Control of Deacetylation in Gum *Karaya* on Storage for Quality Retention

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**ABSTRACT**

Gum karaya is natural exudate from *Sterculia urens* and it is a partially acetylated polysaccharide which is composed of 10-14 % acetyl groups. On ageing, deacetylation process takes place and with the result that there is continuous loss of acetic acid is formed and the quality of gum *karaya* deteriorates subsequently. As there is no data available on the effect the quality aspects of gum *karaya*, therefore a detailed study was undertaken for the control of loss of acetyl groups from gum *karaya* samples with time and storage conditions using different packaging films. Gum *karaya* samples packed in Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE), Polypropylene (PP) and Aluminium Coated Polyethylene (ACP) with normal sealing and vacuum packaging with nitrogen filling. Samples were stored under ambient conditions as well as under refrigerated condition. On the basis of quarterly estimation of quality parameters of gum *karaya* packed in above film it was established that gum *karaya* samples can be stored for longer period in HDPE under cold condition for controlling the deacetylation process of *karaya* gum for retention of all quality parameters.

**Keywords:** Gum *karaya*, Deacetylation, Packaging films, Quality parameters

Gum *Karaya* is the dried exudate obtained from trees of *Sterculia urens* Roxburgh. It is also known as *Katira* or *Kullu* gum in trade. In the natural state, the gum is in irregularly shaped pieces, sometimes of worm like appearance. They are white or pinkish-brown in colour and generally striated. The gum, especially when fresh, may have an acetic odour. After acid hydrolysis, Gum *Karaya* commonly produces D-galacturonic acid, D-galactose, L-rhamnose and small proportions of D-glucuronic acid. The total uronic acid residue content in the gum can be up to 35-40%. (Anderson *et al.* 1985). Structurally, it is acetylated acidic polysaccharide containing α-D-galacturonic acid α-L- rhamnose residues as the main chains with O-4 of the acid and O-2 of rhamnose linkages (Meer W, 1980; Stepień *et al.* 1995 and Franco YL and Ciapara IH, 2009).

Natural Gum *Karaya* is a complex, branched, partially acetylated polysaccharide with a reported molecular weight of 9,500,000 dalton. An average, new Gum *Karaya* contains about 10-14% acetyl groups (IS: 12498 and JECFA 1988), from which acetic acid is formed and is split off an ageing. Increased temperature, humidity and fine particle size increases the rate of acetic acid formation. Gum *karaya* loses viscosity-forming ability when stored in dry state. The loss is greater for a powdered material than for the crude gum (Money, 1951). It has been reported that the decrease in viscosity related to the loss of acetic acid (Goldstein, 1954). In the present investigation, an effort will be made to check the loss of the acetyl group in gum *karaya* by keeping the samples in different packaging material under ambient and cold conditions.

**MATERIALS AND METHODS**

Fresh samples of gum *karaya* was collected from the Hyderabad. The gum *karaya* samples (100g each) were packed in different types of packaging material such as Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE), Polypropylene (PP) and Aluminium Coated Polyethylene (ACP) with
normal sealing (NS), and vacuum packaging with nitrogen filling (NVS). Samples were stored under ambient conditions as well as under refrigerated condition with 3 replicates for each film (Fig. 1).

The analysis of 192 samples were carried out in four quarters each quarters comprises of 48 samples. The sample were analyzed quarterly for physicochemical parameters viz. Loss of drying (percent by mass), volatile acid (percent by mass), swelling property (ml) and water absorption (ml) as standard specification of BIS for gum karaya (IS: 12408 – 1988) to asses the deacetylation process with the time and storage condition. The statistical analysis was carried out in SPSS package version 16 using factorial RBD design.

RESULTS AND DISCUSSION

The fresh sample was analyzed for physicochemical parameters and results are given in table 1 with the requirements as per BIS specification.

The quality parameters of gum karaya (1st quarter) were analyzed (Table 2) and on comparing the data of 1st quarter for acid value (%) of the gum karaya samples packed in LDPE, HDPE, ACP and PP showed that there is not much change in the acid value among all the above treatments. But swelling index showed higher value for the samples of gum karaya kept in cold condition with normal seal and vacuum packaged nitrogen seal as compared to the samples kept in ambient condition with normal seal and vacuum packaged nitrogen seal.

The same quality parameters of gum karaya (2nd quarter) were analyzed (Table 3) and on comparing the data of 2nd quarter for acid value (%) and swelling index (ml) of the gum karaya samples packed in LDPE, HDPE, ACP and PP kept in cold conditions showed higher value than the samples kept in ambient temperature for all the above treatments. The samples packed in HDPE and LDPE showed highest values for both and swelling index (ml) among all treatments.

The analysis of quality parameters of gum karaya (3rd quarter) samples were continued and the data of 3rd quarter revealed the same trend observed as in the 2nd quarter (Table 4). On comparing the data of 3rd quarter for acid value (%) and swelling index (ml) of the gum karaya samples packed in LDPE, HDPE, and PP kept in cold conditions showed higher value than the samples kept in ambient temperature for all the above treatments except in the ACP. The samples packed in HDPE, LDPE and ACP under cold condition showed higher values for both swelling index (ml) and water retention (ml) among all treatments.

The analysis of quality parameters of 4th quarter (Table 5 & Fig. 2) revealed that the acid value (%) of the samples packed in LDPE, HDPE and ACP kept in cold conditions showed higher value than the samples packed in PP in cold condition and samples packed in LDPE, HDPE and ACP and kept in ambient temperature. After keeping the sample for almost one year of storage, it has been observed that the samples kept in ambient temperature showed drastic reduction in the value of swelling index than the samples kept in cold condition.
Table 1: Physicochemical analysis of fresh sample of gum karaya

| Sl. No. | Characteristic                  | Fresh sample | BIS Requirement as per (IS: 12408 – 1988) |
|---------|--------------------------------|--------------|------------------------------------------|
| i)      | Loss on drying, percent by mass | 17.4         | 16 (Max)                                 |
| ii)     | Volatile acid (as acetic acid), Percent by mass | 13.64       | 10 (Min)                                 |
| ix)     | Swelling property, ml           | 440          | 200 (Min)                                |
| x)      | Water absorption, ml            | 360          | 75 (Min)                                 |

Table 2: Estimated Quality parameters of stored gum karaya samples (1st quarter)

| Package film | Storage condition | Storage Atmosphere | Physicochemical Parameters analysed | % volatile acid | Swelling index (ml) | Water Retention (ml) | Loss on Drying (%) |
|--------------|-------------------|--------------------|-------------------------------------|-----------------|---------------------|----------------------|-------------------|
| LDPE         | Cold              | NS                 |                                     | 12.36           | 100                 | 45                   | 16.90             |
|              |                   | NVS                |                                     | 11.28           | 125                 | 55                   | 16.21             |
|              |                   | NS                 |                                     | 12.6            | 65                  | 35                   | 17.42             |
|              |                   | NVS                |                                     | 11.4            | 65                  | 30                   | 17.19             |
| HDPE         | Cold              | NS                 |                                     | 13.68           | 85                  | 40                   | 18.82             |
|              |                   | NVS                |                                     | 11.46           | 95                  | 40                   | 16.29             |
|              |                   | NS                 |                                     | 12.9            | 60                  | 25                   | 16.43             |
|              |                   | NVS                |                                     | 12.06           | 55                  | 25                   | 17.04             |
| ACP          | Cold              | NS                 |                                     | 12.48           | 70                  | 35                   | 18.59             |
|              |                   | NVS                |                                     | 12.4            | 140                 | 75                   | 16.29             |
|              |                   | NS                 |                                     | 12.3            | 55                  | 40                   | 17.75             |
|              |                   | NVS                |                                     | 10.9            | 75                  | 40                   | 17.86             |
| PP           | Cold              | NS                 |                                     | 12.72           | 140                 | 70                   | 15.95             |
|              |                   | NVS                |                                     | 12.4            | 110                 | 50                   | 16.14             |
|              |                   | NS                 |                                     | 12.1            | 90                  | 45                   | 17.66             |
|              |                   | NVS                |                                     | 12.3            | 90                  | 40                   | 17.76             |

Table 3: Estimated Quality parameters of stored gum karaya samples (2nd quarter)

| Package film | Storage condition | Storage Atmosphere | Physicochemical Parameters analysed | % volatile acid | Swelling index (ml) | Water Retention (ml) | Loss on Drying (%) |
|--------------|-------------------|--------------------|-------------------------------------|-----------------|---------------------|----------------------|-------------------|
| LDPE         | Cold              | NS                 |                                     | 11.82           | 130                 | 65                   | 16.52             |
|              |                   | NVS                |                                     | 13.56           | 100                 | 50                   | 16.07             |
|              |                   | NS                 |                                     | 11.7            | 105                 | 45                   | 17.24             |
|              |                   | NVS                |                                     | 11.4            | 85                  | 35                   | 18.19             |
| HDPE         | Cold              | NS                 |                                     | 12.72           | 120                 | 60                   | 15.56             |
|              |                   | NVS                |                                     | 12.42           | 80                  | 40                   | 15.11             |
|              |                   | NS                 |                                     | 12.3            | 60                  | 40                   | 18                |
|              |                   | NVS                |                                     | 11.4            | 80                  | 35                   | 18.38             |
| ACP          | Cold              | NS                 |                                     | 11.82           | 110                 | 55                   | 15.81             |
|              |                   | NVS                |                                     | 11.46           | 145                 | 80                   | 17.0              |
|              |                   | NS                 |                                     | 12.0            | 70                  | 35                   | 17.41             |
|              |                   | NVS                |                                     | 10.68           | 90                  | 35                   | 18.07             |
| PP           | Cold              | NS                 |                                     | 12.54           | 120                 | 50                   | 15.04             |
|              |                   | NVS                |                                     | 12.6            | 85                  | 45                   | 13.30             |
|              |                   | NS                 |                                     | 9.48            | 80                  | 40                   | 17.16             |
|              |                   | NVS                |                                     | 12.24           | 75                  | 30                   | 17.5              |
Table 4: Estimation of Quality parameters of stored gum *karaya* samples (3rd quarter)

| Package film | Storage condition | Storage Atmosphere | Physicochemical Parameters analysed | % volatile acid | Swelling index (ml) | Water Retention (ml) | Loss on Drying (%) |
|--------------|-------------------|--------------------|--------------------------------------|----------------|--------------------|---------------------|-------------------|
| LDPE         | Cold              | NS                 |                                      | 11.7           | 120                | 65                  | 16.52             |
|              |                   | NVS                |                                      | **12.12**       | 100                | 75                  | 16.07             |
|              |                   |                    |                                      | 11.4           | 50                 | 45                  | **14.53**         |
|              |                   | NVS                |                                      | 10.92          | 65                 | 35                  | **14.60**         |
|              |                   |                     |                                      |                |                    |                     |                   |
| HDPE         | Cold              | NS                 |                                      | **11.94**       | 120                | 60                  | 15.56             |
|              |                   | NVS                |                                      | 11.94          | 80                 | 75                  | 15.11             |
|              |                   |                    |                                      | 11.88          | 50                 | 40                  | **15.15**         |
|              |                   | NVS                |                                      | 11.04          | 60                 | 35                  | **15.07**         |
|              |                   |                     |                                      |                |                    |                     |                   |
| ACP          | Cold              | NS                 |                                      | 11.46          | 90                 | 55                  | 15.81             |
|              |                   | NVS                |                                      | 10.86          | 135                | 70                  | 17.0              |
|              |                   |                    |                                      | **12.0**        | 60                 | 35                  | **15.13**         |
|              |                   | NVS                |                                      | 10.32          | 70                 | 35                  | **15.50**         |
|              |                   |                     |                                      |                |                    |                     |                   |
| PP           | Cold              | NS                 |                                      | **11.94**       | 95                 | 50                  | 15.04             |
|              |                   | NVS                |                                      | 11.4           | 85                 | 45                  | 13.30             |
|              |                   |                    |                                      | 9.24           | 65                 | 40                  | **14.78**         |
|              |                   | NVS                |                                      | **11.58**       | 55                 | 30                  | **14.91**         |

Table 5: Estimation of Quality parameters of stored gum *karaya* samples (4th quarter)

| Package film | Storage condition | Storage Atmosphere | Physicochemical Parameters analysed | % volatile acid | Swelling index (ml) | Water Retention (ml) | Loss on Drying (%) |
|--------------|-------------------|--------------------|--------------------------------------|----------------|--------------------|---------------------|-------------------|
| LDPE         | Cold              | NS                 |                                      | 12.0           | 100                | 65                  | 13.59             |
|              |                   | NVS                |                                      | 12.06          | 105                | 50                  | 16.46             |
|              |                   |                    |                                      | 10.68          | 45                 | 45                  | **14.53**         |
|              |                   | NVS                |                                      | 9.96           | 50                 | 35                  | **16.18**         |
|              |                   |                     |                                      |                |                    |                     |                   |
| HDPE         | Cold              | NS                 |                                      | **12.42**       | 120                | 60                  | 14.05             |
|              |                   | NVS                |                                      | 12.18          | 80                 | 40                  | 15.935            |
|              |                   |                    |                                      | **10.8**        | 45                 | 40                  | **15.15**         |
|              |                   | NVS                |                                      | 10.56          | 45                 | 35                  | **17.46**         |
|              |                   |                     |                                      |                |                    |                     |                   |
| ACP          | Cold              | NS                 |                                      | **12.24**       | 110                | 55                  | 11.19             |
|              |                   | NVS                |                                      | 12.42          | 135                | 80                  | 13.865            |
|              |                   |                    |                                      |              |                    |                     |                   |
|              |                   | NS                 |                                      |              |                    |                     |                   |
|              |                   | NVS                |                                      |              |                    |                     |                   |
|              |                   |                     |                                      | **10.8**        | 35                 | 35                  | **15.13**         |
|              |                   | NS                 |                                      |              |                    |                     |                   |
|              |                   | NVS                |                                      |              |                    |                     |                   |
|              |                   |                    |                                      | **10.8**        | 35                 | 35                  | **15.13**         |
|              |                   | NVS                |                                      | 10.06          | 50                 | 35                  | **18.50**         |
|              |                   |                     |                                      |                |                    |                     |                   |
| PP           | Cold              | NS                 |                                      | **11.82**       | 100                | 50                  | 13.58             |
|              |                   | NVS                |                                      | 11.76          | 75                 | 45                  | 10.16             |
|              |                   |                    |                                      | 8.82           | 45                 | 40                  | **14.78**         |
|              |                   | NVS                |                                      | **11.1**        | 60                 | 30                  | **16.46**         |

Table 6: Effect of storage treatment on the volatile acid of the stored gum *karaya* samples after completion of storage study

| Sl. No. | Treatment           | Volatile acid (%) |
|---------|---------------------|-------------------|
|         |                     | Mean ± S.D.       |
| 1       | LDPE-Cold-NS        | 11.97 ± 0.39<sup>abc</sup> |
| 2       | LDPE-Cold-NVS       | 12.25±0.91<sup>ab</sup>  |
quality parameters. It is further observed that the packaging condition does not affect significantly in retaining the quality parameters.

After the combined analysis, the storage study revealed that the samples stored in the HDPE under cold with normal sealing showed best performance in terms of controlling the deacetylation of the gum karaya samples. Other packaging films (LDPE, ACP and PP) under cold condition showed the good results and found statistically at par in controlling the deacetylation of the sample.

CONCLUSION

The results of storage study of gum karaya samples may be summed up as follows: After the 1st quarter analysis indicated that there is no significant deviation in the quality parameters. In the 2nd quarter, the sample packed in HDPE and LDPE under cold condition retained acetyl value and swelling index of the samples as compared to the sampled kept in ambient condition. The 3rd quarter data showed the similar trend as observed in the 2nd quarter. After the analysis of the 4th quarter, the samples kept cold condition with normal and vacuum packaging revealed that out of four packaging films, three films namely HDPE, LDPE and ACP showed better performance in respect of controlling the process of deacetylation. Hence, it may be concluded that the gum karaya samples can be stored for longer period using HDPE as best packaging film under cold condition for controlling the deacetylation process of karaya gum as well as retention of other quality parameters.

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