Changes in Quality of Dried Fig(Ficus Carica L) cv. Poona; Ambient Storage

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Abstract- *The fig (Whole and cut fruit) was dried under different drying methods to a moisture content of 15-16 % (w.b). The dried fig was subjected to sensory evaluation and five best treatments with higher scores were selected for the storage studies. The samples were packed in the 200 gauge polyethylene films and stored in ambient condition (26.1 o C, 45-60 percent relative humidity) for study of quality changes during storage for a period of 90 days. The samples were analyzed for quality attributes like rehydration ratio, biochemical properties and sensory evaluation. There was considerable decrease in rehydrating capacity of the dried fig fruits with increase in storage period. The protein content and titrable acidity decreased during the storage. Whereas the total sugars content of dried fig fruits increased slightly but there was a considerable decrease in reducing sugars. The same samples also showed the decrease in non reducing sugars. The sensory quality was slightly decreased after the storage period and all the stored samples were acceptable for consumption after the 90 days of storage. The microwave dried samples had better sensory scores compared to other methods.*

I. INTRODUCTION

Fig is a delicious and healthy fruit. It is called as "Nature's most perfect fruit". Fig (Ficus Carica Linn) is a subtropical fruit, a member of family Moraceae. It includes an estimated 900-950 species. Botanically, fig is known as 'syconium'. Fig is a fleshy, hallow receptacle with a narrow aperture at the tip and numerous small flowers lining the inner surface. Depending on the age of the tree, a fig tree can yield 150-300 fruits per annum (Bose and Mitra, 2002). Fig is thought to be a native to southern parts of Arabian Peninsula, Italy, the Balkan Peninsula and the USSR (Tutin, 1964). The common cultivars grown are Capri, Andriatic, Sonyrna and Poona. Although wild figs have grown in India for thousands of years; dried figs are imported in large quantities. But fig fruits are highly perishable in nature. They have to be marketed immediately after harvest since their quality declines rapidly after harvest. The fresh market figs must be harvested when almost fully ripe but firm to be of good eating quality.

Drying is one of the most practical methods of preserving foods and fruits. Drying enhances the shelf life of products without loosing its nutritional qualities. The dried figs are generally consumed without further processing. Very little information is available on the retention of quality parameters, packaging requirements and storage behavior of dried fig fruits. Sen et al, in 2010 have conducted a study for quality analysis of fig and two fig processed products in cold (3±0.5°C, 55-65% relative humidity) and ambient storage conditions for 12 months. Under ambient storage conditions, quality loss was observed whereas cold storage conditions extended storage ability and no significant changes were observed for a 12 month period. Meyvaci et al., in 2003 have conducted studies of improving shelf life of intermediate moisture sun dried figs in gas tight (Vacuum and N_2 + CO_2) polyethelene packages. The results proved that darkening of the fruit color and sugaring were the major quality attributes affected by the storage conditions. They observed that vacuum packaging had resulted in exudation of fruit juice and was not suitable for storage.

The present study was therefore undertaken to obtain the necessary information on changes in quality during ambient storage conditions with packaging for a period of 90 days.

II. MATERIAL AND METHODS

Fig fruits (cv. Poona) were procured from the market and the ripened fruits without bruises cuts and other damages were used for the experiments. The TSS (Total soluble solids) of the fresh fig fruits was in the range of 13 to 16 °Brix. The fig fruits were pre-treated with 2 percent KMS solution for 30 minutes (Dipping). The fruits (both whole and cut form) were dried (thin layer drying) to a moisture content of 15 to 16 percent (w.b.) in sun, solar cabinet dryer, cabinet tray dryer (at 55, 60 & 65°C) and microwave oven at power level 1. The dried figs were subjected to sensory evaluation (Five point hedonic scale) to a panel of ten judges. The evaluation was done for appearance, aroma, taste and overall acceptability. The samples of five treatments with higher sensory score based on sensory analysis, were taken up for storage studies.

Dried fig of the five treatments was packed in 200 gauge polyethylene film with a pack size of 40 g (3 replications for each treatment). The packed samples were stored at ambient conditions (26.1^{o}C, 45-60 percent relative humidity) to study the shelf life for three months and samples were analyzed for the quality.

a. **Moisture content:** Moisture content of fig fruits were determined by the method recommended by Ranganna (1986).
b. **Rehydration ratio:** Rehydration ratio was determined by the method recommended by Ranganna (1986).
c. **Biochemical properties:** All the biochemical properties were determined by chemical analysis methods.
   Crude protein: Crude protein of fig fruits was estimated by Micro-Kjeldhal method using Gerhardt automatic nitrogen analyser (Ranganna, 1986).
   Titrable acidity: Total titrable acidity of fig fruit samples were determined by visual titration method (Ranganna, 1986).
   Sugars (reducing, non-reducing and total sugars): Sugars present in the dried fig fruit samples were estimated by using the method given by Lane and Eynon (1923).
d. **Sensory Evaluation:** The sensory evaluation was done by a panel of ten judges.

The evaluation was done for five sensory attributes; appearance, aroma, texture, taste and overall acceptability using the five point hedonic scale with a maximum score of 5 (like extremely) and minimum of 1 (dislike extremely) (Amerine et al., 1965).

III. RESULTS AND DISCUSSION

Dried fig fruits are commonly stored in polyethylene films under ambient conditions for few months in market in ambient as well as lower temperatures. Retention of the dried fig quality during storage is influenced by environmental factors like temperature and relative humidity. The moisture content increase was marginal in all the samples stored in ambient condition which is ranging from 0.53 to 0.63 percent increase.

The increase in the moisture content can be attributed to the relative humidity and the moderate water vapour transmission rate of the polyethylene film which is in accordance with the results obtained by Sagar et al. (1999). The final moisture content (90 days of storage) of the MOC, MOW, SNC, SLC and SLW samples was in the range of 16.02 to16.48 percent. The rehydration capacity was decreasing with the increase in storage period (Table 1). The decrease can be attributed to the reduction of water binding sites due to the chemical and structural changes in the cells of dried fig fruits (Sagar and Maini, 1997).

During the storage period there were changes in the biochemical properties of the figs. A gradual decline in protein content was observed during storage (Table 1). During storage, increase of the proteinase activity results in breakdown of some proteins further, resulting in decline of the protein content (Suguna et al. 1995). The titrabale acidity also decreases during storage (Table 1). The titrable acidity per cent reached almost near to zero per cent. The reasons though not clear, the decrease in acidity might be due to the chemical reaction between the organic constituents of the fruit. The KMS used during the sulphitation might also have induced the decrease in acidity of the dried fig fruits. Similar results were observed by Khurdiya (1980) for storage of dried ber fruits.

Total sugars content of dried fig fruits stored in polyethylene film increased slightly, during ambient storage. This increase in total sugars could be attributed to the hydrolysis of polysaccharides like cellulose and hemicelluloses that were present in the fruits into sugars. There was a considerable increase in reducing sugar contents of dried fig fruits during storage at ambient conditions (Table 1). The increase in reducing sugars could be attributed to inversion of non-reducing sugar that were present in the fruit into reducing sugars and also due to increase in total sugars due to hydrolysis of some polysaccharides into sugars. The same samples also showed the decrease in non-reducing sugars. As discussed earlier, this might be due to the action of some enzymes which invert the non-reducing sugars into reducing sugars. The decrease in non reducing sugar was high in all the stored samples of dried fig fruits. The results obtained in this investigation pertaining to the reducing, non-reducing and total sugars content are similar with the observations made by Bal (1982).

The sensory evaluation of stored samples after three months of storage period showed a slight decrease in the quality attributes appearance, aroma, texture, taste and overall acceptability (Table 2). All the samples were acceptable for consumption after the storage. The microwave dried figs (cut and whole both) were having the highest scores of overall acceptability and other quality attributes compared to other treatments, even after 90 days of storage. The sulphitation pretreatment before the drying may have helped in preservation of the samples during the storage. This is in accordance with the studies made by Khurdiya (1980) on the storage of dehydrated ber fruits. The quality loss was observed slightly during the storage in ambient conditions similar to the observations made by Sen et al., 2010. The results of the storage study indicates that the shelf life of dried

fig fruits could be preserved for atleast 3 months at ambient conditions when stored in sealed polyethylene films (200 guage) with pretreatment before drying.

IV. CONCLUSION

The dried figs consumption is high and production is also more. The quality of the dried figs has to be maintained for a longer period for direct consumption and processing. So the storage conditions and type of packaging plays an important role during storage. Under ambient conditions the quality of the dried figs using microwave drying (cut and whole fruit), Sun drying (cut fruit) and Solar cabinet drying with pretreatment with KMS and packed in 200 gauge polyethylene has retained the quality for a period of 90 days. There was slight decrease or loss in the quality parameters. Further studies can be conducted with different types of packaging and storage conditions to improve the storage shelf life and better quality retention of dried figs.

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Table1: Effect of storage period on biochemical properties of dried fig samples stored at ambient conditions

Storage period (days)	Samples	Final moisture content % (wb)	Rehydration ratio	Biochemical parameters (%)				
				Crude protein	Titrable acidity	Reducing sugars	Non Reducing Sugars	Total sugars
0	MOC	15.40±0.18	2.18±0.15	4.38±0.12	0.028±0.07	42.08±0.07	9.01±0.15	51.09±0.16
	MOW	15.30±0.15	1.59±0.10	4.55±0.02	0.029±0.03	42.11±0.03	9.07±0.05	51.18±0.06
	SNC	15.91±0.11	2.14±0.16	4.50±0.02	0.023±0.11	41.94±0.05	9.02±0.02	50.96±0.03
	SLC	15.58±0.20	2.15±0.03	4.46±0.18	0.023±0.11	42.23±0.11	8.99±0.11	51.22±0.03
	SLW	15.55±0.15	1.51±0.21	4.79±0.01	0.022±0.09	42.22±0.10	9.12±0.06	51.34±0.11
30	MOC	15.67±0.10	2.01±0.12	4.31±0.05	0.019±0.09	42.83±0.05	8.33±0.06	51.16±0.10
	MOW	15.58±0.05	1.50±0.19	4.34±0.01	0.018±0.07	42.85±0.11	8.41±0.09	51.26±0.15
	SNC	16.22±0.13	2.03±0.19	4.46±0.03	0.012±0.11	42.64±0.10	8.53±0.10	51.17±0.06
	SLC	15.79±0.06	2.02±0.21	4.40±0.10	0.014±0.08	42.94±0.07	8.45±0.05	51.39±0.12
	SLW	15.80±0.11	1.43±0.09	4.65±0.10	0.010±0.11	42.82±0.09	8.61±0.09	51.43±0.18
60	MOC	15.84±0.17	1.84±0.22	4.25±0.08	0.012±0.10	43.37±0.02	7.92±0.07	51.29±0.11
	MOW	15.78±0.09	1.45±0.15	4.21±0.10	0.013±0.07	43.35±0.11	7.02±0.11	51.37±0.06
	SNC	16.36±0.12	1.83±0.18	4.41±0.05	0.003±0.08	43.03±0.08	8.31±0.05	51.34±0.07
	SLC	15.98±0.08	1.79±0.24	4.36±0.13	0.006±0.11	43.48±0.15	8.03±0.06	51.51±0.09
	SLW	15.96±0.09	1.38±0.21	4.57±0.11	0.002±0.06	43.25±0.10	8.34±0.05	51.59±0.02
90	MOC	16.02±0.12	1.71±0.19	4.11±0.06	0.002±0.01	43.76±0.12	7.66±0.10	51.42±0.12
	MOW	15.86±0.25	1.38±0.20	4.09±0.05	0.005±0.02	43.73±0.05	7.55±0.07	51.48±0.15
	SNC	16.48±0.15	1.72±0.11	4.36±0.10	0.0001±0.01	43.54±0.03	8.01±0.03	51.55±0.13
	SLC	16.21±0.15	1.69±0.18	4.30±0.07	0.0001±0.01	43.82±0.09	7.86±0.05	51.68±0.05
	SLW	16.11±0.23	1.34±0.21	4.49±0.12	0.0001±0.02	43.69±0.07	8.21±0.07	51.70±0.09

Results are the means of three replicate samples ± SD

MOC - Microwave oven dried, Sulphited cut fig fruits
MOW - Microwave oven dried, Sulphited whole fig fruits
SNC - Sun dried, Sulphited cut fig fruits
SLC - Solar cabinet dried, Sulphited cut fig fruits
SLW - Solar cabinet dried, Sulphited whole fig fruits

Table 2: Effect of storage period on sensory qualities of dried fig samples stored at ambient conditions

Storage period (days)	Samples	Sensory parameters				
		Appearance	Aroma	Texture	Taste	Overall Acceptability
0	MOC	4.4	4.4	4.3	4.3	4.4
	MOW	4.2	4.3	4.2	4.1	4.3
	SNC	4.1	4.1	4.2	3.9	4.2
	SLC	4.0	3.8	4.1	4.0	3.8
	SLW	3.9	3.6	3.9	3.5	3.7
30	MOC	4.4	4.3	4.2	4.3	4.3
	MOW	4.2	4.2	4.0	4.1	4.3
	SNC	4.0	4.0	4.0	3.9	4.1
	SLC	3.9	3.7	3.9	4.0	3.8
	SLW	3.9	3.6	3.8	3.5	3.6
60	MOC	4.3	4.2	4.0	4.2	4.2
	MOW	4.1	4.1	3.9	4.0	4.1
	SNC	3.9	3.9	3.9	3.9	4.0
	SLC	3.8	3.6	3.8	3.8	3.7
	SLW	3.8	3.5	3.7	3.4	3.5
90	MOC	4.1	4.1	3.8	4.0	4.0
	MOW	4.0	4.0	3.7	3.8	3.9
	SNC	3.7	3.7	3.6	3.7	3.7
	SLC	3.6	3.5	3.6	3.6	3.5
	SLW	3.6	3.4	3.5	3.1	3.2

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