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STANDARDISATION AND QUALITY EVALUATION OF SPREADS USING FRUIT EXTRACTS AND TENDER COCONUT PULP

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Abstract: Spreads were prepared using extracts of guava, Jack fruit rind and plantain with tender coconut pulp. Organoleptic evaluation was conducted using score card. Textural quality parameters were analysed using a texture analyser. Physico - chemical qualities of blended spread were estimated initially and at monthly intervals for a period of six months. Spread was evaluated for Bacteria, Yeast and Mould initially and at the end of storage. Cost of production was calculated.

Key words: spread, tender coconut, guava, jack fruit, organoleptic evaluation, textural properties, physico – chemical qualities, microbial enumeration and shelf life

1. INTRODUCTION

Coconut palm (*Cocos nucifera* L) a member of the palmaceae family, is one of the economically important trees in the world. This multi-purpose tree crop is widely referred to as 'tree of life' due to its endless potential uses. Among the various horticultural crops, grown in the universe, coconut commands a unique position by virtue of its contribution to the food sector as well as to the edible oil economy. Around 50-55% of the matured nuts harvested in India are utilised for consumption in household culinary uses and in social and religious functions leaving only the balance for processing into oil and diverse food products. Around 15 % of the harvested nuts is utilised at the tender nut stage for direct drinking purposes as well as for converting into bottled drink (GOI, 2008).

Tender coconuts are generally cut and the inside water is consumed as such as a drink or used for the development of beverages. Coconut water industry is picking up with coconut water in bottles and tetra packs which is mostly exported. However, the food use of residual pulp left after removal of water from the kernels has not been explored much. Thus, it has become essential to give emphasis to evolve technologies for the development of value added products from coconut and tender coconut. It will also ensure stability to coconut based economy. A

valuable by-product that can be obtained from fruit waste is pectin. Pectin exists in varying amounts in fruit cell walls and has important nutritional and technological properties, mainly because of its ability to form gels. (Westerlund et al. 1991). Jack fruit rind was used a good source of pectin for making jellies (Madhav, 2002).

Hence, the study was conducted to utilise residual tender coconut pulp for the development of blended products in combination with natural fruit extracts with the objectives to standardise spread using tender coconut pulp with fruit extracts and also to evaluate the quality attributes and shelf life of the selected standardised products.

2. MATERIALS AND METHODS

2.1. Raw Materials

Tender coconuts of around 7-8 months old were procured from the local markets and fully ripened fruits were collected from local areas of Thrissur, Kerala. The flesh of the young coconut is an albuminous endosperm which is white in colour; edible and soft were selected for the study.

2.2. Spread preparation

Spread was prepared using tender coconut pulp as the base and also blended with fruit extracts at three proportions viz. Tender coconut pulp (TCP): Guava extracts at the ratio of 75:25, 50:50 and 25:75. Tender coconut pulp (TCP): Jackfruit rind extracts at the ratio of 75:25, 50:50 and 25:75. Tender coconut pulp (TCP): Plantain extracts at the ratio of 75:25, 50:50 and 25:75. The experiment was conducted in CRD with three replications

Table 1. Actual quantity of ingredients used to prepare spread

Treatments	TCP (gm)	Fruit Extracts (gm)		Sugar (gm)	Pectin (gm)	Citric acid (gm)
ST_1	75	Guava	25	100	1	0.5
ST_2	50	Guava	50	100	1	0.5
ST_3	25	Guava	75	100	1	0.5
ST_4	75	Jack fruit rind	25	100	1	0.5
ST_5	50	Jack fruit rind	50	100	1	0.5
ST_6	25	Jack fruit rind	75	100	1	0.5
ST_7	75	Plantain	25	100	1	0.5
ST_8	50	Plantain	50	100	1	0.5

ST_9	25	Plantain	75	100	1	0.5

The mixture of tender coconut pulp and fruit extracts were taken in required ratio in an open pan and heated continuously with above ingredients. Heating was stopped when the TSS reached 68-69^0 Brix, and filled in clean sterilized and dried glass bottles of 200 ml capacity and sealed air tight. The bottles were then stored in ambient condition for storage study. Quality evaluation of the products was carried out initially and at monthly intervals for a period of six months. Organoleptic evaluation of spread was conducted using score card by a panel of 10 judges and the quality attributes such as appearance, colour, flavour, texture, taste and overall acceptability were assessed by a nine point hedonic scale.

2.3. Selection of spread

The scores obtained for the nine treatments with fruit extracts were analysed by Kendall Wallace Analysis of variance to select the most acceptable spread. Kendall's coefficient of concordance (W) which expresses the degree of association among the ten judges was carried out for each treatment. Thus, from preliminary study, after statistical analysis the spread prepared using 75% Guava extracts and 25% tender coconut pulp (ST3) , the spread prepared using 75% Jackfruit rind extracts and 25% tender coconut pulp (ST6) and the spread prepared using 50% Plantain extracts and 50% tender coconut pulp (ST8) was selected for further storage study.

2.4. Physico-chemical analysis

The texture analysis of spread was determined using Texture Analyser (Stable Micro Systems, UK). The texture analyser measures force, distance and time and hence provide a three-dimensional product analysis. The sample was kept on the flat platform of the instrument and was subjected to double compression by a cylindrical probe with 5mm diameter. The test was conducted at a speed of 10 mm/s using 50 N load cell. The sample was allowed for double compression of 40% with trigger force of 0.5 kg during various textural parameters were determined from the force deformation curve, the gel strength, rupture strength, brittleness and adhesiveness were determined. Total soluble solids were measured using an Erma hand juice brix refractometer at room temperature and the values were expressed in degree brix (Ranganna, 1986). The pH of the products was measured using food grade pH meter. The solution for reading pH was prepared in a ratio of 1:10 (Berwal *et al.*, 2004). Reducing and Total sugar

contents were determined using the Lane and Eyon method as described by Ranganna, 1986. The moisture and fat contents of spread were determined according to AOAC methods (1980).

The minerals like Ca, Fe, Zn, P, Na and K were determined using by atomic absorption spectrophotometric method using the diacid extract prepared from the sample (Perkin-Elmer, 1982).

2.5. Organoleptic evaluation

Organoleptic evaluation of spread were conducted using score card by a panel of 10 judges and the quality attributes such as appearance, colour, flavour, texture, taste and overall acceptability were assessed by a nine point hedonic scale.

2.6. Statistical Analysis

The observations recorded were tabulated and the data was analysed statistically using Completely Randomised Design (CRD). The scores of organoleptic evaluation were assessed by Kendall's Coefficient of Concordance (W). The data on quality evaluation of Tender coconut blended spread during storage was analysed statistically using one way ANOVA.

3. RESULTS AND DISCUSSION

3.1. Organoleptic evaluation of spread

The mean score obtained for different quality attributes of blended spread prepared using tender coconut pulp and fruit extracts in three proportions are presented in Table 2.

Table 2. Mean scores obtained for organoleptic evaluation of blended tender coconut spread

Treatments	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
ST_1 - (75% TCP + 25% GE)	6.8 (1.10)	7.1 (1.05)	7.2 (1.20)	7.5 (1.05)	7.2 (1.00)	7.5 (1.05)
ST_2 - (50% TCP + 50% GE)	7.6 (1.90)	7.9 (2.05)	8.0 (1.85)	7.8 (2.00)	8.1 (2.10)	8.0 (1.95)
ST_3 - (25% TCP + 75% GE)	8.7 (3.00)	8.6 (2.90)	8.8 (2.95)	8.7 (2.95)	8.5 (2.90)	8.9 (3.00)
ST_4 - (75% TCP + 25% JFE)	8.4 (1.95)	7.9 (1.75)	7.8 (2.20)	8.0 (1.95)	7.7 (1.35)	8.0 (2.15)
ST_5 -(50% TCP + 50% JFE)	8.0 (1.77)	7.9 (1.75)	7.8 (1.60)	7.6 (1.90)	7.9 (2.05)	8.0 (1.65)
ST_6 - (25% TCP + 75% JFE)	8.3 (2.30)	8.2 (2.50)	8.2 (2.20)	8.1 (2.15)	8.4 (2.60)	8.2 (2.20)
ST_7- (75% TCP + 25% PE)	6.9	6.7	7.5	7.5	7.4	7.5

	(1.10)	(1.30)	(1.10)	(1.15)	(1.05)	(1.00)
ST_8 - (50% TCP + 50% PE)	8.8 (2.90)	8.3 (2.95)	8.7 (2.60)	8.6 (2.75)	8.6 (2.80)	8.8 (2.90)
ST_9 - (25% TCP + 75% PE)	8.1 (2.00)	7.7 (1.75)	7.9 (2.30)	8.3 (2.10)	8.1 (2.15)	8.2 (2.10)
Kendall's value	0.738**	0.879**	0.846**	0.824**	0.958**	0.977**

Value in parentheses is mean rank score based on Kendall's W which was significant
** Significant at 1% level
TCP- Tender coconut Pulp, GE- Guava extract, JFE- Jack fruit rind extract, PE- Plantain extract

Based on Kendall's (w) value, significant agreement among the judges was noticed in the evaluation of different quality attributes of tender coconut blended spreads.

3.1.1. Products selected for the storage study

After statistical analysis the treatments ST3 (25% TCP + 75% guava extract) , ST6(25% TCP+ 75% Jackfruit rind extract) and ST8 (50% TCP + 50% Plantain extract) were selected for storage study.

3.2. Physico- Chemical Characteristics of selected tender coconut blended spread during storage.

The textural quality parameters such as gel strength, adhesiveness, brittleness and rupture strength of the tender coconut blended spread were evaluated using a Texture Analyser. . The results of the textural quality parameters such as gel strength, adhesiveness, brittleness and rupture strength of the tender coconut blended spreads are presented in table 4.

Treatments	Textural properties

Table 3. Textural properties of freshly prepared tender coconut blended spread

	Gel Strength (N)	Adhesiveness (N)	Brittleness (mm)	Rupture Strength (N)
ST_3 - (25% TCP + 75 % GE)	0.0287[a]	0.0472 [b]	84.960 **[a]**	0.6549 **[a]**
ST_{6-} (25% TCP + 75 % JFE)	0.0252 [b]	0.0783 [a]	76.921 **[b]**	0.3294 **[b]**
ST_8 - (50% TCP + 50 % PE)	0.0253[b]	0.0794 [a]	64.183 **[c]**	0.3240 **[b]**

GE- Guava extract, JFE- Jack fruit rind extract, PE- Plantain extract
Values with same alphabet for different treatments represented in each column form a homogenous group

The maximum gel strength was recorded in 25% TCP + 75% guava extract. The high pectin content in guava might cause greater gel strength as compared to the jack fruit rind and plantain extracts. The maximum adhesiveness in 50% TCP + 50% plantain extract (ST_8). The treatment ST_3 (25%TCP +75% GE) and ST_6 (25% TCP+ 75% JFE) with the treatment ST_8 (50% TCP + 50% PE) with maximum TCP recorded maximum brittleness minimum TCP recorded minimum brittleness. The maximum rupture strength was recorded in ST_3 (25% TCP + 75% guava extract). The increased rupture strength could be attributed to the increased pectin content in guava.

The chemical constituents such as acidity, moisture content, total soluble solids, reducing sugar, total sugar, fat, sodium, potassium, phosphorus, calcium, iron and zinc present in the selected tender coconut blended spread was estimated initially and at monthly intervals for a period of six months and analysed statistically and compared using one way ANOVA.

Table 4. CHEMICAL QUALITIES OF TENDER COCONUT BLENDED GUAVA SPREAD DURING STORAGE

Qualities	Months of storage						
	0	1	2	3	4	5	6
Acidity	3.78[a]	3.70[a] (2.11)	3.69[a] (0.27)	3.65[a] (1.08)	3.63[a] (0.54)	3.49[a] (3.85)	3.47[a] (0.57)
Moisture	22.04[a]	22.55[a] (2.31)	23.83[a] (5.67)	24.03[a] (0.83)	25.88[a] (7.69)	26.79[a] (3.16)	27.21[a] (1.56)
Tss	69.44[a]	69.44[a] (0)	70.11[b] (0.96)	70.66[b] (1.75)	71.55[a] (3.03)	72.00[a] (3.68)	73.00[a] (5.12)
Reducing sugar	26.23[a]	27.56[a] (5.07)	27.96[a] (1.45)	28.39[a] (1.53)	28.57[a] (0.63)	29.19[a] (2.17)	29.62[a] (1.47)
Total sugar	69.44[a]	64.76[a] (6.73)	62.07[a] (4.15)	59.33[a] (4.41)	55.86[a] (5.84)	53.73[a] (3.81)	51.71[a] (3.75)
Fat	1.60[a]	1.55[a] (3.12)	1.53[a] (1.29)	1.44[a] (5.88)	1.31[a] (9.02)	1.15[a] (12.21)	1.13[a] (1.73)

Table 5. CHEMICAL QUALITIES OF TENDER COCONUT BLENDED JACK FRUIT RIND SPREAD DURING STORAGE

Qualities	Months of storage						
	0	1	2	3	4	5	6
Acidity	3.69[a]	3.58[a] (2.98)	3.58[a] (0)	3.54[a] (1.11)	3.51[b] (0.84)	3.48[a] (3.85)	3.43[a] (1.43)
Moisture	22.78[a]	22.91[a] (0.57)	23.13[a] (0.96)	24.93[a] (7.78)	25.02[a] (0.36)	25.83[a] (3.23)	27.32[a] (5.76)
Tss	69.89[a]	69.89[a] (0)	71.00[a] (1.58)	71.33[a] (2.06)	72.00[a] (3.01)	72.44[a] (3.64)	73.00[a] (4.44)
Reducing sugar	25.92[a]	27.56[a] (6.32)	28.02[a] (1.66)	28.73[a] (2.53)	29.29[a] (1.94)	29.86[a] (1.94)	30.21[a] (1.17)
Total sugar	67.70[a]	62.43[a] (7.78)	58.93[a] (5.60)	56.89[a] (3.46)	54.89[a] (3.51)	52.24[a] (4.82)	48.96[a] (6.27)
Fat	1.49[b]	1.37[b] (8.05)	1.34[b] (1.59)	1.33[b] (0.74)	1.26[a] (5.26)	1.15[a] (8.73)	1.13[a] (1.73)

Table 6. CHEMICAL QUALITIES OF TENDER COCONUT BLENDED PLANTAIN SPREAD DURING STORAGE

Qualities	Months of storage						
	0	**1**	**2**	**3**	**4**	**5**	**6**
Acidity	3.70[a]	3.61[a] (2.43)	3.61[a] (0)	3.56[a] (1.38)	3.53[ab] (0.84)	3.50[a] (0.84)	3.46[a] (1.14)
Moisture	19.77[b]	21.09[a] (6.67)	21.93[a] (3.98)	22.18[b] (1.13)	24.83[a] (11.94)	25.24[a] (1.65)	27.04[a] (7.13)
Tss	69.88[a]	69.88[a] (0)	70.67[ab] (1.13)	71.22[a] (1.91)	72.00[a] (3.03)	73.00[a] (4.46)	73.00[a] (4.43)
Reducing sugar	26.85[a]	28.26[a] (5.25)	28.78[b] (1.84)	29.18[a] (1.38)	29.57[a] (1.33)	29.89[a] (1.08)	30.29[a] (1.33)
Total sugar	68.67[a]	64.77[a] (7.78)	61.77[a] (4.63)	59.33[a] (3.95)	56.91[a] (4.07)	54.62[a] (4.02)	51.19[a] (6.27)
Fat	1.64[a]	1.60[a] (2.43)	1.53[a] (4.37)	1.44[a] (5.88)	1.31[a] (9.02)	1.26[a] (3.81)	1.19[a] (1.55)

An increase in acidity for blended tender coconut spread was observed during storage. The increase in acidity might be due to the interaction of organic acids present in the blended spreads. Remya mol (2006) observed an increase in acidity in blended cashew apple beverages. Shakir *et al*., (2009) also noticed an increase in the acidity in apple pear mixed jams with the progress of storage period. Similar effect of increased acidity have been reported in many fruit products by various researchers such as Hema (1997), Sudhagar (2001), Saikia and Saikia (2002), Joy (2003), Shere *et al*. (2003), Naik *et al*. (2003) and Lakshmi and Begum (2004).

In spread, the highest moisture content (22.78%) was recorded in spread prepared using 25% TCP + 75% JFE. The increased moisture content over a period of time might be due to the breakdown of carbohydrates into carbon dioxide and water during storage. An increase in moisture content during storage was also reported by Neelofar (2004) in coconut kernel candy. Fluctuations in the moisture content may also be due to the activity of microorganisms and catabolic enzymes produced in them (Ashaye and Adeleke 2009).

The TSS content of spreads varied from 69.44 to 69.89^0 brix. During the later part of storage a slight increase in TSS observed might be due to the hydrolysis of polysaccharides in to mono and soluble disaccharides as reported by Satkar *et al*. (2012). Stability in TSS content was reported in wood apple jam by (Vidhya and Narain, 2011). Ahmed *et al.* (2011) reported that the TSS of sapota jam remained as 67 °brix from initial to four months of storage period.

In the study, a slight gain in reducing sugar was noticed during the storage. This is tune with the results of Vidhya and Narain (2011) in wood apple jam; Shakir *et al*. (2009) in pear apple mixed jam and Riaz *et al*. (1999) in strawberry Jam. The increase in reducing sugar could be due to the inversion of sucrose to glucose and fructose (Lotha, 1992 and Pruthi *et al*., 1994) or due to the breakdown of poly saccharides into simple sugars.

The total sugar content of the freshly prepared tender coconut blended spread varied from 67.70 to 69.44 g/ 100g. The total sugar content generally decreased during the storage . The loss of total sugar during storage might be due to maillard's reaction, other chemical reaction of sugar in presence of acids and co- polymerization of sugars with organic acids particularly at high temperature (Takur and Barwal, 1998). Sindumathi and Amutha (2014) also reported lso reported a reduction in total sugar content with storage time in tender coconut blended pineapple jam.

The initial fat content of tender coconut blended spread varied from 1.49 to 1.64 g/100g the highest fat content was recorded in the spread prepared using 50%TCP+50%PE .Chauhan *et al*. (2012) also found that the 100% TCP formulation recorded the highest percentage of fat (6.80 %) as against the 100% pineapple jam. With the increase in the concentration of coconut pulp, the fat content was found to increase. The fat content reduced slightly during storage.

The mineral contents like Calcium, Iron, Phosphorus, Zinc, Sodium and Potassium also estimated initially and at monthly in travel for a period of six months. From the figures it is clear that mineral contents of blended tender coconut spread decreased with advancement in storage period. A decrease in calcium content with advancement of storage was observed in the product. A negligible decrease in iron content with advance of storage was noticed in blended spread.

Compared to other minerals the reduction in phosphorus content was very less during storage. A general decrease in Zinc, Sodium and Potassium content was observed with advancement of storage period. On the basis of nutritional qualities, the spread prepared with 25% TCP and 75% jack fruit rind extract (ST_6) were found to be the best. The freshly prepared spreads were ranked on the basis of the scores obtained for different organoleptic attributes . Ranks were individually assigned for appearance, colour, flavor, texture, taste and overall acceptability for all the treatments. From the total scores obtained for each treatment, the spreads were ranked. The treatment ST_8 (50% TCP + 50% PE) attained the highest rank which was followed by ST_3 (25% TCP + 75% GE). On the basis of organoleptic score, the spread prepared using 25% TCP + 75% Jack fruit rind extract (ST_6) attained the least score and found to be the least acceptable compared to other spread treatments.

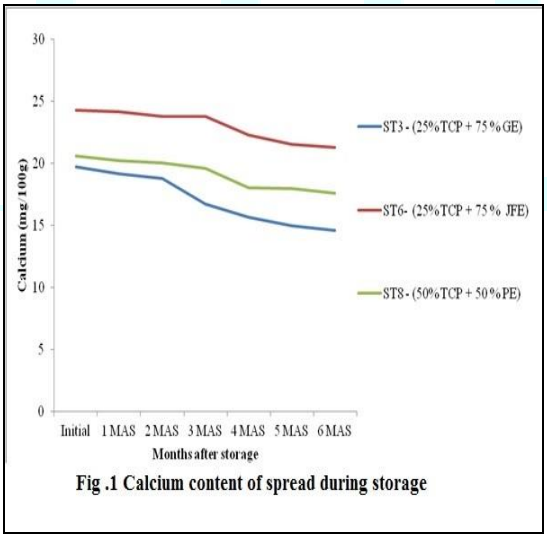

Fig .1 Calcium content of spread during storage

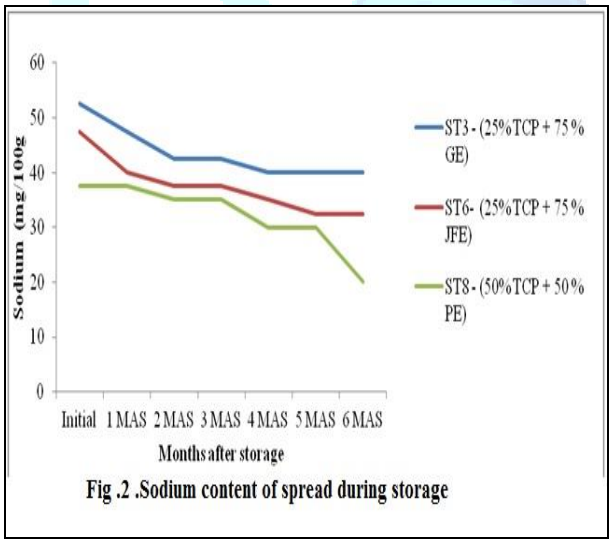

Fig .2 .Sodium content of spread during storage

3.3. Microbial count of tender coconut blended spread

The presence of microbes was not detected in freshly prepared spread. The presence of bacteria, yeast and mould was detected at the end of six months of storage.However, it was within safe limits (For bacteria 0.44x 10^4 cfu/ g, Yeast 1.33x 10^2 cfu/ g, mould 1.66 x 10^2 cfu/ g).

Table 7. Microbial population of tender coconut blended spread during storage

Treatments	Period of storage					
	Bacteria (x10^4 cfu/g)		`Yeast (x10^2 cfu/g)		Mould (x10^2 cfu/g)	
	Initial	6 MAS	Initial	6 MAS	Initial	6 MAS
ST_3 - (25% TCP + 75 % GE)	ND	0.66	ND	2.55	ND	1.33
ST_{6-} (25% TCP + 75 % JFE)	ND	0.44	ND	1.33	ND	1.66
ST_8 - (50% TCP + 50 % PE)	ND	0.44	ND	1.33	ND	1.66

GE- Guava extract, JFE- Jack fruit rind extract, PE- Plantain extract
MAS- Months after storage
ND- Not Detected

3.4. CONCLUSION

` The results of present study have shown that the different fruit extracts like guava, plantain and entirely wasted jackfruit rind and residual coconut pulp left in the tender coconuts after the consumption of coconut water can be effectively utilized for the preparation of spread. The physico chemical and organoleptic analysis of the spread showed the shelf life of the products for a period of six months stored at ambient conditions. The developed spread was also found to have good textural qualities when analyzed for different textural parameters such as gel strength, adhesiveness, brittleness and rupture strength. The presence of microbes were detected at the end of six months of storage but were with in permissible limits. The products were ranked on the basis of the scores obtained for different organoleptic attributes. . For spread, the treatment ST_8 (50% TCP + 50% PE) attained the highest rank which was followed by ST_3 (25% TCP+ 75% GE).

The cost of production for Spread varied from Rs. 14.63 to18.13/200g . The lowest cost for production was found to be in the spread prepared from jack fruit rind extract.. The products being calorie rich, it will be relished by all age groups except of those following a calorie

restricted diets. Blending with tender coconut pulp and fruit extract increased the nutritional and organoleptic acceptability of the spread.

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