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Studies on dehydration of plum using different sugar syrup treatments

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Being highly perishable plums cannot be stored for longer period at ambient condition and only 10 per cent is being processed. There is greater scope and necessity of developing an appropriate technology for drying of plums with long shelf life. Plums are produced around the world, and China is the world's largest producer, The total plum production (of the 10th largest producers) of plum was 9,921,953 MT in 2011. The ripe plums were treated at 100°C for 1 min in boiling water to deactivate the enzyme. The blanched fruits were dipped in sucrose, glucose, fructose and invert sugar syrups at 68°Brix, 72°Brix, 75 ° Brix for 24 hrs for getting desired total soluble solids content. The treated fruits were further dried to 20 per cent moisture in a tray dryer at 60–65°C. Good quality and acceptable dried plums could be prepared by using sucrose syrup treatment at 75°Brix.The chemical analysis of sucrose syrup treated at 75° brix fresh plums and dehydrated plums were carried out with respect to carbohydrate, protein, fat, fibre and ascorbic acid content. No significant loss of nutrient was obtained due to osmotic dehydration. Dried plums prepared using sucrose syrup and packed in aluminium foil pouch and stored at ambient (27 ± 2°C) as well as refrigerated (10 ± 2°C) temperature, organoleptic evaluation shows that plum remained in excellent condition up to 3 months.

Key Words : Dehydrated plums, Sucrose, Glucose, Fructose, Invert sugar

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INTRODUCTION

The fruit *Prunus armeniaca* gained its name from the beliefs of Pliny the Elder, a Roman historian and scientist of the first century, who maintained the apricot was a kind of a plum, and had originally come from Armeni/ Armenian sources support their claims by referring to a 6,000-year-old apricot pit found in an archaeological site near Yerevan. Other historians point to Mesopotamia as a clue to the Latin name.

Plums are a diverse group of species. The commercially important plum trees are medium sized, usually pruned to 5-6 meters height. The tree is of medium hardines without pruning; the trees can reach meters in height and spread across meters. They blossom in different months in different parts of the world; for example, in about January in Taiwan and about April in the United States.)"Production of Plum by countries". UN Food and Agriculture Organization)

Fruits are usually of medium size, between 1 to 3 inches in diameter, globose to oval. The flesh is firm, juicy and mealy. The fruit's peel is smooth, with a natural waxy surface that adheres to the flesh. The fruit has a single large seed.

Plum has many species, and taxonomist differ on the count. Depending on taxonomist, between 19 to 40 species of *Prunus domestica)* plum exist. From this diversity only two species, the hexaploid European plum

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(and the diploid Japanese plum (*Prunus salicina* and hybrids), are of worldwide commercial significance.

Dried plums (or prunes) are also sweet and juicy and contain several antioxidants. Plums and prunes are known for their laxative effect. This effect has been attributed to various compounds present in the fruits, such as dietary fibre, sorbitol, andisatin (Food TV article on plums M. Roach, The power of prunes (1999) Prunes and prune juice are often used to help regulate the functioning of the digestive system. Dried prune marketers in the USA have, in recent years, begun marketing their product as "dried plums". This is due to "prune" having negative connotations connected with elderly people suffering from constipation (Food TV article on plums).

To get good quality dehydrated product, osmotic dehydration in combination with other drying methods is useful. Osmotic dehydration consists of partial removal of moisture from the produce by placing it in concentrated sugar solution. The product prepared by this method showed a porous crispy structure and retained a large percentage of favour volatiles of fresh fruits (Pointing *et al.*, 1966). Considering these points, there is greater scope and need for drying of plum for making it available throughout the year in good quality. Prepared dried plum become very hard and turn into white colour due to sugarcrystallization on the surface of dried plums. Therefore, different sugar syrups were tried for preparing dehydrated plums to find out their effect on sensory quality and changes that take place in chemical composition during storage.

METHODOLOGY

The fruits were obtained from local market and cleaned with water. The clean fruits were subjected to blanched treatment at 100°C for 1 min in boiling. Blanched fruits were dipped in 68°Brix, 72°Brix, 75°Brix syrup of sucrose, glucose, fructose and invert sugar (glucose 50% + fructose 50%) syrup for 24 hrs to get desired total soluble solids (TSS) (Table A, B and C). The soaked fruits were removed from syrup and surface of fruits were subjected to drying in the tray dryer at 60–65°C for 3-4 h to reduce moisture content to safe level of 18–20 per cent (Varma and Joshi, Postharvest technology of fruit and vegetables page no, 821,148). The dried fruits were packed in aluminium foil pouch and stored at ambient (25 ± 2°C) and refrigerated (10 ± 2°C) temperatures.Market samples of dehydrated plum were procured from the local market for sensory and for comparison.

Chemical analysis and sensory characteristics were studied at 0 and 3 months storage. Moisture and titratable acidity were estimated using AOAC (1990) method. Reducing, non-reducing and total sugars were determined (using Lane and Eynon method 1923) while ascorbic acid content was estimated by employing direct titration of fltrate with 2–6 dichlorophenol indophenols dye according to AOAC (1966). Protein analysis was done by macrokjeldal method, carbohydrates was estimated by Anthrone method, while fat determination was done by Solvent Extraction Method and dietary fibre by acid hydrolysis. Sensory evaluation was performed by a panel

Table A : Blanched fruits dipped in 68 ^{0}B

Treatments at 68 ^{0}Brix	Invert sugar			Glucose			Fructose			Sucrose		
	Sensory quality											
	F	A	R	F	A	R	F	A	R	F	A	R
Colour and appearance	7.4	7.4	7.4	7.2	7.2	7.2	7.8	7.8	7.8	7.5	7.5	7.5
Flavour	7.1	7.1	7.1	7.1	8.0	7.1	8.0	8.0	8.0	8.1	8.1	8.1
Texture	7.0	6.7	6.9	7.0	7.7	7.0	8.1	7.7	7.9	7.9	7.6	7.9
Taste	7.3	7.5	7.1	6.9	7.0	6.8	7.4	7.0	7.2	8.4	8.1	8.2
Overall acceptability	7.1	7.1	7.1	7.0	7.8	7.0	7.8	7.8	7.8	8.1	8.1	8.1

Table B : Blanched fruits dipped in 72 ^{0}B

Treatments at 72 ^{0}Brix	Invert sugar			Glucose			Fructose			Sucrose		
	Sensory quality											
	F	A	R	F	A	R	F	A	R	F	A	R
Colour and appearance	7.5	7.5	7.4	7.3	7.3	7.2	8.0	8.0	7.8	7.8	7.8	7.5
Flavour	7.5	7.5	7.1	7.3	7.3	7.1	8.5	8.5	8.0	8.3	8.3	8.1
Texture	7.5	7.0	6.9	7.0	6.7	7.0	8.0	7.7	7.9	8.1	7.7	7.9
Taste	7.8	7.5	7.1	7.0	6.6	6.8	8.8	8.1	7.2	8.9	8.6	8.2
Overall acceptability	7.5	7.5	7.1	7.1	7.1	7.0	8.3	8.3	7.8	8.3	8.3	8.1

Table C : Blanched fruits dipped in 75 ^{0}B

Treatments at 75 ^{0}Brix	Invert sugar			Glucose			Fructose			Sucrose		
	Sensory quality											
	F	A	R	F	A	R	F	A	R	F	A	R
Colour and appearance	7.7	7.7	7.7	7.3	7.3	7.3	8.1	8.1	8.1	8.8	8.8	8.8
Flavour	7.8	7.8	7.8	7.2	7.2	7.2	8.7	8.7	8.7	8.5	8.5	8.5
Texture	7.5	7.2	7.4	7.5	7.1	7.3	8.1	7.7	7.8	8.9	8.3	8.3
Taste	7.9	7.5	7.7	7.4	7.1	7.3	8.5	8.0	8.3	8.7	8.6	8.8
Overall acceptability	7.9	7.9	7.9	7.8	7.8	7.8	8.1	8.1	8.1	8.8	8.8	8.8

F-Fresh dehydrated plums A-Plum stored at ambient temperature R-Plum stored at refrigerated temperature

of 10 semi-trained judges on the basis of 9-point Hedonic scale (Amerine *et al.*, 1965).

Sensory quality :

As in sensory quality fruit treated with 75°Brix gives better overall acceptability so it is used for further storage study.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Sensory quality of fresh dried pineapples:

Sensory quality parameters of fresh dehydrated plum showed excellent organoleptic characteristics for sucrose sugar syrup treatments treated at 75 ^{0}Brix for colour and appearance, texture, taste and overall acceptability as compared to other treatments as well as to market samples (Table A, B and C). Thonta and Patil (1988) reported that maximum TSS was in fruits treated with pre-treatments of dry sugar followed by pricked as well as non-pricked fruits dipped in sugar solution and subjected to oven drying (58 ± 3°C) for 2 days. Gawade and Waskar (2003) found that blanching was the best pre-treatment for preparation of dried plum. Varma and Joshi (1992) also reported similar results for total sugars content in dried plum.

Storage study :

The sucrose sugar syrup at 75 ^{0}Brix was used for storage study and there was a little bit change in score as the time is extend, for texture, taste and overall acceptance in all samples at ambient as well as at refrigerated storage temperature (Table 1). Fresh dried plum prepared using sucrose syrup at 75 ^{0}Brix gave first rank with highest overall acceptability score. Similar trend was observed as time goes, in fruits stored at ambient and refrigerator conditions. Refrigerated storage obtained higher score for all sensory properties than those stored at ambient condition.

Result of chemical analysis (Table 2 and 3, Fig. 1) clearly revel that there is no significant loss of nutrients especially proteins, where carbohydrates, fats, fibre and ascorbic acid has got concentrated after the osmotic dehydration treatment.

Table 1 : Chemical quality of fresh dehydrated plum

Nutrients	Nutrient value per 100 g
Energy	61.27 kcal
Carbohydrates	13.7g
Protein	0.92g
Fat	0.31 g
Dietary fibre	1.50 g
Ascorbic acid	0.9 g

Table 2 : Sensory quality of dehydrated plum treated in sucrose after 3 months

Treatment at 75 ^{0}Brix	Sensory quality		
	Sucrose		
	F	A	R
Colour and appearance	8.0	7.5	7.8
Flavour	8.0	7.7	8.0
Texture	8.1	7.3	8.0
Taste	8.0	7.6	8.0
Overall acceptability	8.1	7.6	8.0

F-Fresh dehydrated plums A-Plum stored at ambient temperature
R-Plum stored at refrigerated temperature

Table 3 : Chemical quality of dehydrated plum after 3 months

Nutrients	Nutrient value per 100 g
Energy	107.9 kcal
Carbohydrates	11.4 g
Protein	0.70 g
Fat	0.28g
Dietary fibre	1.40 g
Ascorbic acid	1.63 g

Fig. 1 : Mean score of nutritive value of *Laddoos*

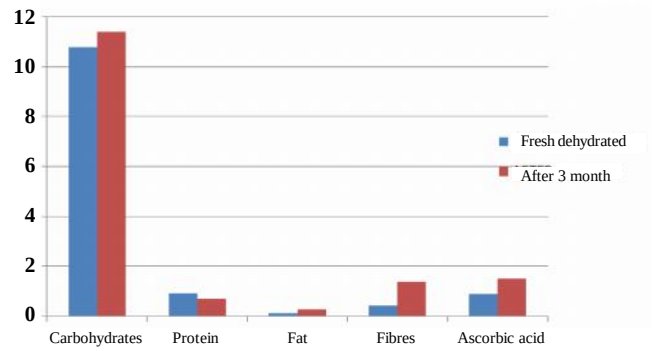

Fig. 1 : Chemical quality of dehydrated plum

It is apparent from above observations that sucrose sugar syrup at 75 ^{0}Brix is best suited for preparation of dried plums.

Conclusion :

The clean fruits were subjected to blanched treatment at 100°C for 1 min in boiling water. Blanched fruits were dipped in 68 ^{0}Brix, 72^{0}Brix, 75^{0}Brix syrup of sucrose, glucose, fructose and invert sugar (glucose 50% + fructose 50%) syrup for 24 hr. to get desired TSS.This study revealed that the dehydrated plum prepared by using sucrose syrup at 75 ^{0}brix shows good organoleptic properties and maintained their market acceptability for 3 months.The nutritional quality is also not affected due to osmotic drying treatment.Studies on sensory evaluation and chemical analysis clearly shows that Sucrose syrup treatment at 75 ^{0}Brix is the best for preparation of dried plums of good quality.

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