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Effect of hydrocolloid on textural and sensorial quality of liquid jaggery based tamarind leather

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Abstract
The tamarind leather is confectionary accepted by all age groups, rich in minerals. The present investigation was carried out to find the effect of hydrocolloid on textural and sensorial quality of liquid jaggery based tamarind leather. Liquid jaggery in the tamarind leather gave product texture sticky. This stickiness could be removed by addition of hydrocolloid like guar gum and maltodextrin. Guar gum and maltodextrin in the leather was added in the proportion T_0 (0%), T_1 (0.5%), T_2 (1%), T_3 (1.5%) and T_4 (2%). The leather was prepared and well dried. The resultant leather was evaluated for its textural and sensory quality to decide the best quality leather, found that the leather with 1% guar gum and maltodextrin was found to be best for color and appearance, flavor, texture and overall acceptability.

Keywords: Tamarind leather, hydrocolloids, guar gum, maltodextrin, pectin

Introduction

Tamarind (*Tamarindus indica* L.) is a tropical fruit that belongs to the family Leguminosae (Fabaceae) and subfamily Caesalpinioideae. Tamarind is native to tropical Africa (Vuyyala *et al*., 2020) [23]. It is multipurpose tree of which almost every part finds at least some use, either nutritional or medicinal (El Sidding *et al*., 2006) [7].

India is world's largest producer of tamarind (Deokar *et al*., 2019) [6]. The tree mostly grows wild, although it is cultivated to a limited extent. The tamarind production in India is concentrated in the drier southern stated and the produce is collected by the villagers and sold in the open market. In some parts of India, it is naturally regenerated on wastelands and forest lands. Science ancient times, India has been exporting processed tamarind pulp to western countries and more recently to the United States of America. The annual export of tamarind to the US exceed 10,000 tonnes earning about 100 million Indian rupees. In India, the area and production of tamarind is 59 thousand ha and 188 thousand MT in the year 2014-2015, respectively (Anon, 2014) [2]. Nutritional composition of tamarind leather fruit varies considerably. The tamarind fruit contains about 55% pulp and 34% seeds, and shell and fiber. The fruit is a good source of calcium, thiamin and niacin, but contains small amount of vitamin A and C. The most outstanding characteristics of tamarind is its most acidic nature with total acidity range varying from 12.2 to 23.8% as tartaric acid (Morton, 1987; Chapman, 1984 and Persueglove, 1987) [10, 4, 15]. Chemical composition of tamarind pulp of variety Ajanta was TSS 27 ^{0}Brix, pH 2.6, acidity 1.5%, tartaric acid 1.8%, reducing sugar 17.7%, total sugar 38.8% and ascorbic acid 3.9% (Joshi *et al*. 2013) [9].

Fruit pulps are mixed with appropriate quantities of sugar, pectin, acid and color the dried into sheet shaped products, added sugar and pectin to mango leathers. The sugar gave the product a sweeter taste and increased the solids content; then pectin was used to thicken the pulp, modify the flexible texture and ensure the retention of the shapes of the dried products (Gujral and Brar, 2003) [24].

Liquid jaggery is an important intermediate product obtained during the preparation of jaggery from sugarcane juice. Liquid jaggery is having additional nutritional components which are having wide spectrum of medicinal properties and hence, it is a good nutraceutical. Liquid jaggery is incorporated in many traditional foods and ayurvedic medicinal compositions (Rajendran *et al*., 2020) [16]. Liquid jaggery is a versatile product finding used in various food compositions as that of honey (Nath *et al*., 2015) [11]. India is the largest producer of jaggery in the world and has the share of more than 70% of world production (Rao *et al*. 2007) [17].

Fruit leather, also called a fruit bar or a fruit slab, is dehydrated fruit-based confectionary dietary product which is often eaten as snack or dessert. It is made by drying a very thin layer of fruit puree and other ingredients in cabinet drier in the form of leathery sheets (Andress and Harrison, 1999) [1]. Hydrocolloids are important in maintaining desired texture of fruit leathers. They have been used as gelling or thickening agents capable of binding water molecules, thereby enhancing the desired textural properties of foodstuffs (Rascón-Díaz *et al*., 2012) [18]. Instrumental textural characteristics of fruit leather are measured to match with the desired characteristics when different types of hydrocolloids are used (Gujral and Brar, 2003) [24]. Instrumental Texture Profile Analysis showed that high water content increased cohesiveness and decreased springiness of pear fruit leather (Huang and Hsieh, 2005; CheMan and Taufik, 1995) [8, 5]. Hardness of mango and guava leathers decreased with the increase of moisture content (Vijayanand *et al*., 2000) [21]. Puncture force of mango leather decreased with the increase in water content due to water absorption during storage (Azeredo *et al*., 2006) [3]. It was observed that using higher pectin content resulted in higher hardness, cohesiveness, springiness, and chewiness of pear fruit leather; however, the addition of corn syrup caused softening of the fruit leathers (Huang and Hsieh, 2005) [8]. Cellulose increased hardness more as compared to pectin in the leather containing both starch and cellulose (0.5 and 1% concentration), whereas starch lowered hardness as compared to cellulose in the leather containing both pectin and cellulose or starch (1.0% concentration). Tensile strength increased considerably with increasing pectin content and the same was true for increasing glucose syrup content in kiwi fruit leather (Vatthanakul *et al*., 2010) [20], and strawberry fruit leather (Ratphitagsanti, 2004) [19].
Hence present investigation, the efforts has been made to prepare liquid jaggery based tamarind leather from Ajanta variety with different levels of hydrocolloids.

Materials and Methods

Materials: An experiment entitled 'Effect of Hydrocolloid on Textural and Sensorial Quality of Liquid Jaggery Based Tamarind Leather' was carried out in the Department of Food Chemistry and Nutrition, College of Food Technology VNMKV Parbhani.
Ingredients used in the preparation of leather *viz.* tamarind, liquid jaggery, pectin, citric acid, guar gum and maltodextrin and packaging material HDPE bags were procured from local market.

Methods

Preparation of tamarind pulp: Tamarind pulp was prepared as per the methods given by Joshi *et al*. (2013) [9].
Fresh sound quality ripe, mature tamarind fruit were selected. These fruits were cleaned by removing shell, rags and seeds. Once tamarind pods were washed with water to remove any foreign particle. Water in the ration with flesh 1:2 was added.
This was heated to 70 °C for 10 minutes and soaked for 6 hours. After soaking process maceration and straining process was carried out to obtain tamarind pulp. Tamarind pulp was filtered through a 1mm filter sieve.

Preparation of tamarind leather

Tamarind leather was prepared as per process standardized by Pavani *et al.* (2022) [14] with slight modification. The puree for drying was prepared by mixing 100 grams of tamarind pulp with 30 grams of liquid jaggery, 0.4 grams of citric acid, 1 grams of pectin and 2 grams of funnel seeds extract stirred continuously till all ingredients distributed uniformly. Quantity of guar gum and maltodextrin was varied according to treatment given in the Table 1.
The puree was then heated to 90 °C for 10 min. Then the puree was poured into aluminium trays smeared with glycerin. Dried the sample in cabinet tray dryer at 65±5 °C for 12 hours. Samples were removed from dryer, cut into pieces and packed in HDPE bags.

Table 1: Formulation of recipe of tamarind leather at different level of guar gum and maltodextrin

Ingredients	Control (T_0)	T_1	T_2	T_3	T_4
Tamarind pulp	100	100	100	100	100
Liquid Jaggery	30	30	30	30	30
Citric acid	0.4	0.4	0.4	0.4	0.4
Pectin	1	1	1	1	1
Guar gum	0	0.5	1	1.5	2
Maltodextrin	0	0.5	1	1.5	2
Funnel Seed Extracts	0	2	2	2	2

Sensorial evaluation of tamarind leather

Leather was evaluated for sensory characteristics like color, flavor, texture and overall acceptability by semi trained panel members on a 9-point Hedonic Scale with corresponding descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely'.

TPA analysis of tamarind leather

There are certain parameters of food which play crucial role in judging the consumer acceptability. Texture is considered as most crucial properties of leather which can be judged on the basis of hardness, stickiness, chewiness, cohesiveness etc. these properties helps in determining the amount of force required to chew/bite the piece of fruit leather during mastication.

Texture analysis was performed using texture analyzer (Single arm texture analyzer TA-XT Plus, Stable Micro Systems, Surrey, UK) with a load cell of 2 kg weight. A force versus time curve for a two-cycle compression was measured, with a disk probe (of 35mm diameter) and at a displacement speed of 10 mm/min. In built software of the texture analyzer was used for analyzing the data generated.

Table 2: Set parameters of TAX-T2 plus texture analyzer

Test mode	Compression
Pre-test speed	1 mm/sec
Test speed	5 mm/sec
Post-test speed	5 mm/sec
Target mode	Distance
Distance	10 mm
Time	5 sec

Statistical analysis

The obtained data in the present investigation was statistically analyzed. The analysis of variance of the data obtained was done by using completely Randomized Design (CRD). The analysis of variance revealed at significant of $p<0.05$ level, S.E. and C.D. at 5% level were mentioned whenever required.

Result and Discussion

Effect of hydrocolloids on sensorial quality of tamarind leather

The hydrocolloids at various levels *viz*. 0, 0.5, 1, 1.5% were used in preparation of tamarind leather and results were obtained are presented in Table 3.

Table 3: Effect of hydrocolloids on sensorial quality of tamarind leather

Treatment	Color and Appearance	Texture	Taste	Flavor	Overall Acceptability
Tg_0	8.3	7.1	8.3	8.3	7.9
Tg_1	8.2	7.5	8.2	8.3	8.0
Tg_2	8.2	8.3	8.2	8.2	8.2
Tg_3	8.1	8.1	8.2	8.2	8.0
Tg_4	8.1	8.0	8.0	8.0	8.0

*Each value is average of three determinations

Color and appearance

When evaluating a product's quality and consumer acceptability, color is a crucial factor. Table 3 shows that the leather's color and appearance were essentially the same for every treatment. Samples Tg_0, Tg_3, and Tg_4 have hedonic ratings of 8.3, 8.1, and 8.2, respectively, on the scale, while samples Tg_1 and Tg_2 have hedonic ratings of 8.2, which is considerably higher than the other treatments. It is important to remember that a greater hydrocolloid content is undesirable for color, as the sensory rating drops from 8.3 to 8.1.

Texture

The addition of maltodextrin and guar gum to the product affected its textural qualities, resulting in why sample Tg_2 (8.3) received the highest hedonic score. Texture scores of Tg0 (7.1), Tg_1 (7.5), Tg_3 (8.1), and Tg_4 (8.0) are hedonic. Because the T_1 sample combines the benefits of maltodextrin and guar gum, it received the highest score. The hard texture of the leather caused the texture to drop from Tg_3 to Tg_4.

Taste

Owing to a lower concentration of guar gum and maltodextrin, Tg_0 was found to have the best taste score, followed by Tg_1, Tg_2, Tg_3, and Tg_4. A maximum of 1% of maltodextrin and guar gum was permitted; any amount above that was not because it would adversely affect the flavor characteristics.

Flavor

Up to 1%, it was discovered that the average flavor score for leather treated with guar gum and maltodextrin at various levels-0, 0.5, 1, 1.5, and 2 was relatively similar. The treatment with the highest percent of maltodextrin and guar gum received the lowest score (8.0).

Overall Acceptability

Furthermore, it was possible to see that the sample Tg_2 (8.2) performed exceptionally well when compared to the control and all other samples. This suggests that the total acceptability of leather may be raised by adding up to 1% more guar gum and maltodextrin, whereas the total acceptability may be lowered by adding more than 1%. These outcomes were similar to those of Patil *et al*. (2017) [13] in terms of the quality characteristics of fruit leather derived from date and mango.

Texture Profile Analysis of Tamarind Leather

Texture is a major factor in deciding whether or not customers are ready to accept the developed product. Using a Texture Analyzer, the textural characteristics of the tamarind leather were measured in relation to hardness, cohesiveness, springiness and gumminess.

Table 4: Texture profile analysis of tamarind leather

Sample	Parameters			
	Hardness (kg)	Cohesiveness (g/sec)	Springiness (mm)	Gumminess
Tg_0	52.1	1.023	0.874	78.8
Tg_1	54.6	1.032	0.877	80.3
Tg_2	57.3	1.244	0.910	82.4
Tg_3	60.2	1.346	0.987	85.5
Tg_4	62.2	1.508	0.998	87.1

The data presented in Table 4 demonstrated that adding hydrocolloids, such as maltodextrin and guar gum, to tamarind leather could make it harder. Sample Tg_4 (62.2 kg) had the highest hardness, whereas sample Tg_0 had the lowest hardness due to the complete absence of hydrocolloids.

According to data revealed in Table 4, the springiness test results for tamarind leather ranged from 0.874 to 0.998 mm. The extremely low springiness value indicates that once force is applied to the tamarind leather, it does not return to its original state. The outcomes closely matched the findings of Parn *et al*. (2015) [12], who noted that both varieties of date bars had low springiness values, with values falling below 1. This suggests that because of their low cohesiveness, leather can be chewed on easily.

With respect to gumminess, guar gum and maltodextrin affects the gumminess of tamarind leather with value Tg_0 (78.8) to Tg_4 (87.1).

Conclusion

It can be concluded that hydrocolloids guar gum and maltodextrin addition in the tamarind leather was accepted up to 1% by sensory attributes. This could be result in the production of high quality tamarind leather with less stickiness problem as well as better quality product with respect to color, flavor, taste, texture and overall acceptability.

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