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Effects of packaging and storage on keeping quality of bleached lac

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ABSTRACT

A study on the effect of different packaging materials and storage conditions was carried out on keeping quality of freshly prepared bleached lac packaged in five different types of packaging materials: Low Density Poly Ethylene (LDPE), High Density Poly Ethylene (HDPE), Poly Propylene (PP), Metalized Polypropylene film (METPP) and five layer craft Paper Bag (PG). The samples were stored in both ambient and refrigerated conditions (14-16^{0}C) and quality parameters were evaluated at quarterly interval after 3, 6, 9 and 12 months of storage followed by comparison with samples stored in open condition. For storage under ambient condition in room, the flow value (fluidity), life (heat polymerization time) and acid value (AV) of the packaging material was highest for metalized film bag i.e.10mm, 5 min. and 70.69 respectively and impurity content was least (2%) after 3 months of storage due to high amount of moisture (4.12% db) retained in the sample. These parameters were lower in other packaging materials due to lower moisture content (1.38-2.40% db) with the lowest value (1.01% db) in open storage condition. For storage under the refrigerated condition, these parameters were higher compared to ambient storage for all packaging material. Flow value, life and acid value of samples in the metalized bag were highest; 35mm, 10 min. and 74.36 after 3 months of storage. However, these parameters were lower in others packaging materials due lower moisture content (1.50-2.61% db) with lowest value (1.23% db) in open storage condition. The flow and life of samples packaged in metalized film bag were highest i.e. 25mm and 5 minutes respectively after six months of storage as compared to when packaged in others. During the study it was observed that keeping quality of bleached lac samples was better in metalized film bag (82.5µ) compared to other packaging materials for both ambient and refrigerated storage condition.

Keywords: Bleached lac, Packaging, Storage, Moisture content, Quality, Metalized film

INTRODUCTION

Bleached lac or white lac forms the major share of world's consumption of lac. Nearly half of the world output of lac is estimated to be converted into bleached lac. The product is thus of considerable commercial importance (Ramani *et al.*, 2014). It is produced by removal of colouring matter (erythrolaccin) from lac. The raw material sticklac, which is obtained by scraping lac encrustation deposited by Kerria *lacca* (lac insect) on twigs of certain host trees like kusum (*Schleichera oleosa*), palas (*Butea monosperma*) and ber *(Zizyphus mauritiana)*, contains two colouring matters, laccaic acid, a water-soluble dye and erythrolaccin, a water-insoluble but spirit soluble dye. The former is more or less completely removed during the washing of sticklac into seedlac. The pale yellow to the deep orange-brown colour of refined lac such as seedlac, shellac or button lac is, therefore, almost entirely due to erythrolaccin.

The manufacture of pale-coloured or bleached lac involves the elimination of erythrolaccin by chemical means is known as the bleached lac of commerce.

Bleached lac/shellac is non-toxic, edible and used widely in different industries like surface coating/polishing, food, food packaging, confectionary and allied industries. It forms a transparent film on wooden and other items and for this reason, it is preferred over shellac in polishing industry. It has also very good qualities like adhesiveness, binding, hardening, gloss and is odourless. There are two types of bleached lac, which are generally manufactured namely regular and refined. The regular bleached lac contains wax (4-5%) and in refined bleached lac, the wax is removed during its preparation. The refined bleached lac is also called as dewaxed bleached lac (wax content below 0.5%). Both regular and refined bleached lac may be in three conditions, wet, surface-dry (air dry) and bone-dry. BIS specification for these two types of bleached lac is for all three conditions (Anonymus, 1973a). Wax content, low hot alcohol insolubility and acid value (80-90) are important characteristics required for both domestic and export market.

The lac resin undergoes various chemical changes during storage, as a result of which deterioration in the physical and chemical properties of lac takes place. As it ages, lac slowly loses its solubility in alcohol, becomes less fluid and possesses poorer life under heat. The extent of such deterioration depends upon various factors such as the method of storage, storage environment (temperature and humidity), type of lac etc. It was reported that storage in air-conditioned go-down at 25°C and 60% relative humidity effectively checked the degradation in lac quality.

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Bleached lac is produced and marketed either in form of powder or in form of *hank*. It is mostly prepared in fresh due to its poor keeping qualities in the dry state. It is also marketed in forms of *hanks*, particularly when it is intended for use in aqueous varnishes or emulsions. *Hanks* usually contains about 25-30% moisture and are made by heating a suspension of the lac in water when the lac melts and become like taffy. The *hank* form is widely used for domestic purpose for polishing of wooden items, whereas in powder form is mostly exported.

Bleached lac is also sold as coarse white powder under the name 'bone-dry' or 'vac-dry' shellac. Packing and storing of hanks present no problem. Bleached lac in a dry condition, however, needs some care. It may be packed in bags or sacks made of water-proof materials similar to the resin treated paper bags used for packing cement. Properly treated jute bags also are satisfactory. It is best stored in a cool dry place avoiding an excess of humidity (Mukopadhyay and Muthana, 1962).

Earlier the ordinary commercial product (*hank*) was stored under water and exported in tin-lined cases containing water, and so solubility was preserved for the comparatively long period. But when dried it cannot, obviously, be so stored without again taking up water and so solubility of "bone-dry" bleached shellac is lost much more rapidly than that of the normal commercial article. Dry bleached lac both regular and the refined wax free types have natural tendency to block or pack solid in the barrel if subjected to heat and humidity of summer months. If kept in warm place too long, dry bleached shellac both regular and wax free, have tendency not only to solidify, but also to become practically insoluble. Therefore, bleached shellac should be kept in cool dry place, preferably in cold storage with temperature not above 50^0F/10^0C (Hicks,1961).

Bleached lac, dewaxed shellac and dewaxed decolourised lac are most often stored in the air-conditioned godown, at around 15-20^0C temperature. Usually, storage of powdered bleached lac is done in loose form by spreading on the cemented floor and packed in a paper bag for transportation. The size of packets/ bags depends on the demand of customers. Paper bags of 25 kg are preferred by most customers. Sometimes 10 kg packets are also used. The bags/packets use for transporting bleached lac are usually made of water proof materials like resin treated paper bags and/or laminated paper cartoons (Anonymus, 2007).

Presently the key packaging materials used for packaging any items are glass, metal, plastics, paper, laminates, co-extrusion and bio-degradable polymers. However, there is a shift in demand which makes laminates and co-extrusion the finest among all. The major segments of the packaging industry in India are flexible packaging, folding cartons, corrugated boards and boxes, labels, shrink sleeves and wrappings and glass bottles. While the concept of sustainable packaging like green polyethene is also prevailing, which is a plastic produced from ethanol sugarcane, a renewable raw material (Ojha *et al.*, 2015).

Effect of packaging materials on the quality of minimally processed rajagira leaves was carried out in HDPE, LDPE, PP (100 & 150 gauge), PET Jar, Muslin cloth and Brown paper pouch. The initial moisture content of fresh leaves was 88.80 %, which decreased on the second day though not significantly. The loss of moisture was significantly higher in rajagira leaves, packed in brown paper pouches (7.66%, 82.03% retention) and muslin cloth (5.399%, 84.05% retention) with a corresponding physiological loss in weight of 18.83 and 21.49 per cent, respectively. Insignificant loss of physiological weight was recorded in leaves packed in LDPE (0.29%), polypropylene 100 (0.66%) and 150 gauge (0.6%) and PET jar (0.12%) after two days of storage (Reddy *et al.*, 2013). In a study carried out by Kuchi *et al.*, 2017 on packaging of burfi prepared from banana in Aluminium foil, butter paper, polyethylene film and its storage under ambient (29±3 °C and 68-81% Relative Humidity) and low temperature conditions (5±1 °C and 85-90% RH) it was observed that aluminium foil packaging along with low-temperature storage was best for maintaining the quality and prolonging the shelf-life of banana burfi.

So, bleached lac, which is highly valued for its many outstanding properties, suffers from one important defect, namely its poor keeping quality in the dry state. It is stored under refrigerated condition due to its poor keeping quality and even in this condition its maximum life is 6 months as its quality flow (fluidity) and life (Heat polymerization time) goes on decreasing and becomes nil after that period resulting in insolubility in spirit/alcohol which restrict its use after that period.

The Bleached lac produced in cold climatic condition gives better keeping quality of products. A study carried out earlier with these packaging materials on packaging and storage of shellac showed no appreciable effect of packaging with initial moisture content 2.5% (Sharma *et al.*, 2014). This may be attributed to the low moisture content in shellac after preparation through heat process. Unlike shellac, bleached lac is prepared through a chemical process and initial moisture content in it can be varied and kept above that of shellac. The present industrial practice of drying before packaging is carried out with certain minute amount of moisture in bleached lac for better keeping quality. The present study has been carried out to find suitable packaging materials among different widely used packaging materials available in market and suitable storage condition for bleached lac.

MATERIALS AND METHODS

For studying the effect of different packaging materials and storage conditions, samples of freshly prepared bleached lac from kusumi lac were packed in seven types of different packaging materials: two grades of Low Density Poly Ethylene (LDPE200-57.1µ and LDPE600-63.5µ), two grades of High Density Poly Ethylene (HDPE300-63.5µ and HDPE400-76.2µ), Poly Propylene (PP-41.1µ), Metalized Polypropylene film (METPP-82.5µ), and five layer craft Paper Bag (PG) and were stored in ambient and refrigerated conditions (14-16°C temperature, 60-70% relative humidity) along with samples stored in open condition in these two environment. The average maximum and minimum ambient temperature during the storage period were 38.2°C and 6°C respectively, whereas the average relative humidity varied between 42.9-89.3%.Quality parameters of bleached lac samples were

evaluated at quarterly intervals (3,6,9 and12 months) up to 01 yr from IS/ISO: 9001:2008 accredited Quality Evaluation Lab, IINRG, Ranchi as per the method of BIS standard IS 6921-1973 (Anonymus, 1973b). The observations for the ambient condition were taken only up to 6th-month keeping in view, the poor life of bleached lac in ambient condition.

RESULTS AND DISCUSSION

Among different quality parameters like flow, life, impurity, moisture content, colour and acid value, the important one is impurity content (hot alcohol insoluble matter) which should not deteriorate rapidly. The maximum limit of impurity content and moisture content as per IS (17:1973) are 1.1% and 6% respectively (Anonymus, 1973a). The initial moisture content, flow value (fluidity), life (heat polymerization time), impurity content, colour index and an acid value of samples before packaging were 5.5%, 55 mm, 10 minutes, 0.5%, 0.70 and 79.40 respectively. The effect of different packaging materials on moisture content and quality parameters under different storage conditions are discussed below.

Effect of different packaging materials on moisture content

For storage of bleached lac in different packaging material under ambient condition in room, moisture content of bleached lac as reported after 3 months of storage was higher in metalized film bag (4.12%) compared to other packaging materials i.e., LDPE, HDPE, PP, Paper bag and lowest was 1.01% in case of open condition of storage.

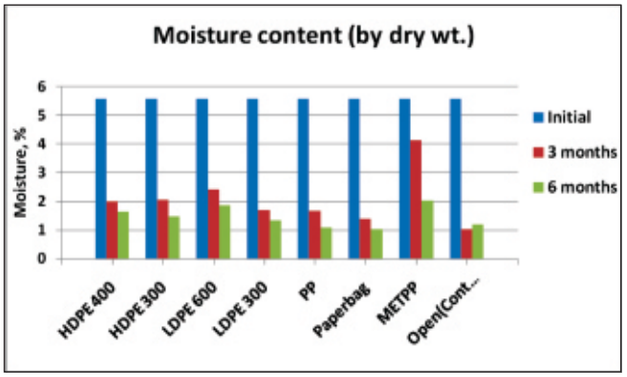

Fig.1: Moisture content for packaging in different materials and storage under ambient condition

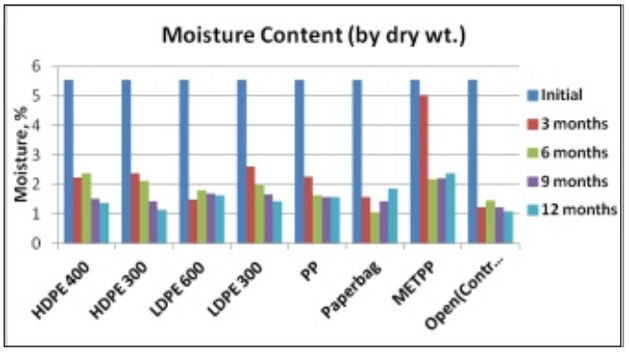

Fig.2: Moisture content for packaging in different materials and storage under refrigerated condition

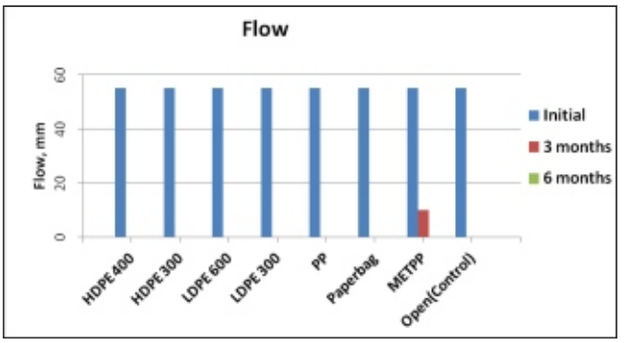

Fig.3: Flow value of sample for different packaging material and storage under ambient condition

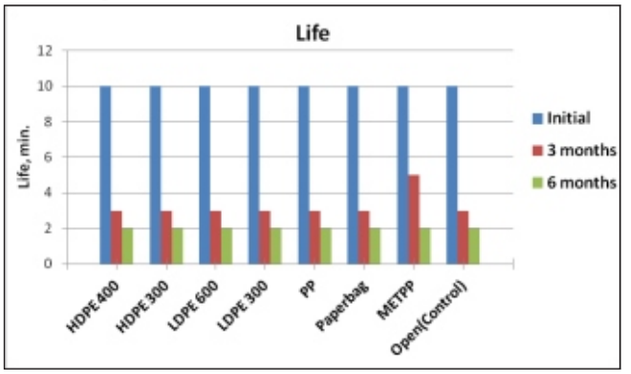

Fig.4: Life of sample or different packaging material and storage under ambient condition

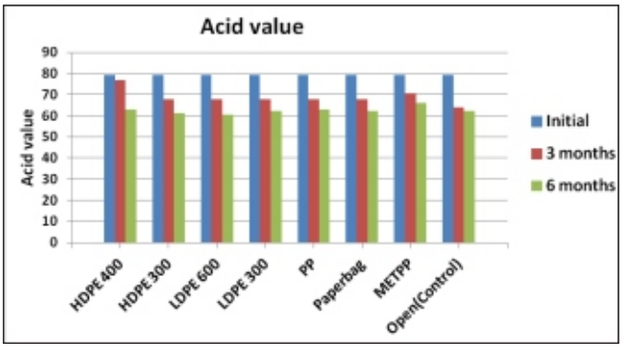

Fig.5: Acid value of sample for different packaging material and storage under ambient condition

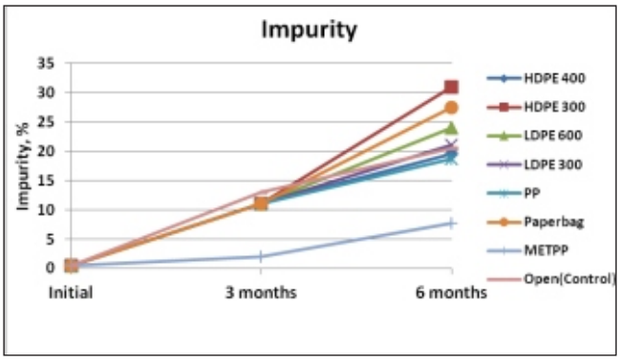

Fig.5: Acid value of sample for different packaging material and storage under ambient condition

Moisture content in other packaging materials was in the range of 1.38-2.40% (Fig.1).

Among different packaging materials least was 1.38% in case of five-layer paper bag which is presently used for packaging and export of powder bleached lac. Moisture content in the metalized film was highest 2.01% after 6 months of storage whereas in others it was 1.01-1.84%.

For storage under the refrigerated condition, these parameters were higher in comparison to ambient storage condition for both the samples packaged in different packaging materials and under open conditions. The moisture content of bleached lac in metalized film bag was higher (5.02%) after 3 months of storage in comparison to others (1.23-2.61%) with lowest (1.23%) in case of storage in open condition (Fig. 2). Moisture content in the metalized film was (2.18%) compared to (1.06%) in case of paper bag after 6 months of storage. Even after one year of storage, moisture content of bleached lac in metalized film bag was higher (2.39%) in comparison to others packaging materials (1.13-1.87%) with the lowest (1.09%) in case of open condition storage. Metalized film was able to retain more moisture in samples compared to other packaging material for both ambient and refrigerated storage due to better barrier properties associated with it.

Effect of different packaging materials on quality parameters during storage under ambient condition

For storage under ambient condition, flow, life and acid value were highest i.e. 10mm (Fig.3), 5 minutes (Fig.4), 70.69 (Fig.5)

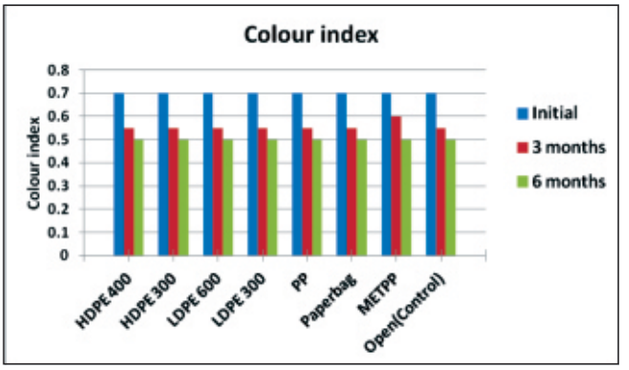

Fig.7: Colour index of sample for different packaging material and storage under ambient condition

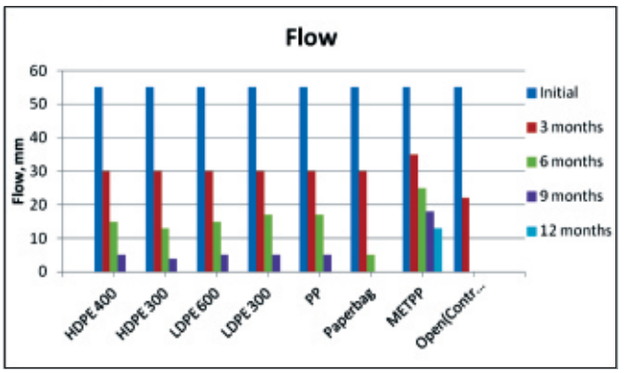

Fig.8: Flow value of sample for different packaging material and storage under refrigerated condition

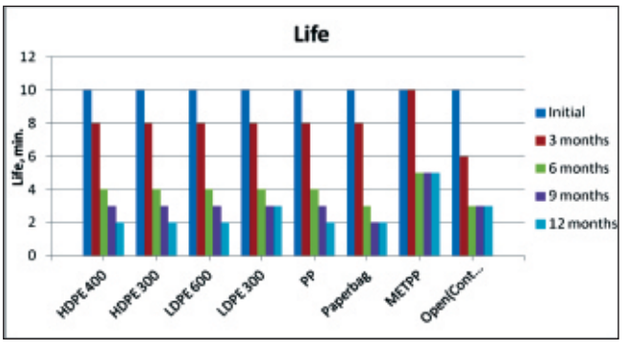

Fig.9: Life of sample for different packaging material and storage under refrigerated condition

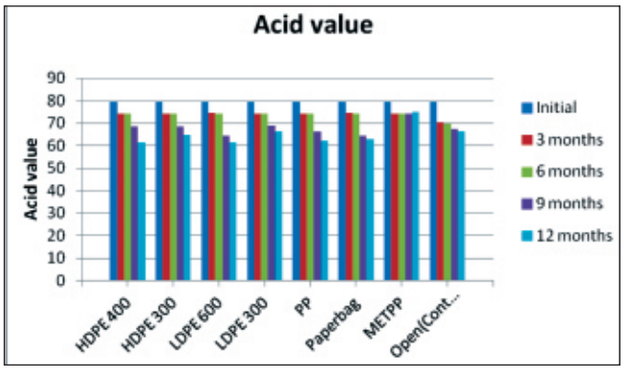

Fig.10: Acid value of sample for different packaging material and storage under refrigerated condition

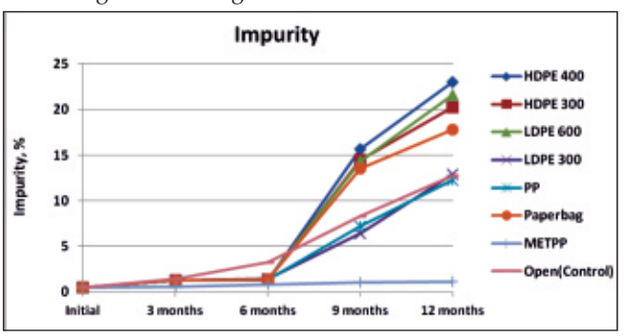

Fig.11: Impurity in sample for different packaging material and storage under refrigerated condition

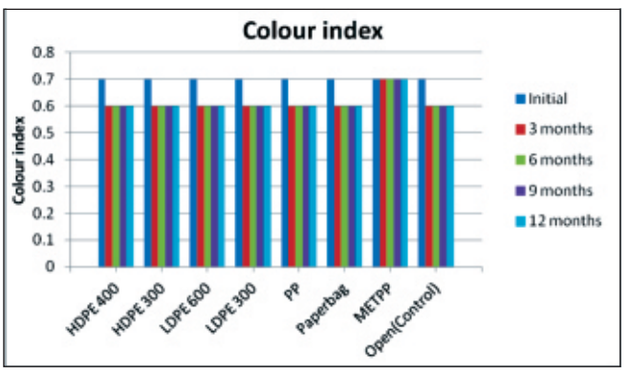

Fig.12: Colour index of sample for different packaging material and storage under refrigerated condition

respectively and impurity content was lowest 2% (Fig.6) for metalized film bag after 3 months of storage due to higher moisture content (4.12%) in the sample. First three parameters were lower and impurity content was higher in other packaging material due to lower moisture content (1.01-2.40%).

Although there was no difference in flow and life of samples after six months of storage in different packaging materials under the open condition, impurities were lesser (7.67%) and the acid value was higher (66.05) in case of metalized film compared to storage in others. Impurity content in others increased up to 18.72-31.02% after six month of storage. There was slight decrease in colour index from 0.70 to 0.50 (Fig.7) during six month storage. Sample evaluation after six months was not continued in further quarters due to higher impurity content obtained just after 3 months.

Effect on quality parameters for storage in different packaging materials under refrigerated condition

For storage under refrigerated condition (14-16^{0}C), the flow, life and acid value were higher compared to ambient condition for both samples packaged in different packaging materials and under open condition. For refrigerated storage, flow, life and acid value were highest i.e. 35mm (Fig.8), 10 min. (Fig.9) and 74.36 (Fig.10) respectively for metalized film bag after 3 months of storage, due to higher moisture content (5.02%) in the sample. However, these parameters were lower in others due to lower moisture content values (1.23-2.61%). The flow and life of samples after six months of storage in metalized film bag were highest i.e. 25mm and 5 minutes respectively. Also, the impurity content was lower (0.80%) compared to 1.30-1.41% (Fig.11) for other packaging material and highest was 3.27% in case of open storage condition. There was a sharp increase in impurity content in other packaging material for storage after six months when moisture content in the samples dropped below 2%. These parameters were also analysed up to one year of storage in different packaging materials. Impurity content was found to be lowest (1.16%) and acid value reported highest (74.96) for metalized film bag compared to impurity value (12.30-23.02%) and acid value (61.23-66.43) for others even after one year of storage. The acid value is a good indicator of the quality of the shellac raw material. During this storage, esterification induced polymerization occurs, resulting in a decrease in the acid value (Farag and Leopold, 2009). No appreciable change in colour value was noticed in bleached lac within one year of the storage period (Fig.12). From this study it was found that quality parameters were better retained in metalized polypropylene film due to higher moisture content in the stored samples. Moreover, the presence of at least 3-4% moisture is beneficial for better keeping quality of bleached lac.

Comparison of storage in ambient and refrigerated conditions

The samples of bleached lac packaged in different packaging materials and stored in ambient and refrigerated condition were compared to determine the effect of temperature on quality parameters. For storage under the refrigerated condition, quality parameters like flow, life, acid value were higher in comparison to ambient condition for both packaged samples and samples stored in open condition. The impurity content for metalized film packaging in refrigerated condition was the lowest i.e. 0.6% and 0.8% respectively even after 3 and 6 months of storage compared to 2% and 7.67% in case of ambient storage. Even after one year of storage, the impurity content for the metalized film in refrigerated condition only increased up to 1.16% (Fig.11). This indicates requirement of refrigerated storage is necessary, as even metalized film packaging for ambient storage is capable of containing impurity content (1.1%) only for initial month's storage while for any extended storage; the refrigerated condition is must for this product.

CONCLUSIONS

It was found that quality parameters like flow, life and acid value were highest for bleached lac samples packaged in metalized polypropylene film compared to others HDPE, LDPE, PP, paper bag and open storage for both conditions of ambient and refrigerated storage. The high impurity content for other packaging materials except for metalized film for initial three months of storage under ambient condition indicates the necessity of refrigerated storage for this commodity. Only metalized film packaging was able to minimise impurity content up to 2% for first three months of ambient storage and below 1.1% even after six months of storage under refrigerated condition. The existing practice of storage under open condition resulted in higher impurity content during the storage period. Moreover, the keeping quality of bleached lac samples was found to be better in metalized film bag compared to others for both ambient and refrigerated condition of storage.

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