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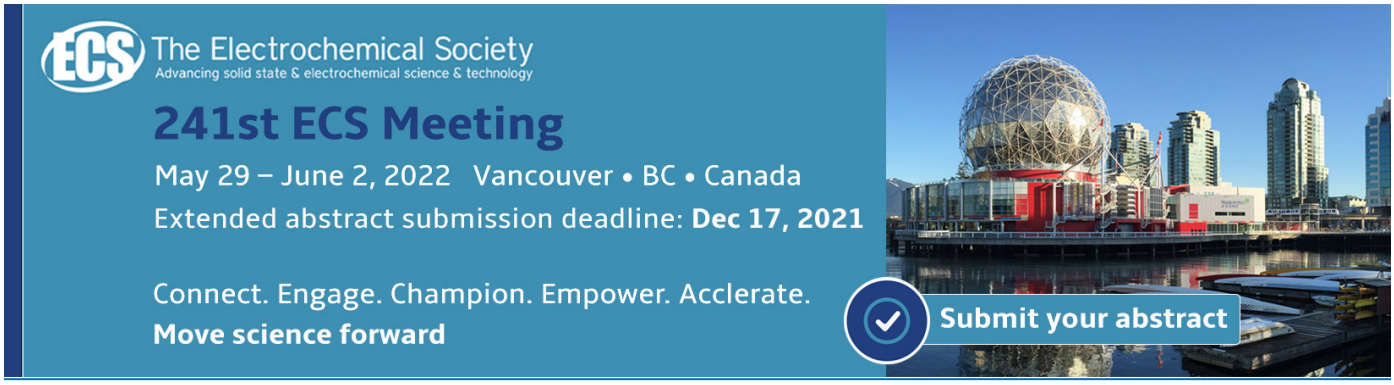

Influence of dark and light colours of *Carica papaya* leaves on physical properties and sensory acceptability in crackers

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Abstract. Papaya (*Carica papaya*) leaves have been used traditionally in treating a wide range of ailments. The leaves contain appreciable amount of nutritional components (protein, fibre, carbohydrate, minerals) and phytochemical compounds. This study was conducted to determine proximate compositions, texture, and sensory properties of crackers as influenced by dark and light colours of papaya leaves. The dark and light colour of leaves were incorporated separately in crackers at 0.5%, 1.0%, and 1.5% of flour substitution. The cracker without papaya leaves powder served as control. The colour attributes that were lightness (L^*), redness (a^*), and yellowness (b^*) were determined using chromameter, while texture properties were determined using a texture analyser. The proximate compositions of crackers (moisture, ash, fat, protein, and carbohydrate content) were determined using AOAC methods. The results showed that the proximate compositions of crackers were not significantly different between crackers containing dark and light colour leaves. The L^*, a^*, and b^* values of crackers containing dark or light colour leaves decreased during storage. Similarly, the hardness and fracturability of crackers were decreased during storage. Hardness and fracturability values of crackers containing dark leaves were found higher than crackers with light leaves. In sensory evaluation, there was no significant differences in flavour, bitterness, crispiness, hardness, and overall acceptability among control and crackers with dark or light color leaves. In conclusion, the incorporation of dark and light colours of papaya leaves in crackers within 0.5% to 1.5% level did not significantly influence physical and sensory properties of the crackers while but improved some nutritional compositions in the crackers.

1. Introduction

Papaya leaf is part of the papaya tree, which is not widely used for human consumptions. The leaves contain nutritional values and active compounds. *Carica papaya* leaves had been used as herbal medicine traditionally. The leaf extract was reported to have potential in treating dengue fever [1].

Papaya leaves of green, yellow, and brown colour contain bioactive compounds, minerals, and vitamins [2]. The bitterness of papaya leaves is caused by the presence of saponins in the leaves [3]. The leaves of papaya contained more crude protein, crude fibre, carbohydrate, Ca, Mg, Fe and K compare to the fruit pulp and also seeds [4]. The papaya leaves being traditionally used in treating a wide range of ailments for malaria, dengue, jaundice, and antiviral activity. This could be due to the phytochemicals presence in the leaves. The leaves were reported to contain secondary metabolites with wide range of biological activities [5].

Cracker is flat baked food product usually consumed as a snack. It is typically a hard, dry type of bread in flat shapes, crispy and formulated with some flavours. It also has low fat and sugar levels as they are often used as a base items for savoury toppings. Thus, this study was conducted to determine the proximate composition, physical and sensory properties of crackers influenced by several percentages of papaya leaves.

2. Methodology

2.1. Preparation of papaya leaves powder

The light and dark *Carica papaya* leaves were collected in the Jeli district, Kelantan. The leaves were washed, chopped into small pieces, and dried in a dehydrator for 24 hours at 60 °C. Next, the dried leaves were ground into fine powder form and sieve to remove the coarse particles. The powdered light and dark papaya leaves were stored in airtight containers separately until further used.

2.2. Preparation of cracker

Cracker was prepared using ingredients such as all-purpose wheat flour (100g), butter (6g), sugar (20g), salt (6g), water (45ml). The light and dark papaya leave powder were incorporated in the dough at three levels (0.5%, 1.0%, and 1.5%) separately. Cracker without papaya leaves served as control. The dough was rolled on a flat surface of 0.4 cm thickness. Then the sheeted dough was cut into 3 cm square shape and baked at 180°C for 15 minutes in the oven. The baked crackers were allowed to cool at room temperature.

2.3. Determination of proximate composition

Proximate composition analyses of the crackers were performed according to AOAC methods. All samples were analyzed for moisture, fat, protein, total ash, and carbohydrate content. Moisture content was determined using the oven drying method, and the content was calculated using the formula:

$$\text{Moisture (\%)} = (\text{initial weight (g)} - \text{final weight (g)}/(\text{initial weight}) \times 100$$

The Kjeldahl method was used to determine protein content. A conversion factor of 6.25 was used to convert the measured nitrogen content to protein. Protein content was calculated using the formula:

$$\text{Protein (\%)} = \text{Kjeldahl Nitrogen (\%)} \times \text{conversion factor}$$

Fat content was determined using the Soxtet instrument and hexane as the solvent. The fat content determined by using the formula below:

$$\text{Fat (\%)} = [(\text{weighing dish+fat) (g)} - (\text{weighing dish) (g)}])/(\text{initial sample weight) (g)} \times 100$$

Ash content was determined by ashing samples in a furnace at 500 ˚C until whitish ash was obtained. Ash content was calculated using the formula shown below:

$$\text{Ash content (\%)} = [(\text{weight of crucible+ash (g)} - \text{weight of crucible (g)}]/(\text{weight of sample) (g)} \times 100$$

The carbohydrate content was calculated by subtracting the percentage of moisture, protein, fat, and ash content by the formula:

$$\text{Carbohydrate content} = 100\% - [(\text{moisture content \%}) + (\text{protein content \%}) + (\text{fat content \%}) + (\text{ash content \%})]$$

2.4. Determination of colour and texture properties of papaya leaves crackers

The colour measurement for both light and dark leave papaya crackers carried out using colour meter (Konica Minolta CR-400). The results of lightness, redness, and yellowness were recorded in *L*a*b**, respectively. The hardness, fracturability, and cohesiveness of the papaya crackers were determined using Texture Analyzer (Brookfield, CT3, USA). Following TPA test type using TA7 probe with 5g trigger load at a speed of 3.0mm/s. The evaluation was performed at seven days intervals for 21 days.

2.5. Sensory evaluation

Descriptive sensory evaluation was carried out using a 7-points hedonic scale. Thirty panels from Universiti Malaysia Kelantan, Jeli Campus, took part in this sensory evaluation. Samples were rated for colour, flavour, taste, crispiness, hardness, and overall acceptance based on panels' preferences.

3. Results and Discussion

Proximate compositions of crackers with dark and light papaya leaves at all percentages were shown in Table 1. Generally, the moisture and fat content of crackers containing dark and light colour leaves at all percentages were significantly lower (p<0.05) than control cracker. Ash and protein content in control and papaya leaves crackers were not significantly different (p>0.05) among samples. The carbohydrate content of control cracker was higher than crackers containing papaya leaves. Moisture levels 13.5% to 15% has higher potential in enabling fungal species and aerobic bacteria to grow and survive. Thus it is recommended to have a food product that records moisture content of less than 10% [6]. Since cracker is dried product, thus it is expected to have a lower moisture content. All the samples recorded for the moisture loss of less than 13%, which is good in preventing mold growth, spoilage, and less quality of these crackers. Ash is an indication of the mineral content of food. Thus it can be said that the ash content of the crackers has implications for minerals values in it [7]. Carbohydrate which is the major macronutrients in crackers present at high percentage. It has been reported that commercial biscuits in Malaysia had carbohydrate content in the range of 56.86% to 66.07% [8].

Table 1. Proximate compositions of crackers with dark and light leaves at all percentages.

Crackers	Proximate compositions (%) (Means ± standard deviation)				
	Moisture	Ash	Protein	Fat	Carbohydrate
Control	5.31 ± 0.00^{c}	5.31 ± 0.00^{a}	8.45 ± 1.17	2.99 ± 0.00^{c}	77.94
Dark leaf					
0.5%	10.52 ± 1.66^{a}	3.31 ± 1.20^{b}	7.84 ± 0.67	10.79 ± 1.44^{a}	67.54
1.0%	11.10 ± 1.65^{a}	6.55 ± 1.26^{a}	8.80 ± 1.41	10.15 ± 1.89^{a}	63.40
1.5%	11.47 ± 1.14^{a}	3.97 ± 2.04^{b}	8.02 ± 0.06	10.17 ± 0.56^{a}	66.37
Light leaf					
0.5%	8.02 ± 0.47^{b}	3.31 ± 2.33^{b}	8.10 ± 0.07	9.64 ± 1.85^{a}	70.93
1.0%	8.98 ± 2.14^{b}	4.62 ± 1.20^{b}	9.62 ± 1.60	6.18 ± 3.34^{b}	70.60
1.5%	11.00 ± 2.06^{a}	3.97 ± 2.00^{b}	9.63 ± 1.48	9.25 ± 1.20^{a}	66.15

^{abc}Means with superscripts in a column differ significantly (p<0.05).

Figure 1.1 – 1.3 showed the effects of dark and light leaves of papaya on colour attributes. Overall, lightness (a*) values of crackers with papaya leaves and the control were decreased as longer time of storage. The lightness values of crackers with dark leaves (52.01-64.09) were higher than that of light leaves (54.49 – 56.03) at initial day of storage. Yellowness (b*) values of crackers with dark and light leaves and control were decreased as longer storage time applied. Yellowness values of crackers with dark leaves were not significantly different (p>0.05) from that of the light leaf at all percentages used. On day 21, the yellowness of crackers with dark leaves was lower than cracker with light leaves. As for redness (a*) values, crackers with dark or light leaves at all percentage showed lower redness intensities than control cracker. The redness values for all crackers were also decreased as longer storage time was applied. The changes in colour attributes could cause be due to the chemicals presence in crackers as well as the duration of storage. Since papaya leaves crackers contain sugar as one of the ingredients, reactions of amino acids responsible for the dark colour. The Maillard reactions could be a reason for the surface colour changes as a result of the complex chemical reaction in dough, caramelisation as well as the high temperature during baking [9].

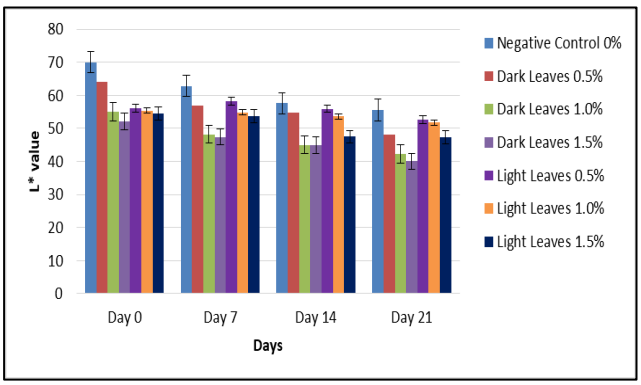

Figure 1.1. Lightness (L*) values of cracker made from dark and light leaves at a different percentage during storage.

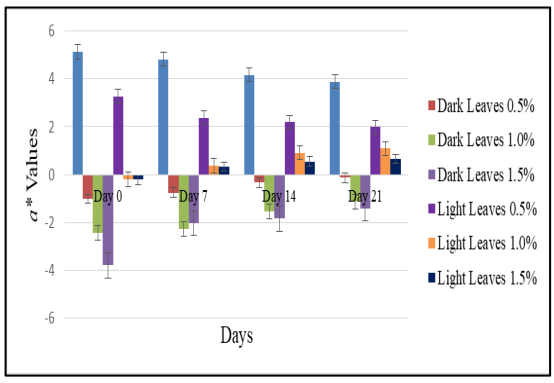

Figure 1.2. Redness (*a**) values of cracker made from dark and light leaves at a different percentage during storage.

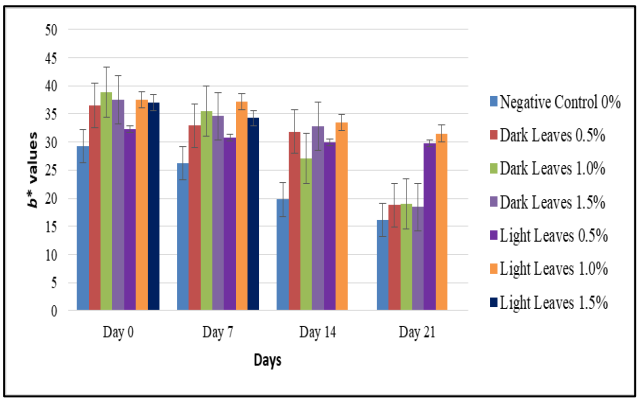

Figure 1.3. Yellowness (*b**) values of cracker made from dark and light leaves at a different percentage during storage.

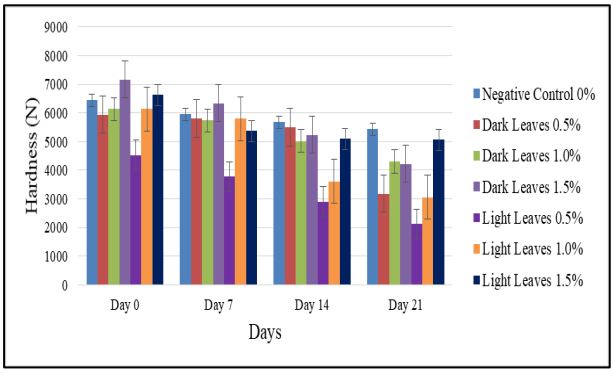

Figure 1.4. Hardness values of light and dark leaves crackers different percentages during four weeks of storage.

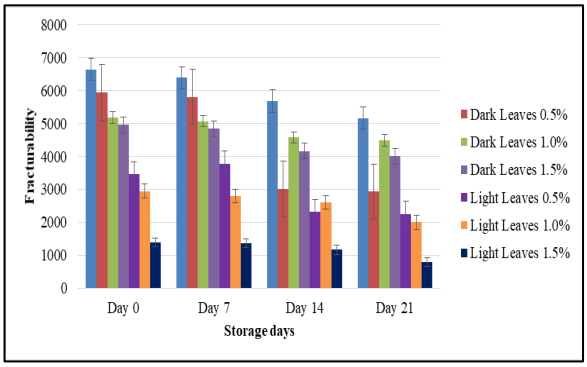

Figure 1.5. Fracturability of light and dark leaves crackers different percentages during four weeks of storage.

The hardness values of crackers containing dark and light leaves were not significantly different among all crackers (Figure 1.4). The hardness values of cracker with dark leaves showed higher values than cracker with light leaves during storage. The hardness values of control and all crackers with light and dark leaves at all percentages had decreased as a longer time of storage applied. The hardness of crackers decreased with increasing storage time due to the increased of moisture content [9].

Fracturability values of crackers containing dark leaves at all percentages were higher than crackers with light leaves (Figure 1.5). This trend was also observed during storage. The fracturability values were decreased as a longer time of storage in all crackers.

Sensory acceptability of crackers containing dark and light leaves colours in crackers were shown in Table 2. There was no significant difference (p>0.05) in many attributes tested in papaya leaves crackers and control. The preferences for all attributes in papaya leaves crackers had decreased with increased percentage of the leaves. Crackers with dark leaves received lower scores in bitterness than other light colour crackers and control. Papaya leaves bitter taste could be due to the saponins present in the leaves. The presence of saponins compound in plant sources causes the bitter taste [10].

Table 2. Sensory evaluation scores of dark and light papaya leaves crackers at all percentages.

Papaya leaves (%)	Sensory attributes (means ± standard deviation)					
	Colour	Flavour	Bitterness	Crispiness	Hardness	Overall acceptance
Control	4.37 ± 1.61	4.60 ± 1.38^{ab}	4.80 ± 1.81^{ab}	4.17 ± 2.04^{b}	3.53 ± 1.85^{b}	4.67 ± 1.03^{ab}
Dark leaf						
0.5%	4.87 ± 1.25	4.93 ± 1.14^{ab}	4.70 ± 1.37^{ab}	5.40 ± 0.98^{a}	4.90 ± 0.96^{ab}	4.93 ± 1.08^{ab}
1.0%	5.07 ± 1.23	3.83 ± 1.56^{b}	3.77 ± 1.72^{b}	4.63 ± 1.35^{ab}	4.43 ± 1.22^{ab}	4.00 ± 1.34^{b}
1.5%	5.10 ±1.37	4.13 ± 1.22^{ab}	3.77 ± 1.78^{b}	5.07 ± 1.14^{ab}	4.77 ± 1.01^{ab}	4.10 ± 1.35^{ab}
Light leaf						
0.5%	4.90 ± 1.19	4.83 ± 1.37^{ab}	4.97 ± 1.75^{a}	5.03 ± 1.63^{ab}	4.73 ± 1.68^{ab}	5.03 ± 1.65^{a}
1.0%	5.13 ± 1.28	5.00 ± 1.17^{a}	4.60 ± 1.33^{ab}	5.27 ± 1.11^{ab}	4.80 ± 1.13^{ab}	4.83 ± 1.29^{ab}
1.5%	5.43 ± 1.34	5.00 ± 1.23^{a}	4.30 ± 1.58^{ab}	5.30 ± 1.02^{ab}	4.93 ± 1.23^{a}	4.70 ± 1.37^{ab}

^{ab}Means with different superscripts in a column differ significantly (p<0.05).

4. Conclusion

In conclusion, the incorporation of dark and light colours of papaya leaves in crackers has increased the moisture, protein and fat content of the bakery product. The hardness and fracturability values of crackers increased during storage. Incorporation of 0.5% papaya leaves received higher consumers' acceptability than other formulations.

Acknowledgment

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References

[1] Ahmad N, Faizal H, Ayaz M, Abbasi B H, Mohammas I and Fazal L 2011 Dengue fever treatment with *Carica papaya* leaves extracts *Asian Pac. J. Trop. Biomed.* **1** 330–33

[2] Yogiraj V, Goyal P K, Chauhan C S, Goyal A and Vyas B 2014 *Carica papaya* Linn: An Overview *Int. J. Herb. Med.* **2** 1–8

[3] Ayoola P B, and Adeyeye A 2010 Phytochemical and nutrient evaluation of *Carica papaya* (pawpaw) leaves *Int. J. Recent Res. Appl. Stud.* **5** 325–28

[4] Nwofia E, Ojimelukwe P and Eji C 2012 Chemical composition of leaves, fruit pulp and seeds in some *Carica papaya* (L) morphotypes *Int. J. Med. Arom. Plants* **2** 200–06

[5] Ahmad N, Fazal H, Ayaz M, Abbasi B H, Mohammad I and Fazal 2011 Dengue fever treatment with *Carica papaya* leaves extracts *Asian Pac. J. Trop. Biomed.* **1** 330–33

[6] Musa A and Lawal T 2013 Proximate composition of ten types of biscuits and their susceptibility to *Tribolium castaneum Herbst* (Tenebrionidae□: Bostrichidae) in Nigeria *Food Sci. Qual. Manag.* **14** 33–41

[7] Norhayati M K, Mohd Fairulnizal M N, Zaiton A, Wan Syuriahti W Z, Rusidah S, Aswir A R, Ang J L, Mohd Naeem M N, Suraiami M, Mohd Azerulazree J and Vimala B 2015 Nutritional composition of selected commercial biscuits in Malaysia *Sains Malays.* **44** 581–

91
[8] Stamatovska V, Nakov G, Dimov I, Traneva I, Kalevska T and Uzunoska Z 2017 The changes in colour of biscuits during baking depending on time and different proportion of barley flour *UBT Int. Conf.* **56** 1–5
[9] Qadri T, Hussain S Z, Rather A H, Amin T and Naseer B 2018 Nutritional and storage stability of wheat-based crackers incorporated with brown rice flour and carboxymethyl cellulose (Cmc) *Int. J. Food Prop.* **21** 1117–28
[10] Heng L, Vincken J P, van Koningsveld G, Legger A, Gruppen H, van Boekel T, Roozen J and Voragen F 2006 Bitterness of saponins and their content in dry peas *J. Sci. Food Agri.* **86** 1225–31