et al., 1986). It has been used to enhance the shelf life of khoa to 45 days at 5°C by packing in butter paper treated with potassium sorbate (Ghodekar et al., 1978); its use also reduced the yeasts and mold growth in khoa (Ghodekar et al., 1980). Potassium sorbate had pronounced effect in reducing microbial counts. Addition of potassium sorbate markedly reduced the rate of growth of yeast and mold count. It took three fold as much time (12 days) to reach the level of control samples (4 days) (Jha et al. 1977).

The spoilage of high sugar products like confectionery is mostly because of yeasts and molds (Frazier and Westhoff, 1978). Since spoilage of khoa jalebi is also mainly due to yeasts and molds and partly because of other microorganisms, potassium sorbate was considered as the most suitable permitted preservative for shelf life enhancement.

MATERIALS AND METHODS

Preparation of khoa jalebi

Khoa jalebi was prepared by the method described...
by Pratik (2010). Firstly, khoa was prepared from cow milk (fat 3.5% and SNF 8.5%). Khoa (100 parts) was mixed with arrowroot powder (30 parts) and tokir powder (5 parts) - a fine gel forming powder, procured from Nagpur market, and blended in a laboratory blender followed by addition of desired quantity of water till a smooth and a homogeneous batter was obtained. The smooth batter was extruded through 4-6 mm hole made in a thick cloth directly into a frying pan containing refined oil at 150 - 160°C till brown colour developed. All the jalebi pieces were soaked in 60% sugar syrup at 60°C for about a minute. The syrup soaked pieces were drained for a few minutes.

Addition of potassium sorbate
Potassium sorbate (AR grade, Loba Chemie) was used at two levels viz. 0.05% and 0.1% on the basis of dry ingredients. The maximum limit was within the permitted level i.e. 1000 ppm (FSSA, 2006, Sl.No. 392). The calculated quantity of the sorbate was dissolved in small quantity of water and blended with the mix and then proceeded with preparation of batter.

Packaging
Khoa jalebi samples (3 pieces in each pouch) were packaged in metalized aluminium pouches [(size 22.5 X 17.5 cm, 320 gauge film thickness (50 gauge Met PET/270 gauge LDPE), abbreviated as MAIP320] (M.H. Packaging, Ahmedabad) and heat sealed using an impulse sealer. Before packaging the product, the pouches were exposed to UV light for about an hour to eliminate contamination. The MAIP320 may be considered as high barrier material with WVTR of 2 g/m²/day at 30°C and OTR of 182 cc/m²/day at 28°C and 65%RH.

Storage
The packaged khoa jalebi samples were stored at 30°C±1°C and relative humidity of about 65%. Khoa jalebi was taken out at five day interval and evaluated for sensory, physico-chemical (pH, FFA and tyrosine value) and microbial (SPC and yeasts and mold) characteristics.

Analytical methods
Sensory evaluation
The organoleptic attributes of khoa jalebi were evaluated by a panel of experienced judges on 9-point hedonic scale where a score of 9 represented 'like extremely' and score of 1 represented 'dislike extremely'. The samples for evaluation were coded appropriately. The evaluation was carried out in the sensory evaluation room under proper conditions. The parameters judged were flavor, body & texture, colour & appearance, and overall acceptability.

Chemical analyses
The khoa jalebi units were taken into a mortar and pestle and a homogeneous mixture was made by crushing and mashing. From this mixture required mass of sample was weighed accurately for different chemical analyses. The moisture content of khoa jalebi was determined by gravimetric method as detailed in BIS (1981). Then the pH of the samples (10 g jalebi + 10 ml water) was determined using the calibrated digital pH meter at 30°C. The electrode assembly of a digital pH meter was calibrated against standard buffer solution of pH 7.0 and 4.0 (Qualigens Fine Chemicals) before use. The free fatty acid content was estimated by the method of Deeth et al. (1975). For this purpose, fat was extracted by acid hydrolysis method (AOAC, 2005). Tyrosine value of khoa jalebi was determined by the method as described by Hull (1947).

Statistical analysis
The changes in sensory and physico-chemical characteristics were analysed for statistical significance by two way ANOVA by MS-Excel package version 2007.

RESULTS AND DISCUSSION
Changes in sensory quality of khoa jalebi during storage
The changes in sensory acceptance of khoa jalebi during storage are presented in Table 1. The sensory scores decreased during storage in all the jalebi samples. The decreased flavour score was mainly responsible for decline in the overall acceptance of jalebi samples. Colour and appearance did not exhibit any significant changes during storage, but body and texture became firmer due to slight evaporation of moisture from the surface within the packaging material.

Between two potassium sorbate levels, the flavour scores were better in 1000 ppm sample and 500 ppm samples as compared with control samples (Table 1). Due to mold growth, flavour turned unacceptable. The body & texture scores
of khoa jalebi in control as well as 500 & 1000 ppm potassium sorbate samples remained almost unchanged up to 10 days of storage and thereafter a decreasing trend with further advancement of storage period was noticed. The colour & appearance score of HBC sample changed from 7.66 to 7.49 upto 10 days of storage at 30°±10C after which the sample was unacceptable. In case of 500 ppm & 1000 ppm samples it decreased from 7.64 to 7.52 after 15 days of storage and from 7.72 to 7.52 after 25 days of storage, respectively (Table 1). The rate of decrease was almost similar in all samples up to 10 days of storage. The overall acceptance scores declined during storage, more significantly in control than in the samples with preservative.

Statistical analysis indicated that during storage all the sensory scores decreased significantly (P<0.05), but preservative showed no effect on colour and appearance, body and texture and moisture contents of khoa jalebi (Table 2). Khoa jalebi containing potassium sorbate displayed slower changes than the control sample. Further analysis revealed that there was no much difference between 500 ppm and 1000 ppm levels of preservative in all sensory attributes.

Changes in moisture content during storage
Moisture content plays a key role on the quality of the any food items regarding sensory, physico-chemical, microbiological and rheological aspect. Due to good barrier properties (like low WVTR & OTR) of MAiP320 pouch the moisture loss was very low ranging from 0.79 to 1.04% during the storage period irrespective of preservative level (Fig.1). There was no significant effect of preservative on the moisture content (P>0.05), but the storage period itself had a significant influence on the decrease in moisture content of khoa jalebi samples (Table 2). This may be attributed to evaporation of moisture within the package.

Changes in pH during storage
The pH of fresh khoa jalebi was 6.12 and a decreasing trend was observed in all samples during storage at 30°±10C (Fig.2).

### Table 1: Changes in Sensory Score* of Khoa Jalebi (with and without potassium sorbate) Packed in Metallised Aluminium Pouch and Stored at 30°±10C

<table>
<thead>
<tr>
<th>Sensory attribute</th>
<th>Level of potassium sorbate, ppm</th>
<th>Storage period (days)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
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<tr>
<td>Flavour</td>
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<tr>
<td></td>
<td>500</td>
<td>7.82</td>
<td>7.51</td>
<td>7.14</td>
<td>6.62</td>
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<td></td>
<td>1000</td>
<td>7.85</td>
<td>7.64</td>
<td>7.41</td>
<td>7.15</td>
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<tr>
<td>Body &amp; texture</td>
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<td>7.66</td>
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</tr>
<tr>
<td></td>
<td>500</td>
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<tr>
<td></td>
<td>1000</td>
<td>7.85</td>
<td>7.80</td>
<td>7.76</td>
<td>7.71</td>
<td>7.58</td>
<td>7.55</td>
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<tr>
<td>Colour &amp; appearance</td>
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<td>7.58</td>
<td>7.49</td>
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<tr>
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<td>7.64</td>
<td>7.62</td>
<td>7.57</td>
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<tr>
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<td>7.68</td>
<td>7.63</td>
<td>7.60</td>
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<td>Overall acceptance</td>
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<tr>
<td></td>
<td>500</td>
<td>7.85</td>
<td>7.41</td>
<td>7.13</td>
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<tr>
<td></td>
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<td>7.47</td>
<td>7.25</td>
<td>6.92</td>
<td>6.65</td>
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</tbody>
</table>

*Average of three trials  (---) Indicates that the product was not acceptable

![Fig 1: Changes in moisture content of khoa jalebi (with and without potassium sorbate) packed in HB pouch and stored at 30°±10C](image-url)

HB C - High barrier control = (50 gauge Met PET / 270 gauge LDPE)+ 0 ppm potassium sorbate
HB PL1 - High barrier, preservative level 1 = (50 gauge Met PET / 270 gauge LDPE) + 500 ppm potassium sorbate
HB PL2 - High barrier, preservative level 2 = (50 gauge Met PET / 270 gauge LDPE) + 1000 ppm potassium sorbate