*Madras Agric.J.,* 2018; doi:xxxxxxxxx

# 1 RESEARCH ARTICLE

2

# 3 An Avant-Garde for Value Addition of Undervalued Tamarind Kernel Powder

4

5

## ABSTRACT

Tamarind kernel is a typical under-emphasized by product of tamarind pulp industry. The kernel is a fair source of protein, fat (essential fatty acids), carbohydrates and minerals which attributes its potential to replace conventional flour to develop new food produts. In addition to its nutraceutical rich properties, the polysaccharides from the tamarind kernel flour have the potential to be used as food additive. The tamarind kernel flour posses nutrient dense and nutraceutical rich natures, yet there is a fallback in consumption of tamarind kernels. The study aims to exploit the under- utilized tamarind kernel for value addition to improve the acceptability and consumption of tamarind kernel based food products.

6

7 Keywords: *Tamarind kernel flour; Protein-rich legume; Under-utilized legume; Low cost;Cookies* 8

## INTRODUCTION

1. Tamarind, an evergreen, leguminous and multipurpose tree belongs to the family of Fabaceae. Annually,
2. there is wastage of 1,00,000 tones of tamarind kernel fm 2,50,000 tones of Tamarind pulp (Singh *et al*.,
3. 2007). The major area of production including Asian countries mainly Thailand, India, Bangladesh and
4. Srilanka. India is the leading player in production and consumption of Tamarind (Shankaracharya., 1998).
5. Tamarind kernel is nutritionally abundant which contains higher levels of protein content particularly
6. high levels of essential amino acids. Apart from the legumes, iit can be used to address the protein energy
7. malnutrition. The tamarind kernel is a rich in carbohydrate content. The polysaccharide isolated from tamarind kernel
8. possesses excellent thickening property. The tamarind kernel is also a good source of minerals like calcium,
9. phosphorus and magnesium. The phytochemical profile of the tamarind kernel exhibits its potential sources of
10. antioxidant (Siddhuraju., 2007), anti-diabetic, anti-stress (Razali *et al*., 2015) and antihyperlipidemic components (Maiti 20 *et al*., 2005).
11. There is an increases demands for value addition from waste products of food processing industries
12. (Balasundram *et al.*, 2006). Tamarind kernel possess nutritional, nutraceutical and medicinal value which
13. serves as an important source for value addition in food products. The study aims to value add the tamarind kernel by
14. pulverizing it into tamarind kernel flour and replacing the conventionally used flour with tamarind kernel
15. flour. The changes during the storage of the tamarind kernel incorporated cookies were evaluated. What are the results?

## **MATERIAL AND METHODS**

1. ***Raw material collection***
2. The tamarind kernels were procured from the local market in Madurai, Tamil Nadu, India.
3. ***Sample preparation***
4. The tamarind kernels were sand roasted to easen the dehulling process. The dry heat method creates a
5. temperature difference between the outer hull and kernel thereby enhancing the efficiency of dehulling
6. process. After sand roasting the kernels were hand pounded and followed
7. by winnowing to separate the kernel coat. The dehulled kernels were pulverised in flour mill to obtain the kernel powder.
8. Tamarind kernel powder was then sieved using No. 80 mesh size for getting the resultant product with
9. uniform sized powder. The powder was stored in an air-tight container for further use (Sultana *et al.,* 2020).
10. ***Formulation and preparation of cookies***
11. The The composite blends of refined wheat flour and tamarind kernel flour were used
12. to obtain control and tamarind kernel incorporated cookies, respectively. The formulation for cookies is shown in
13. Table 1. The ingredients used in cookies are enlisted in Table 2. 40
14. ***Nutritional analysis of cookies***
15. The proximate analysis namely moisture, carbohydrate, crude protein, crude fat, crude fiber and ash were analysed as per the method of Association of Official Analytical Chemists (AOAC, 2000) .
16. The changes in the above
17. parameters of developed cookies were analysed in initial and end of 45 days of storage at room condition by using different packaging materials such as High Density Polypropylene
18. packages (P1) and Stand-up pouches (P2).
19. ***Statistical analysis***
20. The factorial completely randomized design was adopted for analysis to study the impact of packaging
21. materials, treatments and storage period on the quality of cookies.

## **RESULTS AND DISCUSSION**

1. ***Cookies analysis***
2. ***Moisture***
3. The percentage of the moisture content for developed cookies was given in Table 3. The initial moisture content of
4. control (T0) and tamarind kernel incorporated cookies (T1) was 2.45 and 1.62% respectively in both
5. P1P2. The final moisture content of
6. T0 T1 were 3.08% and 1.79%, respectively in High Density
7. Polypropylene packages and 2.60 and 2.02%, respectively in Stand-up pouches. The highest
8. moisture content was recorded in developed cookies packed in High Density Polypropylene packages at the end of storage days. Statistically, the storage
9. period, treatments and packaging materials had impact on moisture content of the cookies.
10. Akbar (2018) recorded that the initial moisture content of the cookies made from wheat flour (control) was
11. 3.20% and the final moisture content of cookies [after 90 days of storage] was
12. 3.28%. The initial moisture content of cookies made from wheat flour and maize flour was 3.23% and
13. the final moisture content of cookies [after 90 days of storage] was 63 3.31%.....
14. ***Carbohydrate***
15. The percentage of the carbohydrate content of cookies is given in Table 4. The carbohydrate
16. content of control (T0) and tamarind kernel incorporated cookies (T1) was 66.23% and 72.52% respectively
17. in both the packaging materials at initially. There was a
18. decreasing trend in carbohydrate content in both the control and tamarind kernel flour incorporated
19. cookies in both the packaging materials at the end of storage days. Statistically, the storage period, treatments and packaging
20. materials had impact on carbohydrate content of the developed cookies.
21. ***Crude protein***
22. The percentage of the protein content of developed cookies was given in Table 5. There was a decreasing
23. trend in the protein content of both control and tamarind kernel incorporated cookies. Stand-up pouches
24. proved to be better in terms of retention of protein content of the cookies when compared to the High
25. Density Polypropylene packages -. Statistically, the storage period, treatments and packaging materials
26. had impact on protein content of the cookies.
27. ***Crude fat***
28. The percentage of the fat content of developed cookies was given in Table 6. There was a decreasing trend in
29. fat content of cookies in both the packaging materials but the highest loss was recorded in High density
30. polypropylene packages (P1). Statistically, the storage period, treatments and packaging materials had
31. impact on fat content of the developed cookies.
32. The data analyzed showed similarity to the work carried out by Waheed *et al.,(*2010) which
33. reported the fat content of cookies made with inter-esterified fat was 22.87% initially and 21.69% after 45
34. days of storage.
35. ***Crude fiber***
36. The percentage of the fiber content of developed cookies was given in Table 7. The initial fiber content of
37. control and tamarind kernel incorporated cookies was 0.95% and 3.25% respectively in both High
38. Density Polypropylene packages and Stand-up pouches. The final fiber content of control and
39. tamarind kernel incorporated cookies was showed 0.89% and 3.19% respectively in High Density
40. Polypropylene packages and 0.90% and 3.19% respectively in Stand-up pouches. Statistically, the
41. storage period, treatments and packaging materials had impact on fiber content of the cookies.
42. ***Ash***

93

The percentage of the ash content of cookies was given in Table 8. The initial ash content of control

1. andtamarind kernel incorporated cookies were 0.65% and 1.12% respectively in both High
2. Density Polypropylene packages and Stand-up pouches. The final ash content of control (T0) and
3. Tamarind kernel incorporated cookies (T1) was 0.58% and 1.08% respectively in High Density
4. Polypropylene packages and 0.61% and 1.7% respectively in Stand-up pouches at the end of 45 days of storage.
5. The data analyzed showed similarity to the work carried out by Waheed *et al.,(*2010) which
6. reported the fat content of cookies made with inter-esterified fat was 0.64 % initially and 0.52% after 45
7. days of storage.
8. **CONCLUSION**
9. The value addition of tamarind kernel in form of cookies yielded best results in terms of
10. nutrient density. The storage studies revealed that there is minimal loss in Stand-up pouches when
11. compared to High density polypropylene packages. The value added products from tamarind kernel flour
12. could gain good recognition in food industries. Thus value addition of underutilized tamarind kernel would
13. reap benefits to both the grower in terms of increased income and consumer in terms of increased
14. nutritional value.
15. **Consent for publication**
16. All the authors agreed to publish the content.
17. **Competing interests**
18. There were no conflict of interest in the publication of this content

## **REFERENCES**

1. Akbar, K. and M. Ayub. 2018. Effect of storage on the quality of wheat and maize based cookies. *Sarhad*
2. *Journal of Agriculture,* **34(3):** 606-615.
3. Association of Official Analytical Chemists (AOAC). 2000. *Official Methods of Analysis of*
4. *AOAC.*International, 17th ed.; AOAC International: Gaithersburg, MD, USA,
5. Balasundram, N., Sundram, K. and S. Samman. 2006. Phenolic Compounds in Plants and Agri-Industrial
6. by Products: Antioxidant Activity, Occurrence, and Potential Uses. *Food Chemistry*, 99: 191-203.
7. Maiti R, Jana D, Das UK and D.Ghosh. 2004. Antidiabetic effect of aqueous extract of seed of *Tamarindus*
8. *indica* in streptozotocin-induced diabetic rats. *J Ethnopharmacol* , 92:85–91.
9. Razali, N., Junit, S.M., Ariffin, A., Ramli, N.S.F and A.A Aziz.2015. Polyphenols from the extract and fraction
10. of *T. indica* seeds protected HepG2 cells against oxidative stress. *BMC Complementary Alternative*
11. *Medicine*, 15: 438.
12. Sarabhai, S., D. Indrani, M. Vijaykrishnaraj, V. Milind, A. Kumar and P. Prabhasankar. 2014. Effect of
13. protein concentrates emulsiﬁers on textural and sensory characteristics of gluten-free cookies and its
14. immunochemical validation. *J. Food Sci. Tech,* 14(1): 1432-1438.
15. Siddhuraju, P. 2007. Antioxidant activity of polyphenolic compounds extracted from defatted raw and dry
16. heated *Tamarindus indica* seed coat. *LWT - Food Science and Technology*, 40: 982-990.
17. Singh D., Wangchu L. and S.K Moond. 2007. Processed products of tamarind. *Nigerian Product Radiance.*, 130 6(4): 315-321.

131 Shankaracharya N B.1998. Tamarind – Chemistry, Technology and Uses – a critical appraisal. *Journal of*

132 *Food Technology*, 35(3): 193–208.

1. Sultana, B. F., Vijayalakshmi, R., Geetha, P. S., and M. L. Mini. 2020. Optimization of Value Added Products
2. from under-Utilized Tamarind Kernel Powder. *European Journal of Nutrition & Food Safety*, *12*(11): 20-25.
3. Waheed. A., G. Rasool and A. Asghar. 2010. Effect of interesterified palm and cottonseed oil blends on
4. cookie quality. *Agric. Bio. J. N. Am,* 1(3): 402-406.
5. TABLE 1: FORMULATION OF COOKIES

|  |  |  |
| --- | --- | --- |
| Treatment | Refined wheat flour (%) | Tamarind seed flour (%) |
| T0 | 100 | 0 |
| T1 | 50 | 50 |

1. T0- Control T1- Tamarind seed incorporated cookies 143

144 TABLE 2: COMPOSITION OF COOKIES

## Ingredients Quantity

|  |  |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

Flour blend 100g Sugar(Powdered) 30g

Fat 50g

Baking powder 1.67g Salt 0.5g

Water 20ml

|  |  |
| --- | --- |
| 145 | Source: Chinma *et al*., (2012) |
| 146 |  |
| 147 | **Table 3. Changes in moisture content of the tamarind seed flour incorporated cookies** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period | P1 | | P2 | |
| T0 | T1 | T0 | T1 |
| 0 day | 2.45 | 1.62 | 2.45 | 1.62 |
| 15 days | 2.50 | 1.64 | 2.49 | 1.63 |
| 30 days | 2.59 | 1.70 | 2.54 | 1.68 |
| 45 days | 3.08 | 1.79 | 2.60 | 2.02 |

148

|  |  |  |
| --- | --- | --- |
| Source | SED | CD(0.05) |
| P | 0.01532 | 0.03100 |
| T | 0.01532 | 0.03100 |
| S | 0.01789 | 0.03489 |
| PT | 0.02654 | 0.05281 |
| TS | 0.03125 | 0.06119 |

|  |  |  |
| --- | --- | --- |
| PS | 0.03125 | 0.06119 |
| PTS | 0.05296 | 0.10689 |

|  |  |
| --- | --- |
| 149 |  |
| 150 | P-Packaging materials, T-Treatments and S-Storage period |
| 151 | TABLE 4: CHANGES IN CARBOHYDRATE CONTENT OF TAMARIND SEED FLOUR INCORPORATED COOKIES |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period | P1 | | P2 | |
| T0 | T1 | T0 | T1 |
| 0 day | 66.23 | 72.52 | 66.23 | 72.52 |
| 15 days | 66.22 | 72.51 | 66.23 | 72.52 |
| 30 days | 65.98 | 71.99 | 66.02 | 72.14 |
| 45 days | 64.02 | 70.85 | 65.45 | 71.59 |

152

|  |  |  |
| --- | --- | --- |
| Source | SED | CD(0.05) |
| P | 0.15750 | 0.31001 |
| T | 0.15750 | 0.31001 |
| S | 0.18006 | 0.35897 |
| PT | 0.28976 | 0.54798 |
| TS | 0.31300 | 0.65879 |
| PS | 0.31300 | 0.65879 |
| PTS | 0.54321 | 1.06897 |

153

154

155

TABLE 5: CHANGES IN PROTEIN CONTENT OF TAMARIND SEED FLOUR INCORPORATED COOKIES

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period | P1 | | P2 | |
| T0 | T1 | T0 | T1 |
| 0 day | 4.66 | 9.26 | 4.65 | 9.26 |
| 15 days | 4.64 | 9.23 | 4.64 | 9.24 |
| 30 days | 4.63 | 9.21 | 4.62 | 9.21 |
| 45 days | 4.59 | 9.18 | 4.60 | 9.19 |

|  |  |  |
| --- | --- | --- |
| Source | SED | CD(0.05) |
| P | 0.04598 | 0.09165 |
| T | 0.04598 | 0.09165 |
| S | 0.05932 | 0.10598 |
| PT | 0.08019 | 0.10591 |

|  |  |  |
| --- | --- | --- |
| TS | 0.09254 | 0.18525 |
| PS | 0.09254 | 0.18525 |
| PTS | 0.17021 | 0.31892 |

156

157 TABLE 6: CHANGES IN FAT CONTENT OF TAMARIND SEED FLOUR INCORPORATED COOKIES 158

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period | P1 | | P2 | |
| T0 | T1 | T0 | T1 |
| 0 day | 26.36 | 22.98 | 26.36 | 22.98 |
| 15 days | 26.34 | 22.96 | 26.35 | 22.97 |
| 30 days | 26.31 | 22.93 | 26.33 | 22.94 |
| 45 days | 26.26 | 22.89 | 26.29 | 22.90 |

159

160

161

162

163

164

165

|  |  |  |
| --- | --- | --- |
| Source | SED | CD(0.05) |
| P | 0.08698 | 0.17987 |
| T | 0.08698 | 0.17987 |
| S | 0.10054 | 0.19878 |
| PT | 0.16543 | 0.29865 |
| TS | 0.17782 | 0.34585 |
| PS | 0.17782 | 0.34585 |
| PTS | 0.30121 | 0.58987 |

166

167

168

169

170

171

172

173

174

175

176 TABLE 7: CHANGES IN FIBER CONTENT OF TAMARIND SEED FLOUR INCORPORATED COOKIES 177

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period | P1 | | P2 | |
| T0 | T1 | T0 | T1 |
| 0 day | 0.95 | 3.25 | 0.95 | 3.25 |
| 15 days | 0.94 | 3.23 | 0.94 | 3.24 |
| 30 days | 0.92 | 3.21 | 0.92 | 3.22 |
| 45 days | 0.89 | 3.19 | 0.90 | 3.19 |

178

179

180

181

182

183

184

|  |  |  |
| --- | --- | --- |
| Source | SED | CD(0.05) |
| P | 0.02687 | 0.05565 |
| T | 0.02687 | 0.05565 |
| S | 0.03193 | 0.06294 |
| PT | 0.04789 | 0.09549 |

185

186

187

188

189

190

191

192

193

194

195

196

197

198

199

200

201

202

203

204

205

206

207

208

209

210

211

212

213

214

215

|  |  |  |
| --- | --- | --- |
| TS | 0.05598 | 0.11262 |
| PS | 0.05598 | 0.11262 |
| PTS | 0.09693 | 0.19655 |

TABLE 8: CHANGES IN ASH CONTENT OF TAMARIND SEED FLOUR INCORPORATED COOKIES

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Storage period | P1 | | P2 | |
| T0 | T1 | T0 | T1 |
| 0 day | 0.65 | 1.12 | 0.65 | 1.12 |
| 15 days | 0.64 | 1.11 | 0.65 | 1.11 |
| 30 days | 0.61 | 1.09 | 0.63 | 1.10 |
| 45 days | 0.58 | 1.08 | 0.61 | 1.07 |

|  |  |  |
| --- | --- | --- |
| Source | SED | CD(0.05) |
| P | 0.01054 | 0.02565 |
| T | 0.01054 | 0.02565 |
| S | 0.00879 | 0.01794 |
| PT | 0.01897 | 0.03549 |
| TS | 0.01596 | 0.03092 |
| PS | 0.01596 | 0.03092 |
| PTS | 0.02693 | 0.05986 |

216 Figure 1 : Control and Tamarind kernel cookies in Stand-up pouches

217  

218 Figure 2 : Control and Tamarind kernel cookies in High Density Polypropylene packages

219  

220

221