Study of Red Dragon Fruit Peel (Hylocereus Polyrhizus) Extract as Natural Food Colorants to Physicochemical Properties Of Pedada’s Jam as Functional Foods

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Abstract — Red dragon fruit peel has a very high of anthocyanin content. Anthocyanin is commonly used as natural colorants in the food industry. This study was to determine the effect red dragon fruit peel extract to physicochemical quality of Pedada’s jam. Research design used was randomized complete design with 6 combination of treatments which are 100%;0%, 90%;20%, 80%;20%, 70%;30%, 60%;40% and 50%;50% of Pedada and red dragon fruit extract respectively with 4 replicates. The results shows Pedada’jam fortified with red dragon fruit extract have a significant effects on pH, moisture content, anthocyanin content, total soluble solids content, antioxidant activity and colour changed. Adding of dragon fruit peel extract 50% have the best results with pH 3.54 moisture content 28.11%, total soluble solids 33.89°Brix, colour index (L*) 49.05 green (a*) -0.30, yellow (b*) +22.09 and antioxidant activity 94.16%.

1. Introduction
Indonesia has the biggest mangrove forest in the world with a lot of natural resources. Pedada is one of very potential fruit produce from mangrove forest [1]. Pedada has high both vitamin C; 56.74 mg/100g and pectin content; 11.98%, however Pedada is also has high moisture content, therefore easily to spoil by microorganism and has a short shelf-life [2].

Recently, red dragon fruit has received much attention as a source of natural red-purple colour that has great potential in colouring a broad array of foods [3]. In addition, red dragon fruit is also very well known for its good antioxidant activity that may give various health benefits [4]. More over, the skin of red dragon fruit is also manufactured into healthier juice in order to increase the beneficial value of the dragon fruit. Even, the dragon fruit peel is normally used as gabage for aomw home industry; however, it has been recently found that the dragon fruit peel also could be used as a useful material for pectin extraction and natural food colourants [5],[6].

Processing jams is one of the early and most favoured food preserving manufacturing allowing fruit ready in the off-season which cooked by boiling fruit pulp with sugar, pectin, acid and other recipes. In addition, according to the European Union Council Directive, 2004, jams are made of sugars, pulp and or puree of one or more fruits and water brought to a appropriate gelled consistency [7]. Normally, total soluble solids content of the cooked jam should be between 60% and 65% or greater and the
A product should contain at least 45% fruit [8]. Addition of gelling agent from red dragon peel extract is necessary to ensure that the jam product has a perfect thick consistency and is firm adequate to hold the fruit puree-sugar in stable position [9]. The improvement of new food products contributes to the diversification of the market potentials, especially if they are interesting, practical and have a long storage time. However, something have to considere are jams mixed with red dragon peel extract should have consistency and organoleptic qualities that are quite similar to the traditional jam product. To the best of our knowledge, many studies are available on the sensory and textural characteristics of fruit jams, however only few studies were focused on the study of use red dragon fruit peel as natural food colourant for pedada jam as functional food. Therefore, the objective of the present study was to develop Pedada jam product incorporated with red dragon fruit peel extrac. The aims of this research were to investigate red dragon fruit peel (hylocereus polyrhizus) extract as natural food colorants to physicochemical and sensory quality of pedada’s jam as functional foods.

2. Method

2.1. Material

All chemicals used for analytical procedures were analytical grade. Details of chemicals and suppliers were MRSA (Merck), MRS Broth (Merck), APDA (Merck), DPPH 0,05 µM. solutions, Commercial pectin, sugar, HCL, NaCL, NaOH. CaCO$_3$ hydrogen peroxide and Gram test kit, pH meter, Colour Reader, Spectrophotometry UV-Vis, refractometer. Dragon fruits with red epicarp and red-purple pulp (H. polyrhizus) were obtained from a fruit farm in Jambi, Indonesia.

2.2. Preparation of making Pedada Jam

Pedada fruits were obtained from East Tanjung Jabung regency, sorted, washed in cold tap water and was blanched for 5 minutes at 60 C and cooked for 20 minutes to get the pedada puree. To make the dragon fruit puree, the whole skin of each dragon fruit was separated from the pulp immediately after the arrival of the fruits in the laboratory conditioned. Then, the thick layers were peeled from the fruits manually and the peels were washed thoroughly in running tap water to remove any substance that makes it skin become dirty. The whole peels were cut into small parts and dried in oven at 55 C until constant weights were reached. Pedada puree was mixed with half the quantity of sugar (65%) and pectin was added 0.75% (B/b) according the treatment and stirred at room temperature until all sugar dissolved. Then, pH was adjusted to 3 with citric acid 10% (w/v) and the mixture was heated. When the temperature reached 77–82 C, the rest of sugar, previously mixed with dragood fruit peel, was added according the formulation and stirred. Then, calcium was added (0.1%) and the mixture was heated until boiling. Pedada jams were cooked until the final product contained 65% of soluble solids was reached.

Research design used was randomized complete design with 6 combination of treatments which are 100%;0%, 90%;20%, 80%;20%, 70%;30%, 60%;40% and 50% ;50% of Pedada and red dragon fruit extract respectively with 4 replicates. Formulation of treatments

- $PN_0$ = 100% pedada puree : 0% red dragon fruit peel extract
- $PN_1$ = 90% pedada puree : 10% red dragon fruit peel extract
- $PN_2$ = 80% pedada puree : 20% red dragon fruit peel extract
- $PN_3$ = 70% pedada puree : 30% red dragon fruit peel extract
- $PN_4$ = 60% pedada puree : 40% red dragon fruit peel extract
- $PN_5$ = 50% pedada puree : 50% red dragon fruit peel extract

2.3. Physicochemical analysis

2.3.1. pH

The pH was measured using a pH meter. About 1 g of each sample was added to 20 mL of distilled water, homogenized for 30 s, and the pH was then measured. Calibration was performed using standard buffers provided by the manufacturer at pH 4, and 7 at room temperature [10].
2.3.2. **Moisture content (MC)**
Moisture content (MC) was measured gravimetrically by drying in the oven at 105°C until a constant weight was achieved according to AOAC Method [10].

2.3.3. **Total Soluble Solids Content (TSSC)**
Total soluble solids were determined using a hand refractometer and the results were expressed in degree °Brix [14]. 1 g sample was dissolved with 10 ml of

2.3.4 **Colourimetry**
To measure colour changes of the product colour, CIE L, a, b colour coordinates were obtained using colour reader (hunterlab, Reston, Vifginia, USA).

2.3.5 **Antioxidant activity.**
Antioxidant activity was measured according to DPPH (2,2-diphenyl-1-pircryhyrazil) radical-scavenging activity method [11]. Sample was taken around 0.5 g and mixed with 10 ml distillated water, and 3.8 ml DPPH 0,05 µM solution was added, stored at dark room temperature for 30 minutes and finally centrifuged at 3.500 rpm within 10 minutes and sample ready for analyzing with Spectrophotometer UV-Vis. Antioxidant activity was calculated based on 0,05 µM DPPH solution added measured with wavelength at 517 nm. Absorbance of samples recorded was used to calculate the inhibition factor according to formula as bellows:

\[
\text{Inhibition} \% = \frac{\text{absorbance (control)} - \text{absorbance(sample)}}{\text{absorbance (control)}} \times 100\%
\]

2.4. **Statistical Analysis**
The statistical analyses were conducted using one-way analysis of variance (ANOVA). Excel software was used to conduct statistical analysis, when significant differences were detected; the differences among the mean values were determined by performing the Duncan’s multiple comparison test (DNMRT) at a confidence level of p < 0.05 (5%). Data were reported as mean values ± standard deviation.

3. **Results and Discussion**

3.1 **Physicochemical properties of Pedada Jam**
The physicochemical properties of the pedada’s jam are presented in Table 1. Based on Table 1 shows pedada’s jam have characteristics different range of pH, MC, TSSC, colour and antioxidant activity.

| Treatment (%) | pH    | MC* (%) | TSSC* (Brix) | COLOUR       | Antioxidant activity (%) |
|--------------|-------|---------|--------------|--------------|--------------------------|
| PN0 (100% : 0%) | 3.18c±0.08 | 32.14±1.02 | 41.44a±0.69 | L*48.43±0.31 a* -1.18±1.35 b* +22.81±0.25 | 88.81d±0.92 |
| PN1 (90% : 10%) | 3.24bc±0.11 | 30.92±3.09 | 40.11b±0.19 | L*48.54±0.10 a* -0.72±0.27 b* +22.67±0.54 | 90.15c±0.36 |
| PN2 (80% : 20%) | 3.25bc±0.01 | 30.41±2.26 | 39.00c±0.00 | L*48.87±0.21 a* -0.68±0.38 b* +22.57±0.64 | 90.51c±0.00 |
| PN3 (70% : 30%) | 3.38ab±0.14 | 30.17±0.57 | 37.89d±0.19 | L*49.02±0.72 a* -0.58±0.27 b* +22.53±0.30 | 91.12c±0.00 |
| PN4 (60% : 40%) | 3.45a±0.12 | 28.72±2.35 | 36.22e±0.69 | L*49.03±0.12 a* -0.34±0.23 b* +22.28±0.16 | 92.70b±0.36 |
| PN5 (50% : 50%) | 3.54a±0.04 | 28.11±2.14 | 33.89f±0.19 | L*49.05±1.21 a* -0.30±0.03 b* +22.09±0.57 | 94.16a±1.26 |
Noted: - P= Pedada puree, N= Red dragon fruit peel extract Means with different superscript letters in the same column indicate significant differences (p 0.05) between the carriers.

- PN₀ = 100% pedada puree : 0% red dragon fruit peel extract
- PN₁ = 90% pedada puree : 10% red dragon fruit peel extract
- PN₂ = 80% pedada puree : 20% red dragon fruit peel extract
- PN₃ = 70% pedada puree : 30% red dragon fruit peel extract
- PN₄ = 60% pedada puree : 40% red dragon fruit peel extract
- PN₅ = 50% pedada puree : 50% red dragon fruit peel extract

3.2 pH
There is a significant results addition of red dragon fruit peel extract on increasing of pH Pedada jam which is presented in Fig 1.

![Fig 1. Effects of red dragon fruit peel extract addition on pH of Pedada Jam.](image)

Comparing the addition of red dragon fruit peel extract, it can be noticed that the addition of fibre to pedada jam did not influence the pH of the final product. However, jams incorporated with dragon fruit peel extract, were more acidic than less added the extracts. Acidity of the fruit or its pH value is one of the most important factors in jam process which should be monitored and controlled. Indeed, acidity is an imperative fact influencing pectin gelation, texture and overall quality of fruit jams [12].

3.3 Moisture Content (MC)
There is a significant results addition of red dragon fruit peel extract on decreasing of MC Pedada jam which is presented in Fig 2.

![Fig 2. Effects of red dragon fruit peel extract addition on MC of Pedada Jam.](image)

3.4 Total Soluble Solids Content (TSSC)
As expected, increasing of red dragon fruit peel extract, significantly decreased TSSC of Pedada jam. It is expected that the higher TTSC mainly resulted from the higher soluble sugar content of pedada puree as these sugars are the main contributors of higher TSSC in pedada jam. There is a significant
results addition of red dragon fruit peel extract on increasing of TTSC Pedada jam, which is presented in Fig 3.

![Graph showing TSSC of Pedada Jam](image)

**Fig 3.** Effects of red dragon fruit peel extract addition on TSSC of Pedada Jam.

During metabolism the breakdown of carbohydrate, TSS is one of the main product were produced. The dry matter ranged between 59.8% and 66.5%. Therefore, This was why the jams incorporated with dry peel presented higher dry matter than those incorporated with lyophilized peel (Thibault, Lahaye, & Guillon, 1992).

### 3.5 Colour

There is no significant results addition of red dragon fruit peel extract on increasing of Pedada jam colour intensity which is presented in Fig 4.

![Graph showing Pedada Jam colour intensity](image)

**Fig 4.** Effects of red dragon fruit peel extract addition on Pedada Jam colour intensity.

From the graph obtained showed the stability of anthocyanin in addition of red dragon fruit peel extract, as demonstrated by lower changes in colour fading and visual appearance of the product. Increasing the addition of red dragon fruit peel product actually was not led to increasing colour stability (anthocyanin). Holzwarth et al. (2013) statet that pectin type was also influence the anthocyanin pigment stability for the strawberry jam. Pectin was shown to enhance anthocyanin stability which was mostly ascribed to electrostatic interactions between the positively charge flavylum cations and the dissociated carboxylic groups of the pectin backbone (Hubbermann, Heins, Stöckmann, & Schwarz, 2006). Furthermore, according to Grigelmo-Miguel and Martin-Belloso (1999) the addition of dietary fibre turned the strawberry jams less red, yellower and lighter of the product produced.
3.6 Antioxidant activity (DPPH assay) of extract (%)
The antioxidant activity of extract at different concentrations was evaluated applying the DPPH method and shown in Fig. 5.

![Fig 5. Effects of red dragon fruit peel extract addition on Pedada Jam antioxidant activity.](image-url)

When considering the antioxidant activity with higher addition of red dragon fruit peel extract, there is an increase in antioxidant activity. Antioxidant activity of anthocyanin is increased with increases in extract of red dragon fruit peel. This clearly suggests the effective antioxidant activity of extracts at the higher addition of red dragon fruit peel extract.

4. Conclusion
In conclusion, Pedada Jam samples prepared with different formulations showed that addition of red dragon fruit peel extract concentration had a significant effect on pH, moisture content, TSSC and colour of pedada's jam, however not significantly detected on antioxidant activity. Based on physicochemical characteristics, the best pedada’s jam formulation was that containing combination of 50% of pedada pure and 50% of red dragon fruit peel extract.

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