

1 DEVELOPMENT AND SHELF LIFE STUDY OF PAPAYA-BLACK GRAPE 2 BLEND FRUIT ROLLUPS

3 ABSTRACT:

4 Standardization of papaya – black grape blend fruit rollups in proportions of 70:30, 60:40,
5 50:50 with experimental Ezidri food dehydrator and compare it with 50:50 of control cabinet dryer
6 rollups. Experimental Ezidri 50:50 ratio rollups was accepted by taste panel judges compared to
7 other ratios and control sample. The results revealed that moisture content, TSS, thickness, pH,
8 vitamin C, β – carotene, L^* , a^* and b^* color values of fruit rollups decreases while, titrable acidity
9 and microbial counts increase in storage period to 10 weeks at room temperature. It was concluded
10 that Ezidri papaya – black grape sample showed superior qualities than control sample (cabinet)
11 during storage.

12 **KEY WORDS:** Ezidri, cabinet, papaya, black grape, moisture, TSS, acidity, pH, microbial count
13 and sensory evaluation.

14
15 **INTRODUCTION:** India is one of the largest producers of fruits in the world but the country
16 faces lots of wastages during processing and harvesting time [1]. In the last few decades, consumer
17 demands in the field of food production have changed considerably. Hence, in order to utilize the
18 produce in glut season, it becomes necessary to adopt low cost processing techniques to preserve
19 the produce as preserved pulps, jams, jellies, candies, fruit bars / leather and promote them in a
20 commercial way like fruit rollups [2]. This helps to generate opportunities for self-employment
21 through small scale processing units. The fruit leather / rollups have high calorific value while
22 retaining their natural vitamins and minerals [3]. They were developed from fresh fruit pulps by
23 simple dehydration technique to provide good nutritional supplementation.

24 Papaya (*Carica papaya L.*) is an important fruit crop of tropical world and has long been
25 known as wonder fruit of the tropics. In India, papaya is widely cultivated in Andhra Pradesh,
26 Gujarat, Maharashtra, Tamil Nadu, Kerala and plains of Uttar Pradesh [3]. They are rich source of
27 vitamin C, vitamin A, riboflavin, folates, thiamine, niacin, calcium, iron, potassium and fiber [4].

28 Papaya contains 64 mg ascorbic acid / 100g of fresh fruit, which is higher than oranges
29 which has 37 mg/100g [5]. Papaya was used in commercial preparations such as meat tenderizer,
30 chew – gums and as stabilizer to clarify the beer as it contains the enzyme papain [6]. Now-a-days,
31 farmers have shown keen interest in cultivating papaya crop because of its higher fruit yield but, the
32 main problem is its post-harvest handling and lower shelf life during marketing.

33 In India, grapes are an important commercial fruit crop. It is the second most important fruit
34 crop after mango and they are exported to Europe and Middle East countries. Grapes are good

35 source of antioxidants, polyphenols and antimicrobial agents against *Escherichia coli* O157:H7 [7].
36 The slight delay in the harvest affect the berry size, weight and juice content, but it increased the
37 TSS to acid ratio and sugar units [8]. Grapes contains high percent of sugars that help in processing
38 of different products like wine, raisins, juice, crush, jelly and canned grapes. Grape juice contains
39 80% water in which nutrient elements, sugar and natural acids are present in readily available
40 forms, thus it acts as instant energy source [9]. Fresh grapes contain vitamin A of 80 IU/100g and
41 vitamin C to 0.30 mg/100g [10].

42 The papaya flavor does not appeal to many consumers and hence combining with seasonal
43 fruits like black grape will increase the acceptance of the product and also helps in promoting a
44 unique commercial product. Thus, current study highlighted the shelf stability of papaya – black
45 grape combination fruit rollups using Ezidri and cabinet dryers over a period of 10 weeks.

46 **METHODOLOGY:** Fully matured, firm, ripe and healthy fruits of papaya, black grapes and other
47 ingredients were collected from the local market of Hyderabad. The experiments were conducted at
48 Post Graduate & Research Center, PJTS Agricultural University, Rajendranagar, Hyderabad.

49 The cleaned fruits were blanched separately, pulps prepared in electric juicer mixer, strained
50 to remove seeds and skin particles. Papaya and grape fruit pulp were mixed in proportions of 70:30,
51 60:40 and 50:50 and dried in Ezidri food dehydrator and compared with 50:50 ratio of control
52 sample developed using cabinet dryer. Pulp mixture was heated with continuous stirring for 5 min
53 along with 0.2% w/w of citric acid, pectin, potassium metabisulphite and sugar syrup with 55⁰B and
54 adjusted to final brix of 25-30⁰ for the preparation of fruit rollups. The mixture then poured as two
55 layers on trays and allows it for drying in cabinet dryer at 60⁰C for 12 h time period and at 55⁰C for
56 16 h in Ezidri food dehydrator. The best accepted combination fruit rollup was determined using
57 sensory evaluation carried out by 15 semi trained panel members.

58 The best accepted combination and control samples were packed in LDPE, stored at room
59 temperature and analysed for its physico-chemical analysis like moisture [11], TSS [12], thickness
60 [13], colour [14], pH [15], titratable acidity [16], reducing sugars [17], ascorbic acid [18], β -
61 carotene [19] and microbial counts [20] were determined initially. All the parameters were
62 analysed on 6th, 8th and 10th week along with sensory evaluation of rollups during storage period
63 using the modified 5-point hedonic scale [21]. The results were analyzed by two factorial CRD
64 analyses at different weeks of storage [22].

65 **RESULTS AND DISCUSSION:** The results of standardized papaya – black grape rollups showed
66 that highest rating was found for Ezidri 50:50 combination. The appearance of Ezidri papaya –
67 black grape (50:50) rollup was attractive with shiny appearance as judged by 87% judges and 27%
68 in case of control. The color of control rollups was felt as characteristic bright dark red color by

69 60% judges and 73% felt the same for 50:50 Ezidri rollups. Forty percent of judges felt that 50:50
70 Ezidri and control had strong flavor of black grape and papaya. The texture of 50:50 Ezidri rollup
71 was felt to be typical soft and non-sticky by 47% against 33% for control.

72 The balanced taste of papaya and black grape was found by 67% for 50:50 Ezidri rollup
73 against 40% in control rollups. Tartness of black grape was well pronounced in all proportion of
74 fruit rollups. Shape of the papaya-black grape blend rollups was evaluated to be very good by 53%
75 for 50:50 rollups and 47% in control. Increase in percentage of papaya pulp masked the taste of
76 black grapes and decreased the shiny appearance of rollups after drying. Hence, Ezidri papaya+
77 black grape (50:50) rollups was selected for further analysis and compared with control sample.

78 The results of physico-chemical, microbial and sensory evaluation of papaya-black grape
79 rollups during storage period among the dryers was given in Tables 1, 2 and Figure 1a, 1b and 2.

80 **Moisture:** The moisture content of papaya blend rollups decreased gradually as storage period
81 extended from 1st week to 10th week in the order of 16.51 to 15.17% for cabinet dryer and 16.87 to
82 15.38% from Ezidri sample. In Ezidri, movement of air and space was restricted in the equipment
83 and hence moisture loss from the product was lower. It had significantly ($p < 0.001$) higher moisture
84 content than control rollups initially and the moisture levels decreased during storage period due to
85 the evaporation through LDPE packaging material.

86 The correlation between four storage periods and two dryers of 4 formulations of papaya
87 blend rollups did not show any significant difference but two dryers of papaya – black grape rollups
88 were significantly ($p < 0.001$) different. Similar decreased moisture levels were observed in sapota-
89 papaya (50:50) fruit bar stored for 90 days where moisture has decreased from 16.4 to 16.05g%
90 during 90 days shelf life (Sreemathi *et al.*, 2008). Papaya leather developed from cabinet dryer has
91 shown a reduction of moisture from 19 to 16.9% in pet jar stored for 60 days [23].

92 **TSS:** The mean TSS (brix) of papaya-black grape blend rollups decreased significantly ($p < 0.001$)
93 from 82.53 to 80.57⁰Brix in control and 82.30 to 79.93⁰Brix in Ezidri rollups with advancement of
94 storage period due to increase in acidity during storage as complex sugars converted to simple
95 sugars. The prolonged storage period also might have reduced the pore space in the product due to
96 reduction in moisture levels. This kind of observation was reported in papaya – sapota (50:50) fruit
97 bar, where TSS has decreased from 80⁰ to 78⁰ Brix during 90 days storage period [24]. Reduction of
98 TSS from 84.83⁰ to 83.62⁰ during 6 months storage period was reported in papaya – banana leather
99 [3].

100 **Thickness:** The mean thickness of papaya – black grape blend fruit rollups decreased significantly
101 ($p < 0.001$) from 2.50 to 2.27 mm in control and 2.80 to 2.53 mm in Ezidri rollups during 10 weeks
102 storage period due to the decrease of moisture levels. The thickness of Ezidri sample was

103 significantly ($p < 0.001$) higher than cabinet sample. There was no significant difference between the
104 interaction of dryers and weeks.

105 **Color values:** Color of papaya – black grape fruit rollups was estimated using Hunter lab
106 colorimeter. L^* , a^* and b^* values are nearer to human perception. It was observed that the intensity
107 of brightness (L^*) value decreased significantly ($p < 0.001$) with increase of a^* (redness) due to the
108 loss of blue color (b^*) with increased shelf life. The mean L^* color values of control rollups was
109 decreased from 17.19 to 13.43 and 20.96 to 15.32 in Ezidri rollups. The increase of a^* color value
110 from 38.23 to 47.60 in Ezidri was higher than cabinet dried rollups with 37.27 to 45.88 and the
111 intensity of blue color was decreases with increase of b^* color value from -6.48 to -2.50 in control
112 and -7.22 to -4.73 in Ezidri rollups.

113 The interaction of dryers and weeks of L^* ($p < 0.001$) and b^* color ($p < 0.01$) values had
114 statistically significant difference but a^* color value did not show any significant difference. The
115 decreased L^* and increased a^* , b^* color values may be due to browning reactions (caramelisation of
116 sugars) and accelerated oxidative process controlled enzymatically.

117 Identical observations to this were also reported in papaya leather where L^* and b^* color
118 values was decreased from 19.65 to 17.31 and 3.68 to 2.98 respectively while a^* color value
119 increased from 6.80 to 8.48 in its 90 days storage period [25]. The wide difference in the color
120 values of this study in comparison with the present study can be attributed to the varietal differences
121 of papaya.

122 **pH:** The mean pH value of papaya – black grape blend fruit rollups was significantly ($p < 0.001$)
123 decreased from 3.87 to 3.58 in control and 4.07 to 3.69 in Ezidri rollups during 10 weeks storage
124 period. The increased acidity levels influenced the decreased pH levels. The mean pH value of
125 Ezidri sample was significantly ($p < 0.001$) higher as more acidity levels found in cabinet sample
126 during 10 weeks storage and no significant difference between the interaction of dryers and weeks.

127 Similar results of decline in pH upon storage for 90 days were reported in 50:50 sapota –
128 papaya fruit bar from 4.65 to 4.41 [24]. In papaya leather, pH decreased from 3.80 to 3.58 [26] and
129 in 50:50 papaya – guava leather, pH decreased from 3.43 to 3.2 [27].

130 **Titrable acidity:** The mean titrable acidity of papaya – black grape fruit rollups slightly
131 increased from 0.62 to 1.02% in control and 0.59 to 0.98% in Ezidri rollups during 10 weeks
132 storage which might be due to hydrolysis of pectin, ascorbic acid degradation, formation of acid
133 from sugars and conversion of SO_2 to sulphurous. The cabinet dried papaya – black grape rollup
134 had significantly ($p < 0.001$) higher acidity level than Ezidri and it was found that there was no
135 significant difference between the interaction of dryers and weeks of papaya-black grape rollups.
136 Similar types of observations on variations in acidity also reported in 50:50 banana – papaya fruit

137 bar [3] where acidity increased from 1.21 to 1.74% during 6 months storage and in sapota – papaya
138 fruit bar (50:50), acidity level increased from 0.405 to 0.423% during 90 days storage period [24].

139 **Reducing sugar:** The mean reducing sugar value of papaya – black grape fruit rollups was
140 increased from 15.13 to 16.93% in control and 14.73 to 16.20% in Ezidri. Reducing sugars increased
141 significantly due to more acid hydrolysis of sucrose at high temperature which resulted in inversion
142 of non-reducing sugars to reducing sugars. The reducing sugar of cabinet dried papaya – black
143 grape rollups was significantly ($p < 0.001$) higher than Ezidri rollups due to higher concentration of
144 TSS. There was no significant difference between the interaction of dryers and weeks in papaya –
145 black grape blend rollups. Similar findings of increased reducing sugars was observed in 50:50
146 sapota – papaya fruit bar by 7.50 to 8.98% during 90 days storage period [24] and 16.6 to 22.4% in
147 papaya leather during 6 months storage period [2].

148 **Ascorbic acid:** The mean ascorbic acid content of papaya – black grape fruit rollups decreased
149 significantly ($p < 0.001$) between the weeks from 33.48 to 20.58 mg in control and 37.33 to 26.68 mg
150 in Ezidri rollups. Loss of vitamin C during storage may be due to the exposure to high atmospheric
151 temperature even under controlled conditions and increased acidity in the products.

152 Papaya – black grape rollups from cabinet dryer had significantly ($p < 0.001$) lower ascorbic
153 acid content than Ezidri rollups and also a significant difference ($p < 0.01$) was found between the
154 interaction of dryers and weeks. Similar results of decreased vitamin C content were observed in
155 papaya leather from 58.75 to 50.35 mg/100g during 90 days storage [26]. In papaya – apple (50:50)
156 leather packed in LDPE, vitamin C has decreased from 22.24 to 17.60 mg/100g during 90 days
157 storage [28]. In banana – papaya (50:50) leather, vitamin C decreased from 31.16 to 20.41 mg/100g
158 during 6 months storage [3].

159 **β -carotene:** The mean β -carotene (μg) content of papaya-black grape fruit rollups decreased from
160 284.6 to 155.10 μg in control and 341.6 to 146.1 μg in Ezidri rollups with significant difference
161 ($p < 0.001$) in 10 weeks storage period. Cabinet dried papaya-black grape rollups had lower β -
162 carotene content than Ezidri with significant difference ($p < 0.001$) between the dryers. The
163 interaction of dryers and weeks of papaya-black grape rollups showed significant difference
164 ($p < 0.001$). The retention of β -carotene in Ezidri fruit rollups than cabinet dryer fruit rollups may be
165 due to slow drying period which preserves the nutrients. The enzyme responsible for carotenoid
166 biosynthesis was inactivated during processing resulting in stimulation of isomerization that causes
167 oxidative degradation of carotenoids during storage. Results of β -carotene reduction during storage
168 were reported in storage of sweet potato chips for 11 months to 10% [29].

169 Sun dried chips of cassava stored for 4 weeks showed a reduction of β -carotene from 37.9 to
170 18.4% [30]. In sapota-papaya (50:50) fruit bar, β -carotene content has decreased from 605.17 to

171 595.87 μ g during 90 days storage period [24]. The β -carotene decreased in sweet potato from 5.9 μ g
172 to 4.2 μ g under sun drying [31].
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UNDER PEER REVIEW

Table 1: Physico-chemical constituents of papaya – black grape blend fruit rollups during storage

Weeks		Moisture (%)	TSS (Brix)	Thickness (mm)	L*	a*	b*	pH	Titrable acidity (%)	Reducing sugar (%)	Ascorbic acid (mg / 100g)	β-carotene (µg / 100g)
Initial	Ezidri	16.87 ± 0.04	82.30 ± 0.06	2.80 ± 0.04	20.96 ± 0.12	38.23 ± 0.04	-7.22 ± 0.11	4.07 ± 0.02	0.59 ± 0.01	14.73 ± 0.11	37.33 ± 0.18	341.6 ± 1.10
	Cabinet	16.51 ± 0.07	82.53 ± 0.14	2.50 ± 0.00	17.19 ± 0.12	37.27 ± 0.08	-6.48 ± 0.05	3.87 ± 0.01	0.62 ± 0.01	15.13 ± 0.11	33.48 ± 0.12	284.6 ± 1.20
	Mean	16.69^d ± 0.09	82.42^d ± 0.12	2.65^c ± 0.07	19.08^d ± 0.85	37.75^a ± 0.22	-6.85^d ± 0.19	3.97^d ± 0.05	0.61^a ± 0.01	14.93^a ± 0.14	35.40^d ± 0.88	313.13^d ± 12.80
6 th wk	Ezidri	16.25 ± 0.03	81.43 ± 0.02	2.70 ± 0.00	19.54 ± 0.11	44.03 ± 0.03	-6.61 ± 0.12	3.89 ± 0.00	0.77 ± 0.00	15.47 ± 0.11	32.51 ± 0.13	204.7 ± 0.90
	Cabinet	16.06 ± 0.05	81.63 ± 0.08	2.43 ± 0.02	15.37 ± 0.15	43.25 ± 0.22	-5.66 ± 0.12	3.72 ± 0.00	0.81 ± 0.01	16.33 ± 0.11	27.62 ± 0.21	155.1 ± 1.30
	Mean	16.16^c ± 0.06	81.53^c ± 0.08	2.57^b ± 0.06	17.46^c ± 0.94	43.64^b ± 0.24	-6.14^c ± 0.24	3.80^c ± 0.04	0.79^b ± 0.01	15.9^b ± 0.22	30.57^c ± 1.33	179.87^c ± 11.1
8 th wk	Ezidri	15.89 ± 0.05	80.57 ± 0.04	2.67 ± 0.02	17.51 ± 0.13	45.35 ± 0.14	-5.61 ± 0.13	3.84 ± 0.01	0.81 ± 0.01	15.87 ± 0.04	29.51 ± 0.29	163.6 ± 0.90
	Cabinet	15.52 ± 0.10	80.97 ± 0.08	2.37 ± 0.02	14.54 ± 0.12	44.06 ± 0.14	-4.35 ± 0.10	3.65 ± 0.01	0.92 ± 0.01	16.67 ± 0.04	23.36 ± 0.21	124.5 ± 0.50
	Mean	15.70^b ± 0.11	80.77^b ± 0.11	2.52^b ± 0.07	16.03^b ± 0.68	44.70^c ± 0.32	-4.98^b ± 0.30	3.75^b ± 0.04	0.86^c ± 0.03	16.27^c ± 0.18	26.44^b ± 1.40	144.02^b ± 8.8
10 th wk	Ezidri	15.38 ± 0.05	79.93 ± 0.06	2.53 ± 0.02	15.32 ± 0.11	47.60 ± 0.10	-4.73 ± 0.10	3.69 ± 0.01	0.98 ± 0.01	16.20 ± 0.07	26.68 ± 0.18	146.1 ± 0.50
	Cabinet	15.17 ± 0.02	80.57 ± 0.04	2.27 ± 0.02	13.43 ± 0.15	45.88 ± 0.08	-2.50 ± 0.18	3.58 ± 0.01	1.02 ± 0.02	16.93 ± 0.04	20.58 ± 0.08	104.4 ± 1.70
	Mean	15.27^a ± 0.06	80.25^a ± 0.15	2.40^a ± 0.06	14.38^a ± 0.44	46.74^d ± 0.39	-3.62^a ± 0.52	3.63^a ± 0.03	1.00^d ± 0.02	16.57^d ± 0.17	23.63^a ± 1.37	125.27^a ± 9.40
C.D. value		0.18	0.25	0.07	0.43	0.39	0.39	0.03	0.05	0.29	0.63	3.57
Week probability		0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
Dryer Probability		0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
Dryers × Weeks		0.595 ^{NS}	0.264 ^{NS}	0.917 ^{NS}	0.02***	0.099 ^{NS}	0.056**	0.102 ^{NS}	0.29 ^{NS}	0.364 ^{NS}	0.0034**	0.03***

Note: Values are Mean ± S.D of triplicates.

Values with same superscript in respective columns indicates no significant difference.

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The percentage change in moisture, pH, tritritable acidity, reducing sugars, ascorbic acid and β – carotene for Ezidri and cabinet dried samples are given in figures 1a and 1b respectively.

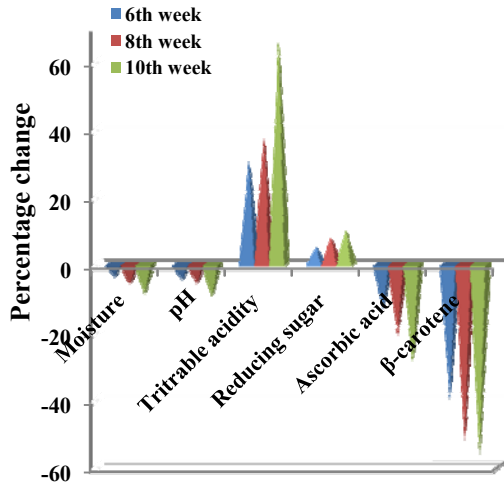


Figure 1a: Percentage change in Ezidri dried rollups

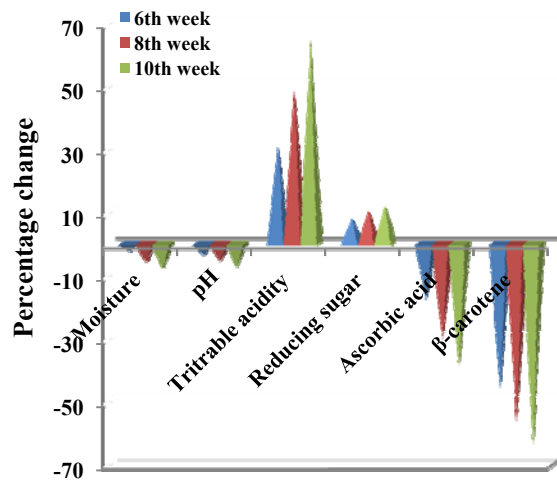


Figure 1b: Percentage change in cabinet dried rollups

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A decrease in moisture content was observed in all the samples during storage. The decrease in pH indicates that the acidity in the samples has increased and it ranged between 4.0 to 9.5% in the samples. The slight decrease in the pH resulted in an increase in tritritable acidity by about 30.0% in the 6th week of storage and increased to 65.0% by the 10th week. The increase in tritritable acidity was 48.0% for the 8th for the cabinet dried sample and it increased to only 37.0% in Ezidri sample. The decreased ascorbic acid and β – carotene contents were observed in all the samples during storage as reported by many researchers as reported above.

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There was slight decrease of 1.0 to 3.0% in the TSS of both samples where as thickness decreased by 3.0 to 10.0 % in all samples due to moisture loss. In colour parameters, L* and a* did not show much percentage where as b* showed significant percentage change indicating that loss of blue colour during storage was more compared to loss of red colour. It was considerably higher in cabinet dried sample by the 10th week of storage increasing to 61.25% from 12.65% during 6th week in comparison to 0th week sample. The loss of blue colour in Ezidri sample ranged between 8.45 to 34.49% during storage.

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Microbial quality of the papaya fruit rollups during storage period: There was no fungal growth in papaya – black grape fruit rollups packed in LDPE up to final week storage. In cabinet dried rollups, bacterial growth was seen from 8th week with 0.33×10^{-6} log of CFU/g and increased to 0.67×10^{-6} log of CFU/g where as in Ezidri rollups it was 0.67×10^{-6} log of CFU/g in 8th week and gradually increased to 1.0×10^{-6} log of CFU/g at final storage period. Samples had the microbial growth in permissible limits and hence safe for consumption from the point of TBC. The bacterial

198 count increased to 4×10^6 log of CFU/g and fungal count to 6×10^3 log of CFU/g in 50:50 sapota –
 199 papaya fruit bar [24] which are more or less similar to the present study.

200 **Table 2: Changes in microbial quality of papaya-black grape blend fruit rollups during**
 201 **storage**

	Cabinet rollups				Ezidri rollups			
Microbial load (Cfu/g)	1st week	6th week	8th week	10th week	1st week	6th week	8th week	10th week
Bacterial (10^{-6})	Nil	Nil	0.33	0.67	Nil	Nil	0.67	1.0
Fungal (10^{-1})	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

202 **Sensory evaluation of papaya- black grape blend fruit rollups during storage:** Papaya- black
 203 grape rollups were evaluated by 15 semi trained judges and its mean scores given in Figure 1. Fruit
 204 rollups were evaluated for sensory parameters like appearance, color, flavor, texture, taste,
 205 sweetness, shape of the roll and overall acceptability by using 5-point hedonic scale.

206 The mean sensory scores of control cabinet dryer rollups significantly decreased from 1st to
 207 10th week from 4.20 to 2.40 for appearance, 4.27 to 2.53 for color, 4.60 to 2.87 for flavor, 3.73 to
 208 2.00 for texture, 4.20 to 2.00 for taste, 4.47 to 2.60 for sweetness, 4.07 to 2.00 for shape of roll and
 209 4.20 to 2.40 for overall acceptability. The sensory scores of Ezidri rollups also decreased from 4.93
 210 to 2.80 for appearance, 4.47 to 3.13 for color, 4.80 to 3.13 for flavor, 4.13 to 2.47 for texture, 4.67
 211 to 2.13 for taste, 4.67 to 2.80 for sweetness, 4.07 to 2.87 for shape of the roll and 4.93 to 3.13 for
 212 overall acceptability during 10 weeks storage.

213 It was observed that Ezidri rollups had higher sensory scores than control rollups because
 214 high hot air currents over the fruit pulp in the cabinet chamber causes more flavor, taste, color
 215 losses and appearance changes than Ezidri. Hence, Ezidri rollups could be considered superior in
 216 quality parameters compared to cabinet dried rollups.

217 During 10 weeks storage period, significant decrease of sensory scores was observed for
 218 papaya – black grape rollups in both cabinet and Ezidri which might be due to chemical reactions
 219 like degradation of pigments by non-enzymatic reaction, moisture losses, LDPE packaging material,
 220 increase of reducing sugars and acidity in the product under ambient temperature during storage
 221 period. Similar findings of decrease in sensory scores of sapota-papaya fruit bar (50:50) was
 222 reported by [24] and papaya-guava leather by [27].

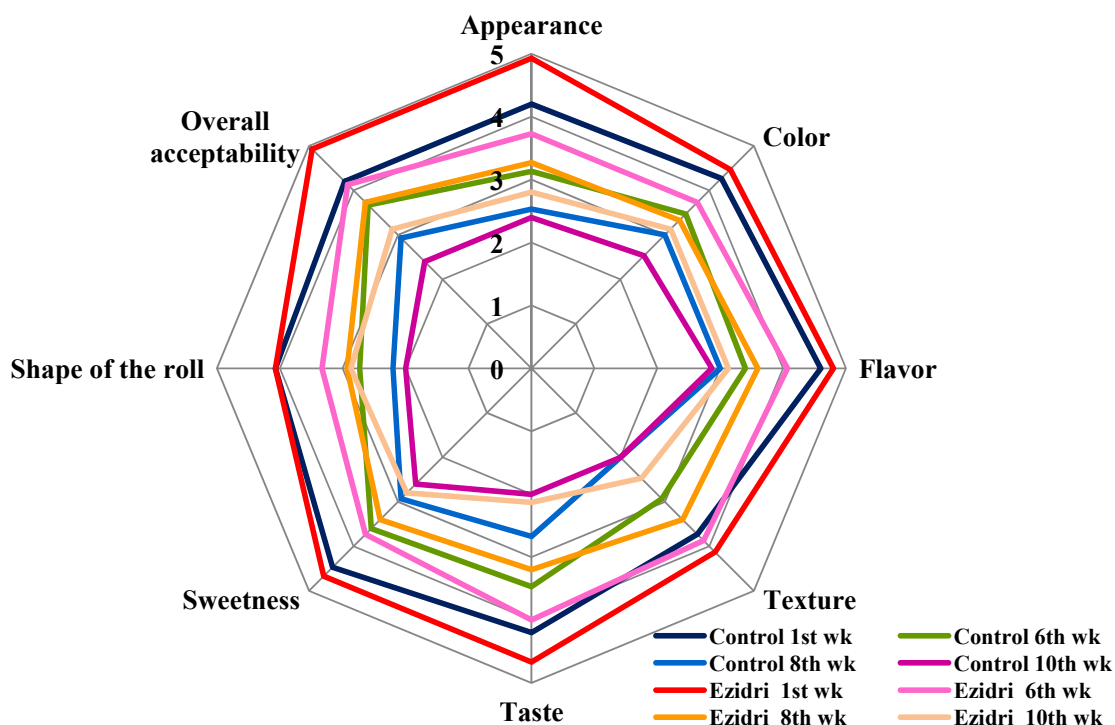


Figure 2: Sensory scores of papaya-black grape blend fruit rollups during storage

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225 **CONCLUSION:** Papaya – black grape fruit rollups are nutritionally enriched product. The
226 moisture, TSS, pH, thickness, color (L) value, ascorbic acid, β -carotene content of the both samples
227 was decreased while, acidity, reducing sugars, color (a and b) values, bacterial count was increased
228 significantly during storage period. Retention of β -carotene, ascorbic acid was higher in Ezidri
229 sample than cabinet fruit rollups. No fungal growth was observed throughout storage time but with
230 negligible loads of bacterial load was found with safe limits during storage hence it was declared as
231 safe for consumption. Among two samples, Ezidri papaya – black grape fruit rollups was found best
232 on the basis of sensory parameters throughout storage period.

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234 REFERENCES:

- 235 1. Pantastico, E.B., 1975. Post-harvest physiology. Handling and utilization of tropical and sub-
236 tropical fruits and vegetables. AV 1 Pub. Co., Inc, Weser Connecticut. 103-127.
- 237 2. Attri, S., Anju K. D., Manisha, K and Rakesh, S. 2014. Development and storage stability of
238 papaya (*Carica papaya L*) toffee and leather. *International Journal of Farm Sciences*. 4(3): 117-
239 125.
- 240 3. Piyush, V., Ashok, S., Ramesh, T., Mayani, J and Koyan, B. 2016. Evaluation of Physico-
241 chemical and organoleptic quality of Papaya Cv. Taiwan and Banana Cv. Grand naine based
242 mixed fruit bar during storage. *International Journal of Agriculture, Environment and*
243 *Biotechnology*. 9 (4): 541-544.

- 244 4. Gomez, M., Lajolo, F and Cordenunsi, B. 2002. Evolution of soluble sugars during ripening of
245 papaya fruit and its relation to sweet taste. *Journal of Food Science*. 67: 442-447.
- 246 5. Santiago-Silva, P and Labanca.R.A. 2011. Functional potential of tropical fruits with respect to
247 free bioactive amines. *Food Research International*. 44: 1264-1268.
- 248 6. Krishna, K. L., Paridhavi, M and Jagruti, P. A. 2008. Review on nutritional, medicinal and
249 pharmacological properties of papaya (*Carica papaya L*). *Natural Product Radiance*. 7(4): 364-
250 373.
- 251 7. Kim, T.J., Silva, J.L and Jung, Y.S. 2009. Antibacterial activity of fresh and processed red
252 muscadine juice and the role of their polar compounds on *Escherichia coli O157:H7*. *Journal of*
253 *Applied Microbiology*. 107(2): 533-539.
- 254 8. Satyamadhava, L.V. 1983. Influence of pruning time and delayed harvesting on quality of
255 Bangalore blue grapes. *Thesis Abstracts*. Haryana Agricultural University. 9(1): 60-61.
- 256 9. Ratnacharyulu, S.V. 2010. Evaluation of coloured grape (*Vitis vinifera L.*) varieties for yield,
257 juice recovery and quality. *M.Sc. Thesis*. Dr. YSR Horticultural University, Andhra Pradesh,
258 India.
- 259 10. Clary, C.D., Mejla-Meza, E., Wang, S. and Petrucci, V.E. 2007. Improving grape quality using
260 microwave vacuum drying associated with temperature control. *Journal of Food science*. 72(1):
261 23-28.
- 262 11. AOAC. 2005. Official Methods of Analysis for moisture in rolls. *Association of Official*
263 *Analytical Chemists*. 18th Ed. Arlington VA 2209. USA. AOAC 929.03, 32 (2).
- 264 12. AOAC. 2000. Official Methods of analysis of TSS in rolls. *Association of Official Analytical*
265 *Chemists*. 17th ed. Washington, DC USA. 920.183.
- 266 13. AACC. 2000. Official methods for measuring thickness in rolls. *American Association of Cereal*
267 *Chemists*. 17th ed. Minnesota St Paul, MN. USA.
- 268 14. Hunter lab. 2013. Hunter Associate Laboratory - Manual version-2.1. 60: 1014-593.
- 269 15. Raghuramulu, N., Madhavan, N., and Kalyanasundaram, S. 2003. Method for measuring pH in
270 rolls. *A manual of laboratory techniques*. 2nd edition. 24-26.
- 271 16. IS 13844. 2003. Fruit and Vegetable Products - Determination of Titratable Acidity in rollups by
272 Bureau of Indian Standards. New Delhi. ICS 67.080.01.
- 273 17. Somogyi, M. 1952. Estimation of reducing sugars by colorimetric method. *Journal of Biological*
274 *Chemistry*. 200: 245.
- 275 18. Sadasivam, S and Balasubramanian, T. 1987. Method of analysis of ascorbic acid in rolls.
276 *Practical manual in Biochemistry*. TNAU. Coimbatore – 14.

- 277 19. Zakaria, M., Simpson, K., Brown, P.R. and Krustulovic, A. M. 1979. Use of reversed phase high
278 performance liquid chromatographic analysis for the determination of β -carotene in tomatoes.
279 *Journal of Chromatography*. 176: 109-117.
- 280 20. AOAC. 2001. Official Methods of Analysis for MLT. *Association of Official Analytical*
281 *Chemists*. Bacteriological Analytical Manual. AOAC 966.23.C
- 282 21. Meilgaard, M., Civille, G. V and Carr, B. T. 1999. Sensory Evaluation Techniques. 3rd edition.
283 CRC Press, Boca Raton.
- 284 22. Snedecor, G. W. and Cochran, W. G. 1980. Statistical Methods, 7th ed. Ames: Iowa State
285 University Press.
- 286 23. Serveshe, K., Vishal, K. and Prakash, C. 2015. Effect of sugar and jaggery on the quality
287 characteristics of papaya leather and shelf life stability at room temperature. *South Asian Journal*
288 *of Food Technology and Environment*. 1 (1): 79-85.
- 289 24. Sreemathi, M., Sankaranarayanan, R and Balasubramanyan, B. 2008. Sapota-Papaya bar.
290 *Madras Agricultural Journal*. 95 (1-6): 170-173.
- 291 25. Jadhavar, S.S., Pujari, K.H., Relekar, P.P and Bhatane, A.V. 2014. Changes in physical
292 parameter and sensory qualities of papaya fruit bar Cv. Red Lady during storage period. *Trends*
293 *in Biosciences*. 7(24): 4080-4084.
- 294 26. Singh, A., Singh, J., Chauhan, N., Kumar, V and Dinesh, K. 2015. Effect of different citric acid
295 levels and packaging materials on quality of sugar based papaya leather. *South Asian Journal*
296 *Food Technology Environment*. 1(1): 75-78.
- 297 27. Devendra, Y.K. 2014. Standardization of recipe for preparation of mixed fruit leather (Guava
298 and Papaya). *M. Sc thesis*. Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, India.
- 299 28. Ramesh, C.F., Vikas, G.J and Muralidhar, I.P. 2016. Studies on effect of drying temperature and
300 storage time on vitamin-C retention capacity and moisture content of papaya-apple fruit leather.
301 *Asian Journal of Dairy and Food Research*. 34(4): 319-323.
- 302 29. Hagenimana, V., Carey, E.E., Gichuki, S.T., Oyunga, M.A and Imungi, J.K. 1999. Carotenoid
303 contents in fresh, dried and processed sweet potato products. *Ecology of Food and Nutrition*. 37:
304 455-473.
- 305 30. Chavez, A., Sanchez, T., Ceballos, H., Rodriguez-Amaya, D.B., Nestel, P., Tohme, J and
306 Ishitani, M. 2007. Retention of carotenoids in cassava roots submitted to different processing
307 methods. *Journal of Food science and Agriculture*. 87:388-393.
- 308 31. Vimala, B., Nambisan, B and Prakash, H. B. 2011. Retention of carotenoids in orange-fleshed
309 sweet potato during processing. *Journal of Food Science Technology*. 48 (4): 520-524.
- 310