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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 acetous odour. After acid hydrolysis, Gum *Karaya* commonly produces D-galaturonic 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; Stepien *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).

Fig. 1. Gum *karaya* samples packed in LDPE, HDPE, ACP and PP film with nitrogen filling

The analysis of 192 samples were carried out in four quarters each quarters comprises of 48 samples. The sample were analyzed quarterly for physico-chemical 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.

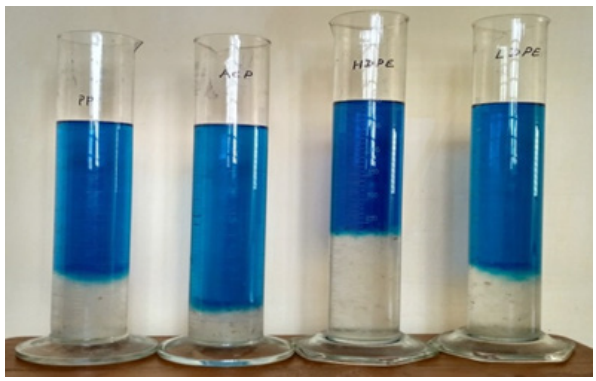

Fig. 2: Effect of swelling index of stored gum *Karaya* samples in different films after 4th quarter

The combined statistical analysis by pooling all the data of four quarters were carried out (Table 6) and observed that storage temperature under cold condition has significant effect in controlling the deacetylation and in addition to the above, the packaging films also has a role in retaining the

Table 1: Physicochemical analyis of fresh sample of gum *karaya*

Sl. No.	Characteristic	Freh 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
	Ambient	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
	Ambient	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
	Ambient	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
	Ambient	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
	Ambient	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
	Ambient	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
	Ambient	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
	Ambient	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
	Ambient	NS	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
	Ambient	NS	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
	Ambient	NS	**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
	Ambient	NS	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
	Ambient	NS	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
	Ambient	NS	**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
	Ambient	NS	**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
	Ambient	NS	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 completetion of storage study

Sl. No.	Treatment	Volatile acid (%) Mean ± S.D.
1	LDPE-Cold-NS	11.97 ± 0.39^{abc}
2	LDPE-Cold-NVS	12.25 ± 0.91^{ab}

3	LDPE-Ambient-NS	11.59 ± 0.88^{bcd}
4	LDPE-Ambient-NVS	10.92 ± 0.76^{de}
5	HDPE-Cold-NS	12.69 ± 0.69^{a}
6	HDPE-Cold-NVS	12.00 ± 0.50^{abc}
7	HDPE-Ambient-NS	11.97 ± 0.39^{abc}
8	HDPE-Ambient-NVS	11.27 ± 0.77^{cd}
9	ACP-Cold-NS	12.00 ± 0.58^{abc}
10	ACP-Cold-NVS	11.78 ± 0.91^{bc}
11	ACP-Ambient-NS	11.77 ± 0.76^{bc}
12	ACP-Ambient-NVS	10.49 ± 0.64^{ef}
13	PP-Cold-NS	12.26 ± 0.74^{ab}
14	PP-Cold-NVS	12.04 ± 0.75^{ab}
15	PP-Ambient-NS	9.91 ± 1.42^{fg}
16	PP-Ambient-NVS	11.81 ± 0.64^{bc}
17	Control	9.27 ± 1.05^{g}
Critical Difference $_{(0.05)}$		0.885

quality parameters. It is further observed that the packaging condition does not affect significantly in retaining the quality parameters.

After the combined analyis, 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 pacakging 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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