International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; SP-8(2): 27-31

Received: 22-01-2020
Accepted: 25-02-2020

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Effect of packaging materials on shelf life of dehydrated green chilli

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DOI: https://doi.org/10.22271/chemi.2020.v8.i2a.9436

Abstract
The green chilli was dehydrated in a hot air oven. The dehydrated green chilli samples were packaged in low density polythene (LDPE) pouch, PET jar, and laminated film pouch and stored at room temperature for 28 days for storage study to estimate shelf life. Green chilli samples were evaluated based on sensory score for visual colour, texture, water activity and moisture absorption during storage at a regular interval of 7 days. Since no appreciable change in quality parameters, water activity and moisture absorption were found after 28 days of storage period stored in PET jar and laminated film pouch, dehydrated green chilli were acceptable. The increase in water activity and moisture absorption was high in LDPE pouch in comparison to PET jar and laminated film pouch. From the storage study, it was found that the shelf life of dried green chilli could be increased to more than 28 days.

Keywords: Green chilli, LDPE, PET, color, texture, shelf life

Introduction
Green chillies are one of the most valuable crops of India and their cultivation and consumption has increased substantially due to their commercial importance and nutritional values. Chillies are excellent source of vitamin A, B, C and E with minerals like molybdenum, manganese, folate, potassium, thiamine and copper. The shelf life of freshly harvested chilli is limited to 2-3 days due to its initial high moisture content (Kaleemullah and Kailappan, 2006) [7]. Green chillies are highly perishable and sometimes farmers get very less profit due to the glut in the market during the main seasonal harvests. A huge amount of green chillies is found to be wasted due to lack of proper preservation techniques (Shanmughavelu, 1989) [12]. It respires after harvest and due to high respiration rate, there is a buildup of temperature, which adversely affects the quality attributes of chilli which ultimately results in short post-harvest life. Fresh green chillies undergo high postharvest losses due to poor postharvest handling during transportation and storage (Singh *et al., 2009*) [11]. The feasibility of green chilli processing and preservation in the form of powder has been reported by Tummala *et al*. (2008) [15]. The basic aim of the drying process is the removal of water from the food products up to a level, at which microbial spoilage and deterioration are minimal (Cohen and Yang, 1995) [6]. Removal of moisture prevents the growth and reproduction of decay causing microorganisms and minimizes many moisture induced deteriorative reactions. The drying of chilli is essential to enhance keeping quality and making available round the year. Drying is one of the important unit operations in food industry. Among various convective hot air drying, the hot air oven drying is common method for small scale drying. Siriwattananon and Maneerate (2016) [13] have reported that the hot air oven drying is widely used in small enterprises or factories as it is advantageous for quality control. Dehydrated green chillies become highly hygroscopic after removing free moisture and tend to absorb moisture quickly from the air. Since dehydrated products become hygroscopic hence selection of appropriate packaging material is important for packaging of dehydration mushroom. It should be packed in air tight suitable packaging material to enhance keeping quality and maintain quality attributes such as colour, texture and rehydration ratio. The quality is the ultimate criterion of the desirability of any food product to the consumers. Shelf life is defined as the period between production and the time the food item loses its state of safe and satisfactory quality in terms of nutritional

value, microbial status, flavor, texture, and appearance. The packaging material plays a fundamental role in maintaining the quality and shelf life of foods items. Al-Sebaeai *et al.* (2017) [1] conducted an experiment to evaluate the effect of packaging materials and storage conditions on the shelf life of powders of dehydrated Pusa Jwara green chilli variety. The green chilli powders (*Capsicum annuum*) were packed in two packaging materials (polypropylene and flexible packaging Foil) and stored under two temperatures (37 and 5 ^{0}C) for a period of 180 days. Mahadevaiah *et al* (1976) [8] conducted studies on packaging and storage of dried Guntur variety chillies in flexible consumer packages and revealed that moisture content higher than 15% is critical with respect to mould growth. Keeping the importance of packaging in enhancing the shelf life of dehydrated green chilli, the present study was conducted to find the effect of packaging materials on shelf life of dehydrated green chilli.

Material and Methods

Dehydration of Green chilli

Fresh green chillies were obtained from Research Farm, Birsa Agricultural University, and Ranchi and stored at 4 to 5 ^{0}C temperature in a refrigerator. The slice length of 13.5 mm was taken. The green chilli was given blanching treatment at concentration of 0.7% potassium metabisulphite and blanching of 1.5 min (Ansari *et al*., 2018) [4]. The blanched green chilli was dehydrated in a hot oven at air temperature of 53 ^{0}C (Ansari *et al*., 2019) [2].

Packaging of Dehydrated Green Chilli Samples

Dehydrated green chilli samples were packaged in low density polythene (LDPE) pouch, PET jar, and laminated film pouch and stored at room temperature for 28 days for storage study.

Quality Evaluation of Dehydrated Green Chilli

The dehydrated green chilli samples were weighed and stored in LDPE pouch, PET jar and laminated pouch at room temperature for 28 days for study its shelf-life with periodic evaluations after every 7 days. The periodic variation in visual colour, texture, water activity and moisture absorption was evaluated at 7 days interval up to 28 days. The sensory quality attributes namely visual colour and texture are the deciding factors in food acceptance. The hedonic rating test is usually used to measure the consumer acceptability of food products (Ranganna, 1986) [10]. Textural parameters of fruits and vegetables are perceived with the sense of touch (Barrett *et al*., 2010). Several researchers in the past have adopted Hedonic rating test method for the evaluation of sensory quality of fruit and vegetables (Chandra and Shamsher, 2006) [5]. For texture and visual color, the evaluation of dehydrated green chilli samples was carried out by a panel of 10 untrained judges. A 5-point hedonic rating was employed for all the attributes evaluated. The Hedonic scale rating used are as follows: Excellent: 1, Good: 2, Fair: 3, Poor: 4 and Very poor: 5. The panelist were given a proforma for evaluation and asked to indicate their preference for each sample based on the quality attributes of visual color and texture.

Determination of Water Activity

The water activity of the dehydrated green chilli samples was directly measured by AquaLab (Model CX_2) water activity measuring device (Decagon Devices, Inc., Washington, USA) at 7 days interval.

Determination of Moisture Gain

Moisture gain in dehydrated green chilli during storage was measured using weighing balance at 7 days interval.

Results and Discussion

Shelf Life Study of Dehydrated Green Chilli

The dehydrated green chilli samples were packed in LDPE pouch, PET jar and laminated pouch and stored at room temperature. The samples were evaluated for visual colour, texture, water activity and moisture absorption at 7 days interval for a period of 28 days.

Sensory Scores during Storage: The sensory score for visual colour and texture are given in Table 1 and Table 2 respectively. The visual colour score for dehydrated green chilli samples packed in LDPE and PET was found to vary from 1.70 to 2.2 and 1.70 to 2.10 while laminated film, it was found to vary from 1.70 to 1.86. The sensory score of texture for samples packed in LDPE and PET was found to vary from 1.20 to 1.41 and 1.20 to 1.38 while laminated film, it was found to vary from 1.20 to 1.34.The changes in these quality attributes during storage may be due to moisture absorption, permeation of light and biochemical reactions. The variation in visual colour and texture of the dehydrated green chilli samples during storage packed in LDPE pouch, PET jar and laminated pouch are presented in Fig. 1 and Fig. 2 respectively.

Table 1: Sensory score for visual colour of dehydrated green chilli samples

Packaging materials/dehydrated green chilli samples	Storage period (days)				
	0	7	14	21	28
LDPE	1.70	1.77	1.81	1.89	2.2
PET	1.70	1.74	1.79	1.85	2.10
Laminated film	1.70	1.72	1.75	1.81	1.86

From Fig. 1, it is clear that visual color changes during storage in all samples stored in different packaging materials. This variation could be due to different permeability of water vapour, light and gases. The samples stored in PET jar and laminated pouch were found to be acceptable.

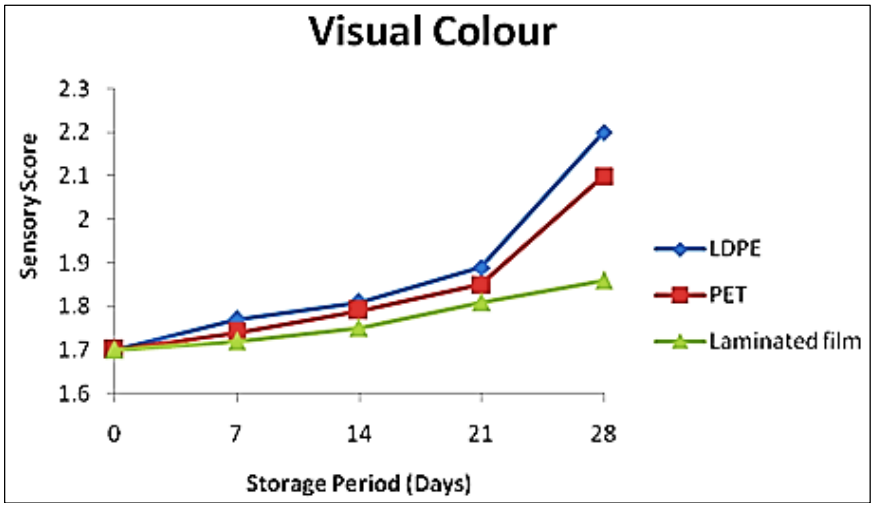

Fig 1: Variation in visual colour of dehydrated green chilli with storage period

Table 2: Sensory score for texture of dehydrated green chilli samples

Packaging materials/dehydrated green chilli samples	Storage period (days)				
	0	7	14	21	28
LDPE	1.20	1.29	1.32	1.36	1.41
PET	1.20	1.25	1.27	1.32	1.38
Laminated film	1.20	1.22	1.25	1.30	1.34

From Fig. 2, it is clear that sensory score of texture changes during storage in all samples stored in different packaging materials. This variation in texture of green chilli samples is due to absorption of moisture. Due to more moisture absorption in sample stored in LDPE, the score is high while lower moisture absorption in PET jar and limited pouch, score is less. The samples stored in PET and laminated films were found to be in a good condition due to lower permeability of PET and laminated film.

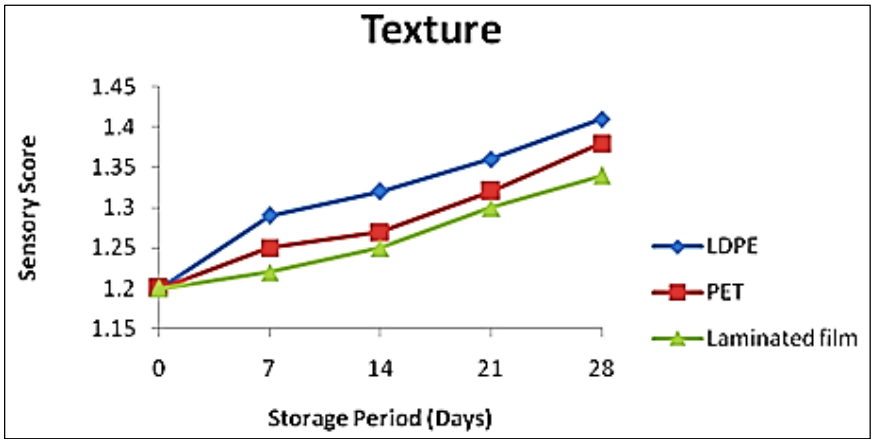

Fig 2: Variation in texture of dehydrated green chilli with storage period

Water Activity during Storage: The water activity and moisture absorption by packaged sample are given in Table 3. The water activity for dehydrated green chilli samples packed in LDPE and PET was found to vary from 0.4600 to 0.4904 and 0.4600 to 0.4750 while laminated film, it was found to vary from 0.4600 to 0.4624.The changes in these quality attributes during storage may be due to moisture absorption, permeation of light and biochemical reactions. Srivastav *et al* (2006) [14] reported that water activities of dried green chilli samples varied from 0.424 to 0.563, which is much lower than the safe storage level of water activity. The variation in water activity of the dehydrated green chilli samples during storage packed in LDPE pouch, PET jar and laminated pouch are presented in Fig. 3. From Fig. 3, it is clear that the water activity in LDPE is high and low in PET and lowest in laminated film. Based on the study the dehydrated product stored in PET and laminated film were found to be good as they gain less moisture during the storage period at ambient temperature. The water activity of LDPE, PET and laminated film are in safe storage level.

Table 3: Water activity of dehydrated green chilli samples

Packaging materials/dehydrated green chilli samples	Storage period (days)				
	0	7	14	21	28
LDPE	0.4600	0.4612	0.4770	0.4811	0.4904
PET	0.4600	0.4608	0.4632	0.4642	0.4750
Laminated film	0.4600	0.4603	0.4615	0.4617	0.4624

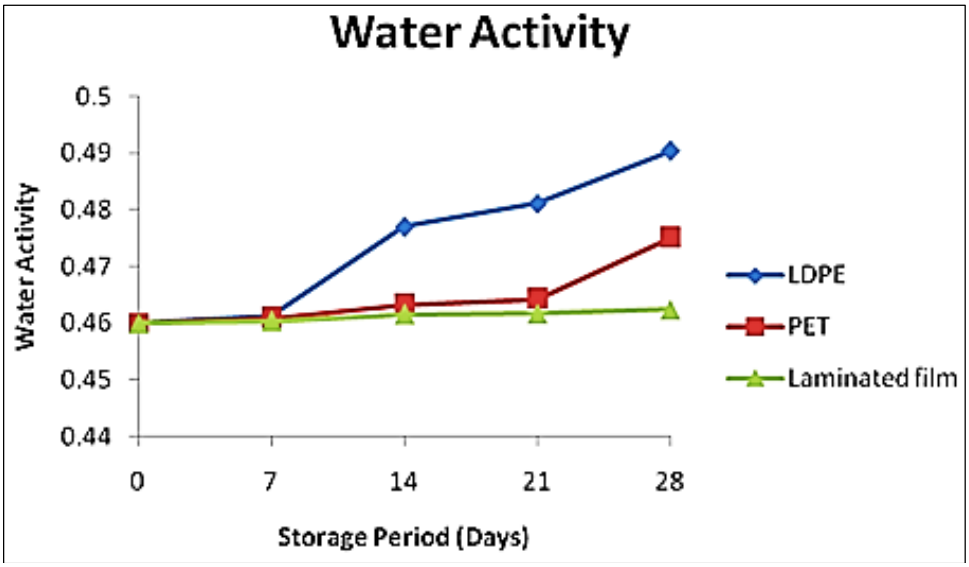

Fig 3: Variation in water activity of dehydrated green chilli with storage period

Moisture Absorption during Storage: The variation in moisture absorption of the dehydrated green chilli samples during storage packed in LDPE pouch, PET jar and laminated pouch are presented in Fig.4. From Fig. 4., it is clear that moisture absorption changes during storage in all samples stored in different packaging materials but minimum absorption occurs in samples stored in PET and laminated film due to their lower permeability to water vapour. Similar finding was reported by Raj *et al*. (2013). Based on sensory score, water activity and moisture absorption study, it can be concluded that the dehydrated green chilli stored in PET and laminated films were in good condition after 28 days of storage period at room temperature. These developed operating conditions have potential for industrial application. Overall it could be concluded that laminated film is the best option for storing dehydrated green chilli.

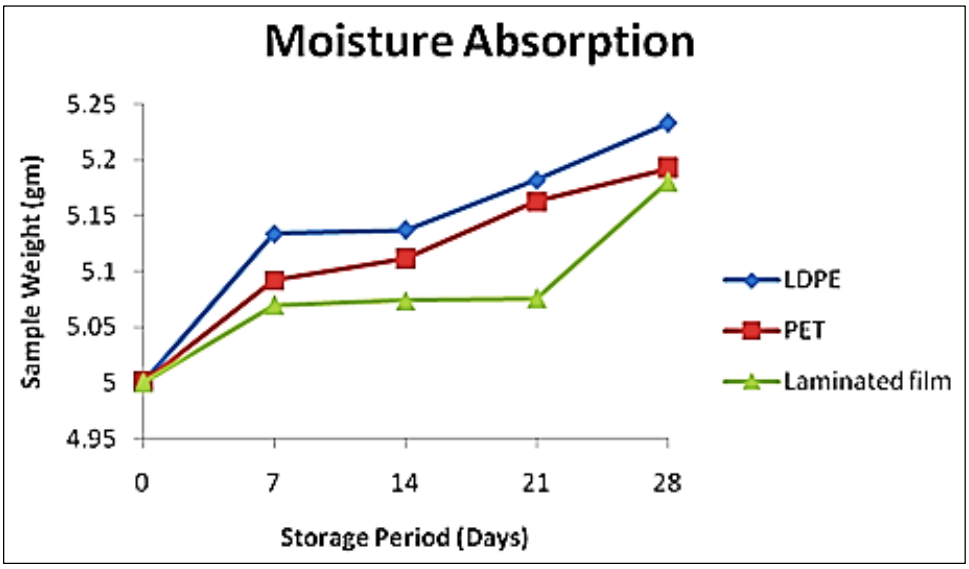

Fig 4: Variation in moisture absorption in dehydrated green chilli with storage period

Conclusion

The dehydrated samples were packaged in LDPE pouch, PET jar and laminated film pouch and stored at room temperature for storage study at room temperature for 28 days. Dehydrated green chilli samples were evaluated based on sensory score for visual colour and texture, and moisture absorption and water activity during storage at a regular interval of 7 days. Since no appreciable change in quality parameters was found after 28 days of storage period stored in PET jar and laminated film, dehydrated green chilli samples were of light yellow colour with good feel of texture. Based on this study it can be concluded that PET jar and laminated film are suitable for packaging of dehydrated green chill for getting the quality of end product with minimum changes during subsequent storage period.

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