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Optimization of Value Added Products from under-Utilized Tamarind Kernel Powder

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To develop value added products from Tamarind kernel powder (TKP).
Place and Duration of Study: Department of Food Science and Nutrition, Community Science College and Research Institute, Madurai.
Methodology: The nutritional value of TKP and the potential of TKP as a food additive were investigated. The TKP and commercial additives were experimented under the refrigerated and room temperature for their viscosity properties in order to identify the potential of TKP as a thickening agent. Standardization for the level of incorporation was done in Mango smoothie using TKP as thickening agent in the rate of T_1-0.25%, T_2-0.50%, T_3-0.75%, T_4-1.00%.
Results: The performance of TKP as thickening agent was not considerably higher. Its performance was not significantly higher on comparison with commercial thickening agents. Xanthan gum ranked high among all the additives in terms of thickening property. Among the different incorporations of tamarind kernel powder T_4 performed best in terms of viscosity.
Conclusions: The results indicate that TKP have poor thickening property. To improve this property the TKP can be subjected to structural modification and isolation of polysaccharide which

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would yield better results. TKP as a food additive replacing conventional food additives will be a great boom to the food industry. There will be increase in anti-oxidant and phytochemical property of the resultant product.

Keywords: Tamarind Kernel Powder (TKP); protein; value addition; phytochemicals.

1. INTRODUCTION

Tamarindus indica L is a significant leguminous tree distributed throughout India. Regarding its production worldwide, India is the leading player producing about 191750 tonnesof tamarind annually [1]. The tree is quoted as a multi-functional tree as all its parts finds its application in industries ranging from feed to food industry, but the primary importance is given for its fruit. The major constituents of tamarind fruit are pulp and seed which constitutes 30% and 40% by weight respectively. The pulp and seed of the fruit are connected by fiber network. The pulp of the Tamarind tree is mainly incorporated as a spice in the Asian culinary.

Tamarind seed, a by-product of tamarind pulp industry is the most underutilised and undervalued product of the industry. It possesses good nutritional profile with increased level of protein [15.0% –20.9%] & fat [3.9%-16.2%] [2] and it is phytochemical rich with increased level of phenolic antioxidants.

The seed on processing into Tamarind kernel powder (TKP) finds various applications in the food industry. Decorticated tamarind kernel powder has about 46-48% of gel forming substance. The seed gum extracted from TKP can be used as food additive in form of gelling agent [3,4] bulking agent [5,6] thickening agent [7]. The oligosaccharide isolated can be used as low calorie sweetener in cookies, dairy desserts, chewing gum [8].

In the view of health effects of *Tamarindus indica* seeds they have a protective role against peptic ulcer which is attributed by the presence of polyphenolic compounds which act as antioxidant [9]. Owing to the anti-oxidant property, the tamarind seed extracts also play a role in being an anti-cancer agent [10], anti-diabetic and anti-thrombogenic agent.Despite being nutritional and nutraceutical rich and also possessing food additive properties there is a lag in consumption of tamarind seeds. The processing difficulties in decorticating seeds and lack of awareness among the processors may attribute the lack of usage. The present study aims to exploit the usage of tamarind kernel powder as a thickening agent in Mango smoothie.

2. MATERIALS AND METHODS

2.1 Raw Material

The tamarind seed samples were procured from local market in Madurai, Tamil Nadu, India.

2.2 Tamarind Seed Processing

The tamarind seeds were sand roasted at 180°C for 3-5 minutes to facilitate the decortication process. The dry heat method creates a temperature gradient between seed coat and kernel thereby enhancing the efficiency of decortication process. After sand roasting the seeds were hand pounded for the removal of seed coat. The process was followed by winnowing to separate the seed coat. The dehulled seeds were pulverised in flour mill. Tamarind kernel powder was then sieved using 80 mesh size for getting the resultant product with minimum variation. The powder was stored in an air-tight container for further usage.

2.3 Proximate Composition

The AOAC (2000) methods were used to determine moisture, fat, protein, fibre, ash and carbohydrate content of tamarind kernel powder.

2.4 Standardisation of Smoothie

The potential of TKP as a food additive was investigated by using TKP as thickening agent in the rate of 0.25%, 0.50%, 0.75%, 1.00% incorporation in mango smoothie.

2.5 Physiochemical Properties Measurement

2.5.1 Viscosity measurement

The viscosity of the mango smoothie was measured using 1-1 coaxial cylinder Brooke field viscometer (DFT Tech, Chennai, Tamil Nadu). The viscosity was measured using spindle number-64 at room and refrigerated temperature- 26°C and 11°C.

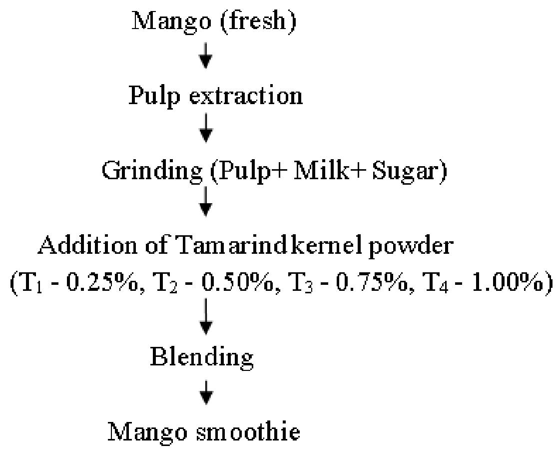

Chart 1. Mango smoothie

2.5.2 Colour value measurement

Colour measurement (L* a* b* values) of Mango smoothie was determined using a Hunter chromometer with the Lovibond RT Color software (Version 3.0).

2.6 Sensory Evaluation of Mango Smoothie

The sensory evaluation was done to measure the degree of acceptability for each treatment. The parameters like color and appearance, texture, flavor, taste and overall acceptability were evaluated on 9 point Hedonic scale by a group of 30 semi-trained panelists.

2.7 Statistical Analysis

The statistical analysis was performed by AGRES-AGDATA for one way analysis of variance. The results are the average of the four replicates and its Standard deviation.

3. RESULTS AND DISCUSSION

3.1 Proximate Composition of Tamarind Kernel Powder

The proximate analysis includes the estimation of moisture, carbohydrate, protein, fat, fibre and ash content of tamarind kernel powder.

As stated in Table 1, the moisture of tamarind kernel powder was found to be 5.55%. Akajiaku [11] stated that the moisture content of roasted tamarind seed was found to be 8%. The carbohydrate and protein content of the tamarind kernel powder was found to be 45 g/100 g and 19.50 g/100 g respectively. Rana (2018) [12] stated that the carbohydrate and protein content of the whole tamarind seed was found to be 49.5 g/100 g and 14 g/100 g respectively.

Table 1. Proximate composition of tamarind kernel powder

Chemical constituents	Result
Moisture (%)	5.55 ±0.003
Carbohydrate (g/100 g)	45 ± 0.265
Protein (g/100 g)	19.50 ± 0.379
Fat (g/100 g)	5.84 ± 0.137
Ash (g/100 g)	2 ± 0.056
Fiber (g/100 g)	7.2 ± 0.178

The fat, ash and fiber content of the Tamarind kernel powder are 5.84 g/100 g, 2 g/100 g and 7.2 g/100 g respectively. Akajiaku [11] stated that fat, ash and fiber content of the roasted tamarind seeds are 6.80 g/100 g, 4.55 g/100 g and 6.30 g/100g respectively.

3.2 Viscosity of Mango Smoothie

3.2.1 Comparative analysis of viscosity of TKP with commercial additives

The comparison of thickening property of TKP with commercial additives at room and refrigerated temperature is presented in Table 2. The viscosity of TKP at room and refrigerated temperature was found to be 80.4± 1.09 cP and 86.4 ± 0.17cPrespectively. The values were close to control whose viscosity at room and refrigerated temperature was found to be 72 ±2.23 cP and 80.6±2.24c Prespectively indicating the less efficacy of the TKP.

Xanthan gum performed best among all the additives ranging which increased the viscosity to 720.2 ±18.62 cP and 300.8±1.02 cP at room and refrigerated temperature respectively. It was observed that there was a higher difference in room and refrigeration temperatures in the thickening property of Xanthan gum. The other gums had a minimum difference in thickening property in room and refrigerated temperatures, but the thickening property of Tamarind kernel powder is unaffected by temperature. The performance of TKP was very low when compared to the other commercial thickening agents.

3.2.2 Effect of tamarind kernel powder on viscosity of smoothie

The effect of tamarind kernel powder on viscosity of smoothie with different levels of treatment: T_1 - 0.25%, T_2 - 0.50%, T_3 - 0.75%, T_4 - 1.00% is furnished in Table 3. The difference was found in the treatment T_4 - 1.00% with viscosity being 69.60±0.42 cP. The other treatments which are the increasing incorporation of Tamarind kernel powder did not show up considerable difference in the viscosity.

3.3 Effect of Tamarind Kernel Powder on Color Value of Mango Smoothie

The effect of tamarind kernel powder on viscosity of smoothie with different levels of treatment: T_1 - 0.25%, T_2 - 0.50%, T_3 - 0.75%, T_4 - 1.00% is given in Table 4. The color value increased with the increasing level of incorporation of Tamarind kernel powder with the treatment T_4 being the highest value. Natkunda (2015) stated that there was a color variation in different levels of incorporation of tamarind kernel powder in Mango juice. On addition of tamarind kernel powder to the mango juice, its color ranged from pale yellow to dull orange.

3.4 Sensory Evaluation of Mango Smoothie

The sensory evaluation by the untrained panelists of 15 members revealed scores showing T_1 performed best among all the treatments. It had a score of about 8 in terms of overall acceptability which is more likely to be the acceptable level. With the increasing level of incorporation of Tamarind kernel powder the panelists interpreted that the kernel powder gives a nutty flavor and T_4 has been interpreted by the panelists to give higher texture to the smoothie. It is evident from Fig. 1 that with the increasing concentration of tamarind kernel powder the acceptability of the smoothie has decreased.

Natukunda [13] reported that with the increase in incorporation of tamarind kernel powder in mango juice there was a decrease in sensory acceptability. They have also interpreted that there was an astringent flavour noted in the highest level of incorporation of tamarind kernel powder in mango juice (2.5%).

Table 2. Comparison of thickening property at room and lower temperature

Type	Centi-poise (cP)		% (torque)	
Temperature	**26ºC**	**11ºC**	**26ºC**	**11ºC**
Control	72 ±2.23^a	80.6±2.24^a	5.9±0.05^a	6.6± 0.2^a
Carrageenan	182.4±4.59^c	220.8±5.55^d	15.3±0.23^d	18.4± 0.3^d
Pectin	116.4 ±1.85^b	123.6±2.47^c	9.6±0.2^c	10.3 ±.01^c
Xanthan	720.2 ±18.62^d	300.8±1.02^e	60.5±0.16^e	24.9± 0.2^e
TKP	80.4 ±1.09^a	86.4 ±0.17^b	6.6±0.18^b	7.2 ±0.22^b

Values are means of 4 replicates. Means in the same column followed by different superscripts are significantly different at P<0.05

Table 3. Comparison of viscosity of smoothie with different treatments

Type	Centi-poise (cP)	% (torque)
Control	52.80±0.80^a	4.4±0.04^a
T1 (0.25%)	55.20±0.15^b	4.4±0.04^a
T2 (0.50%)	58.60±1.19^c	4.4±0.07^a
T3 (0.75%)	60.80±0.70^d	4.9±0.03^b
T4 (1.00%)	69.60±0.42^e	5.6±0.07^c

Values are means of 4 replicates. Means in the same column followed by different superscripts are significantly different at P<0.05

Table 4. Comparison of color value of mango smoothie

Type	L	a	b
Control	129.4 ± 0.45[abc]	6.18 ± 0.06[b]	45.31 ± 0.96[b]
T1 (0.25%)	125.36 ± 2.04[a]	9.81 ± 0.04[a]	28.10 ± 0.63[a]
T2 (0.50%)	136.74 [d]	5.77 ± 0.01[c]	47.02 ± 0.67[c]
T3 (0.75%)	132.44 ± 0.54[c]	8.43 ± 0.27[d]	45.26 ± 0.64 [b]
T4 (1.00%)	138.83[e]	4.53 ± 0.13[e]	55.20 ±1.57[d]

Values are means of 4 replicates. Means in the same column followed by different superscripts are significantly different at P<0.05

Table 5.Sensory score of mango smoothie with different treatments

Attributes	C	T1	T2	T3	T4
Color& Appearance	8	9	8	7	6
Texture	7	7	7	8	8
Flavor	8	8	8	6	6
Taste	8	7	7	6	6
Overall acceptability	*8*	*8*	*7*	*6*	*6*

C-Control T_1 - 0.25%, T_2 - 0.50%, T_3 - 0.75%, T_4 - 1.00%

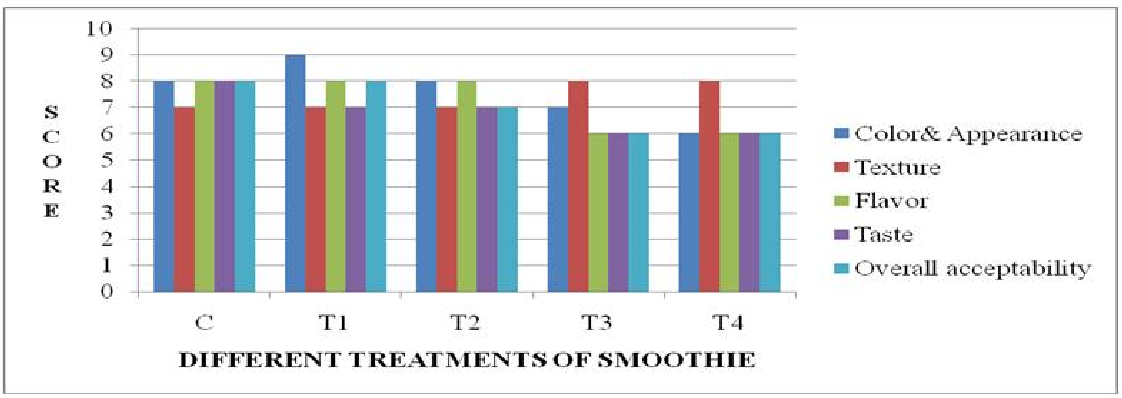

Fig. 1. Comparison of sensory scores of different treatments of mango smoothie
C-Control T_1 - 0.25%, T_2 - 0.50%, T_3 - 0.75%, T_4 - 1.00%

4. CONCLUSION

Comparing TKP with commercial additives revealed that its thickening property is considerably very low. Using TKP as thickener in smoothie, the increase in viscosity was not significantly higher. Considering the poor thickening action of TKP, it can be suggested that structural modification and isolation of polysaccharide from TKP may be experimented for better results. TKP as a food additive replacing conventional food additives will be a great boom to the food industry. There will be increase in anti-oxidant and phytochemical property of the resultant product.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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