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Study the Effect of Different Drying Methods on Quality and Consumer Acceptability of Tamarind Leathers

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ABSTRACT

An investigation was carried out to assess the quality and sensory characteristics of tamarind leather as affected by drying methods. In this study tamarind leathers were dried by two different methods i.e. cabinet drier (70°C) and solar drier (54±4°C). The quality parameters were texture, color, rehydration ratio, drying ratio, pH and titratable acidity and sensory properties of tamarind leathers were evaluated. Results showed that, the moisture content of cabinet dried leathers was lower (5.52%) than that dried by solar drier (7.95%). Instrumental results of texture showed that all the leathers were significantly different ($p \leq 0.05$), the leathers dried by solar drier were tender (2.52) than that dried by cabinet drier (3.29). Drying methods considerably influenced the color changes of tamarind leathers, that tamarind leathers dried by cabinet drier revealed darker color values (0.138±0.01) than that dried by solar drier (0.043±0.03) . The Rehydration ratio values were (1.78) and (1.44) for tamarind leathers dried by solar and cabinet driers respectively. The drying ratio of tamarind leathers values were significantly different ($p \leq 0.05$), 3.5 and 3.25 for tamarind leathers dried by cabinet and solar driers respectively. The pH values of tamarind leathers dried by cabinet and solar driers were 2.78±0.03 and 2.81±0.03 respectively. While the treatable acidity values of tamarind leathers dried by cabinet and solar driers were 6.86±0.03 and 7.83±0.39 respectively. Solar dried leathers were liked and received significantly higher scores ($p \leq 0.05$) on all sensory attributes evaluated.

Keywords: *Cabinet, Drying, Leather, Quality, Solar, Tamarind and sensory.*

INTRODUCTION

Tamarind (*Tamarindus indica L.*) is a multipurpose tropical fruit tree originating in Africa. Although the main commercial production of tamarind fruits takes place in Asia and America, tamarind plays an essential subsistence role in rural West Africa. The tamarind fruit pulp contains tartaric acid, reducing sugars, pectin and proteins, besides fiber and cellulosic material. The fruit pulp was reported to have many industrial and medicinal and uses (Stege *et al*. 2011).

The tamarind pulp is used as flavoring agent in “hot and sour” soups as well in marinades. The juice made of tamarind pulp with addition of dates, sugar, honey, cardamom, cloves, and coriander seeds are a refreshing drink marketed in different parts of the world. Its pulp is also used in confectionaries as solidifying agent. Its pulp has been used in many traditional medicines as a laxative, digestive, and as a remedy for biliousness and bile disorders. Also used as emulsifying agent in syrups, decoctions, etc., in different pharmaceutical products (Guanesa, 2000).

In Sudan, tamarind fruits are traditionally cultivated, harvested and marketed. The food uses of this indigenous fruit remain mainly at house hold level with limited use as a raw material for industrial processing e.g. carbonated beverages, jams and confectioneries (Abdel Rahman, 2011).

The major challenge during drying of food materials is to reduce the moisture content of the material to the desired level without substantial loss of flavor, taste, color and nutrients. Beside the adverse influence of drying on food quality the process is indispensable in many food industry sectors because of the increased shelf-life of the product, reduced packaging cost, lower shipping weights and environmental advantages. Moreover, drying used properly can result in unique properties not achievable by other technological procedures.

One of the most important ways to reduce the adverse influence of drying on food quality or to ensure basic quality properties of the final product is to carefully design the process and implement it consistently (Lewicki, 2006).

Drying of agricultural products is an energy intensive process. High prices and shortages of fossil fuels have increased the emphasis on using alternative renewable energy resources, solar drying can be considered one of these alternatives and it is an efficient system of utilizing solar energy .The tropics and subtropics countries have abundant solar radiation.

Solar drying is a low cost technology. It is widely used, both commercially and at the household level. Solar driers shorten the drying time, better preserve food nutrients and withstand wind, rain and snow. Alongside, the solar drying improves energy efficiency and uses less or non polluting energy sources and it reduces environmental damage, solar drying shorten the drying time as compared to sun drying and reduced operational costs (Farkas, 2000; FAO,2001 and Sagar and Kumar, 2010). El Saebaii et al. (2002) used a natural convection locally made solar drier for drying fruits and vegetables such as seedless grapes, figs, green peas, tomatoes and onions. The experimental results showed good quality dehydrated products and shortest drying time. Mulokozi and Svanberg (2003) reported that the leafy vegetables dried in the solar drier retained more β-carotene than traditionally open sun-dried vegetables most probably due to the reduction of drying time and shielding from UV-radiation. Bala et al. (2005) reported that, the use of a solar tunnel drier led to a considerable reduction in drying time and better quality of dried jackfruit bulbs and leather in comparison to products dried under the sun. Paragati et. al (2011) reported that solar drying was more effective as compared to hot air oven drying method, in terms of quality and retention of vitamin C.

Fruit leather refers to fruit puree or a mixture of fruit juice concentrate and other ingredients which are cooked, dried on a non-sticky surface and rolled (Ashaye et.al, 2005 and Bryk, 2008). A variety of fruits can be used to produce leathers. Leathers have been developed from fruits such as guava, paw paws, jackfruits and durian. Fruit leathers are mainly eaten as snacks .They can, however, also be made into beverages by blending with water or into sauces. Fruit leathers can also be used as ingredients in products such as biscuits and breakfast cereals (Raab and Oehler 1999).

Therefore the objectives of this study were to assess the effect of two different drying methods (cabinet and solar dryers) on the quality characteristics and consumer acceptability of tamarind leathers.

Moisture content, texture, drying ratio, rehydration ratio, pH, titratable acidity and color will be evaluated since they are the most important quality parameters of fruit leathers that are usually affected by the drying methods.

MATERIALS AND METHODS

Samples preparation

Fully ripe tamarind fruits were purchased from the local market (Khartoum). Sorted, washed and soaked in distilled water (the ratio of water to tamarind fruits was 1: 4) for two hours and then passed through a pulper (Model: Reeves, size: IVIF-18) to get tamarind pulp. Fifteen percent of sucrose (by weight of tamarind pulp) was added to the recovered pulp and then the pulp was cooked in an open double jacketed kettle till it became puree (Mircea, 1995).

Drying of tamarind leathers

One kilogram of the tamarind puree was loaded on fabricated stainless steel drying trays with a solid base (51cm length x 39 x cm width x 3 cm depth). The tamarind leathers were dried in solar and cabinet driers. Solar drying was carried out using a prototype solar cabinet dryer (average drying temperature was 54±4°C). Drying in the cabinet dryer (Gallenkamp, Model, O. V – 160) was done at 70°C.

Physico-chemical analysis

Moisture, texture, color, rehydration ratio and pH of tamarind leathers were determined according to A.O.A.C, 2003 methods. While titratable acidity and drying ratio were determined according to Ranganna (2001).

Sensory evaluation

Four samples of tamarind juice were subjected to the sensory evaluation following the score scale method of 5 points as described by Ihekorony and Ngoddy (1985). Two samples were prepared from tamarind leathers dried by the two drying methods, the third one was purchased from the local market (traditional preparation) and the forth one was prepared from industrial tamarind concentrate (Sudanese food factory). Twenty six panelists from the Food Research Centre were asked to evaluate different samples of tamarind juice in terms of appearance, flavor, taste, after taste and overall acceptability. Scoring methods was conducted to compare different perceptions, then the sensory ratings were subjected to analysis of variance

(ANOVA) and the significance of mean differences was determined by the Duncan Multiple Range Test (DMRT) at $P \leq 0.05$ significance level as described by (Mead and Gurnow, 1983).

Statistical analysis

The data was statistically analyzed as for complete randomized design. The significance of mean differences was determined by the same method mentioned above.

RESULTS AND DISCUSSION

Moisture content and drying time

It was clear that drying temperature has a significant effect on reduction of moisture content and drying time (Figure 1). The tamarind leathers lost half of their moisture content in the first hour and after 11 hours when dried in cabinet and solar driers respectively. All tamarind leathers were dried to levels range of 5.52-7.95% moisture content. It was obvious that, the cabinet drier at 70°C was the fastest followed by solar drier at 54± 4ºC. Such an increase in drying temperature usually results in increase of vapor pressure inside the product forcing the moisture to move faster towards surface and this resulted into substantial reduction in drying time. These findings were also obtained by earlier workers (Abdalla, 2002; El Saebaii *et al.* 2002; Mulokozi and Svanberg 2003; Bala *et al.* 2005; Henriette *et al.*, 2006; Revaskar *et al.*, 2007; Mudgal and Pande, 2007; Demir and Sacilik ,2010 and Robin *et al* .,2012) for okra, fruits and vegetables, leafy vegetables, jackfruit bulbs and leather, mango leather, onion slices, cauliflower ,tomato slices and mango pulp respectively.

Quality of dried products

Table.1 shows the effect of different drying method on quality of tamarind leathers. There was a significant distinction ($P \leq 0.05$) in texture of different tamarind leathers produced. The tamarind leathers dried by cabinet drier were recorded the highest value for texture (3.29) while tamarind leathers dried by solar drier were recorded the lowest value (2.52). It was clear that the texture of the different tamarind leathers dried by different drying methods became tender as the drying temperature became low. The texture of fruit leathers is generally affected by their moisture content and drying temperatures (Che Man *et al*., 1997). Drying methods exerted a significant impact on the color of tamarind leathers. Tamarind leathers dried by cabinet dryer were darker (0.138±0.01) than that dried by solar dryer (0.043±0.03) and this may be due to influence of high drying temperature (Arslan and Özcan, 2010 and Suna et.al 2014).

Rehydration ratio for the solar dried tamarind leather was higher (1.78) than the one for cabinet (1.44) dried. These findings agreed with Jadhav et al. (2010) and Sahin et al. (2013) for dried green peas.

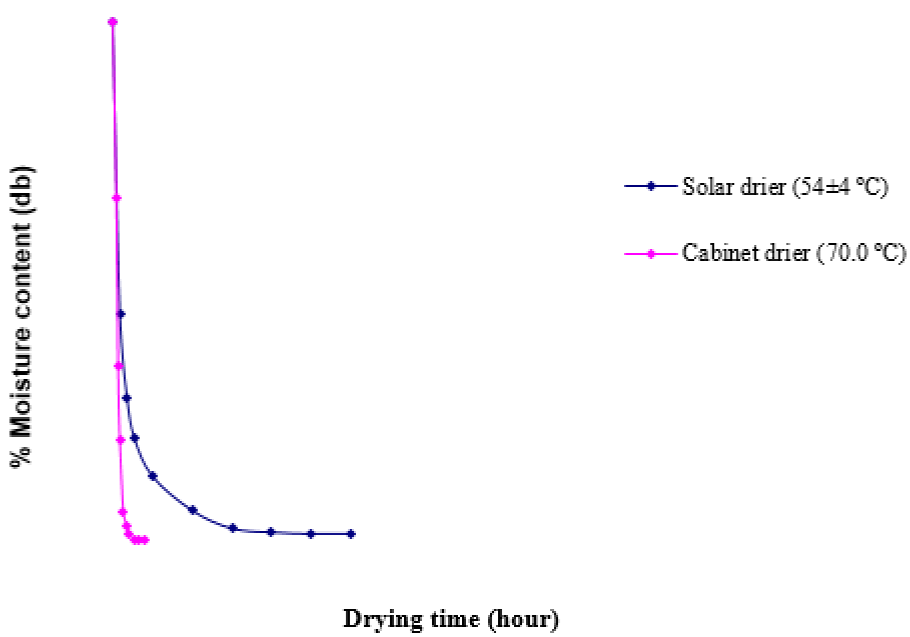

Figure (1) Variation in moisture content of tamarind puree as affected by drying method

Table 1. Effect of different drying methods on quality characteristics of tamarind leathers

Parameter	Drying system		S.E	L.S.D (5%)
	Cabinet drier	Solar drier		
Texture	3.29±0.31	2.52±0.36	0.336	0.762
Color	0.138±0.01	0.043±0.03	0.010	0.022
Rehydration ratio	1.44±0.16	1.78±0.26	0.214	0.484
Drying ratio	3.50±0.00	3.25±0.06	0.039	0.088
pH-value	2.78±0.03	2.81±0.03	0.029	0.067
Titratable acidity	6.86±0.03	7.83±0.39	0.274	0.622

Regarding drying ratio of tamarind leathers, there was significant slight decrease ($P \leq 0.05$) in drying ratio of tamarind leathers dried by the different drying methods. Tamarind leathers dried by cabinet drier gave the highest value of drying ratio (3.50), while tamarind leathers dried by solar drier gave the lowest value (3.25). It was obvious that as the drying temperature increased, the drying ratio increased (Abdel Rahman, 2011).

There were significant differences between the different tamarind leathers samples in the pH and the titratable acidity values. The pH values of tamarind leathers dried by cabinet and solar driers were 2.78±0.03 and 2.81±0.03 respectively. While the titratable acidity values (as malic acid) of tamarind leathers dried by cabinet and solar driers were 6.86±0.03 and 7.83±0.39 respectively. The increased in the acidity of tamarind leather dried by solar drier might be attributed to concentration of constituents during drying. Similar result has been observed during drying of kokum rind by (Hande *et.al*, 2014).

Consumer acceptability of tamarind leathers

Table 2 shows scores from organoleptic test run for tamarind juices prepared from cabinet and solar- dried leathers as well as from Sudanese food factory (industrial) and traditional ones.

There were significant differences ($P \leq 0.05$) in appearance among the different juices. Tamarind juice made from solar dried tamarind leather received the highest scores while tamarind juice made from cabinet dried leather received the lowest scores.

With respect to flavor, tamarind juice tamarind juice made from solar dried leather given the highest scores and the industrial tamarind juice was given the lowest scores. Also the taste of tamarind juice made from solar dried leather was superior in scoring compared to inferior scores given to industrial tamarind juice.

Regard to after taste character, although there were no significant differences ($P \leq 0.05$) between tamarind juice made from cabinet dried leather and traditionally prepared tamarind juice, tamarind juice made from solar dried leather remained the best and the industrial tamarind juice gave the lowest scores.

In general, it was apparent that tamarind juice made from solar dried leather was the most acceptable in overall preference followed by tamarind juice made from cabinet dried leather, then the juice traditionally prepared and least in quality the industrial processed juice.

Conclusion

The results presented in this study demonstrated the good quality performance of tamarind leathers dried by solar drier. Although it has the lowest drying time compared with the cabinet drier.

Table 2. Acceptability of tamarind juice prepared from tamarind leathers against control

Sample	Appearance	Flavor	Taste	After taste	Overall acceptability
Solar dried tamarind leather	3.69 ± 1.41^{a}	4.65 ± 1.41^{a}	4.30 ± 1.41^{a}	4.38 ± 1.41^{a}	4.19 ± 1.41^{a}
Sudanese food factory (Industrial)	3.15 ± 1.41^{c}	2.34 ± 1.41^{d}	2.19 ± 1.41^{d}	3.30 ± 1.41^{c}	2.57 ± 1.41^{d}
Cabinet dried tamarind leather	2.92 ± 1.41^{d}	4.07 ± 1.41^{b}	3.92 ± 1.41^{b}	3.80 ± 1.41^{b}	3.53 ± 1.41^{b}
Traditional juice (market)	3.46 ± 1.41^{b}	2.57 ± 1.41^{c}	2.84 ± 1.41^{c}	3.73 ± 1.41^{b}	3.03 ± 1.41^{c}
$Lsd_{0.05}$	0.151	0.151	0.151	0.151	0.151
SE±	0.038	0.038	0.038	0.038	0.038

Means ±SD bearing different superscript letters within a column are significantly different ($P \leq 0.05$).

Solar drying improved the color, texture and rehydration ratio of tamarind leathers. Also tamarind juice made from tamarind leather dried by solar dryer was acceptable as compared with the others tamarind juices.

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