Colour and chemical characteristics of patty burger added with red fruit paste (*Pandanus conoideus Lamk*)

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Abstract: Red fruit is a Papua endemic plant which is rich in bioactive components such as carotene, tocopherol and fatty acids. Red fruit paste (RFP) is a waste from the process of making red fruit oil which is processed using wet rendering and still rich of bioactive component. This study aims to determine the effect of adding red fruit paste on the colour and chemical characteristics beef patties. The colour beef patty observed based formulated by different level of red fruit paste (*Pandanus conoideus Lamk*) at 0, 5, 10 and 15% to replace fat animal. The addition of up to 15% red fruit paste to beef patty formulation showed the higher L* (brightness) value and the lower value was the control patty. All red fruit paste-based beef patty enhance colour a* (redness). Higher level paste will made patty became more redness. The addition red fruit paste in 5% had higher b* (yellowness) value, on the other hand parameter of chemical characteristic of beef patty was compared with patty control treatment and patty with 15% level RFP was the best colour result. The data took before and after cooked. The protein content before and after cooking had a higher value by control treatment but for the value of fat, carbohydrate, water, ash and carotene content in the patty with 15% RFP the value was higher than the control both before and after cooking.

1. Introduction

The red fruit (*Pandanus conoideus Lamk*) is an exotic fruit that is synonymous with the ethnic life of the local Papuan community. Entotaxonomically, according to Waluyo et al (2007) the red fruit plant is one of the pandan-pandan (Pandanceae) families which has the characteristic of leaves measuring 189–200 cm, drupe 25 mm, cephalium triangular shaped with a size of 42–110 cm [1]. This fruit has a different nickname in each area of the distribution. The name of the red fruit was first introduced by researcher Made Budi because this fruit when ripe is maroon. Red fruit is used not only as a medicinal plant [2] but is also used as a spice in cooking, especially during the traditional "Barapen" event, a culinary tradition of local people with slow cook cooking techniques that use heat from a stone that is burned first and then arranged as a basis, and cover the ingredients to be cooked. All food ingredients that will be cooked, especially the meat, will be mixed first with red fruit that is in the form of a paste, this red fruit paste functions as a flavor enhancer and natural colorant to the meat that is served. Red fruit is rich in bioactive components including carotene and tocopherol compounds, the main types of carotenoids found in red fruit are lutein, β-carotene, α-carotene, γ-carotene, zeaxanthin, lycopene, prolycopene, α-cryptoxanthin, cantaxhantin, trans-lycopene and 4-keto-y-carotene [3].
carotene content of 332.58–3330.51 ppm and the total content of tocopherol between 964.52 – 11,917.81 ppm and the main composition of fatty acids in red fruit oil is oleic acid of 68.80% and linolenic acid of 8.49% [4,5]. Carotenoids are a group of polyene compounds consisting of 3 to 13 conjugated double bonds and up to 6 carbon structure rings at one or both ends of the molecule which contributes as a colorant from yellow to red in food [6]. Carotenoids have a lipophilic yellow-orange-red pigment found in photosynthetic plants, algae and other microorganisms but animals cannot synthesize carotenoids so that their intake is obtained from food [7]. Several studies on the use of red fruit paste, among others, in sausages can increase moisture content, protein content and brightness intensity, as a substitute for flour by 15% red fruit pulp produces an attractive red color on lunkhead, red color in red fruit paste can be used as a dye in mackerel fish sausage [8–10].

Patty burger is one of the restructured meat products. The advantage of restructuring products is uniformity of form and production costs that are not too expensive, because restructuring products generally use small cuts of meat [11]. Because the quality of the meat used in restructured meat is low quality meat (from the neck, quadiceps, and the part of flesh attached to the bone), one of the drawbacks is that the color of the product is not uniform due to differences in connective tissue that causes color differences and causes the product to become tough and fibrous [12]. According to Gadekar et al (2015) the use of natural antioxidants such as sodium ascorbate and alpha-tocopherol acetate can improve (P<0.01) the color of restructured goat meat products. Patty burger among healthy food adherents is classified into junk food because it contains high calories [13]. According to Gehan and Emara (2010) most meat products such as burgers are rich in animal fat content, especially saturated fatty acids and cholesterol which are associated with cardiovascular disease, some types of cancer, and obesity. Based on the content of bioactive compounds possessed by red fruit, it is very potential to be used to minimize the effects of the fast-food properties of various restructured meat products such as burgers [14].

Red fruit paste is the remnant of the production of red fruit oil which is traditionally processed, the character of the soft red fruit paste has a slightly oily emulsion and a red-orange color. This paste has not been utilized optimally, especially in restructured meat products such as burger patties. Substituting animal fat to red fruit paste is expected to increase the brightness quality and chemical value of patty conventional. This study will compare two kind of red fruit paste which made from red fruit plant by different habitat and paste with high value of bioactive component will choosing as a fat substitution in patty dough. Red fruit paste as a fat replacer in a burger patty will be analyzed for the brightness (colour) and chemical value of the burger patty. This research is hoped to be able to add information about the benefits of red fruit paste as a source of natural dyes to replace synthetic dyes in restructured meat products as well as its potential as a functional food.

2. Materials and methods
There are two step testing in this research. First testing is unpaired sample T-test method for compare the composition of bioactive component red fruit paste (carotene and tocopherol) take from two different habitat of red fruit plant. The red fruit is obtained from local farmers in Jayapura district represent the lowland red fruit (LRF) and from the district of Wamena representing the highland red fruit (HRF) of Papua Province. Red fruit paste (RFP) with highest value content used as fat substitute in the second testing. This testing used varian analize with 4 treatment and 3 repetition. Beef and spices for the patty are obtained from the local store in Malang, East Java province. The paste was obtained by using a modified wet rendering method for 60 minutes of boiling each stage and maintaining its boiling point for 20 minutes. paste and oil separated by pressing. Red fruit paste (RFP) substitutes fat with a level of 0%, 5%, 10%, 15%, the composition of other ingredients is 250 gr ground beef in each level of pasta, 0.7% carboxy methyl cellulose (CMC), eggs (1/2 g), 35 g of onions, 15 g of garlic, 4 g of salt, ½ teaspoon of pepper, ½ teaspoon coriander, ice water to taste. Ground beef with spices for 30 seconds in a food processor then add the level of red fruit paste and grind again for 30 seconds. After the dough is smooth and well blended then it is shaped, molded and steamed.
2.1. Research implementation
Carotene content was presented as total of carotenoids using the HPLC method. The analysis was carried out by ultrasonic (power sonic 405) and UV-VIS-6500 spectrophotometer. Tocopherol content according [15] was measured using HPLC brand Shimadzu LC-10 AD ODS column. Sample tocopherol levels were measured by fluorometry. The color intensity was measured as the level of brightness (lightness) using a CR-300 chromameter with a hunter notation system which has 3 parameters to describe color, namely L, a* and b*. Protein content were calculated by Kjeldahl. Fat content was calculated by soxhlet. Moisture content by the gravimetric method.

2.2. Statistical Analysis
This study used an unpaired T-test for total carotene and tocopherol data, the brightness level data used with 4 treatments and 3 replications. If the results of one-way ANOVA are significantly different, then continue with the Duncan test [16]. The data obtained were analyzed using the Statistical Program for Social Science (SPSS) for windows.

3. Results and discussion
3.1. Red fruit paste (RFP) carotene and tocopherol
Table 1 shows the comparison of the total carotene and tocopherol data of pastefrom lowland red fruit (LRF) and the highlands Red Fruit (HRF). Based on the results of the unpaired sample T-test, the mean total carotene LRF group was 2376.96 and tocopherol was 6.69, this value was higher than the HRF group for carotene 1316.34 tocopherol 3.28 and the difference was significant. This result is in line with the results of research Murtiningrum et al (2012) on the exploration of 16 cultivars of red fruit originating from the lowlands, medium plains and highlands showing that the highest total carotene content was in the lowlands with total carotene of 594.15–3,309.42 ppm [4]. The total carotene of red fruit from the moderate plains ranges from 603.16 to 857.9 ppm and the highlands ranges from 332.65–749.06 ppm.

Table 1. Tocopherol and carotene content of red fruit paste.

| Bioactive component | LRF     | HRF     |
|---------------------|---------|---------|
| Carotene (µg/g)     | 2,376.96| 1,316.34|
| Tocopherol (mg/100g)| 6.69    | 3.28    |

Note: Analysis by Maxzer Steril Laboratory Malang, 2020.

3.2. Color analyzes of beef burger patty
Table 2 shows that the L value for the patty brightness level was significantly different between each treatment. The higher the pasta level, the higher the brightness of the patty (brighter). treatment P3 has the highest L value that is 28.19 and the lowest L value is P0 as a control treatment of 18.32. The value of L (brightness) corresponds to the degree of brightness, which ranges from zero to one hundred on the chromameter. The a * value in the table shows a significant difference in P3 treatment against other treatments, but P1 and P2 treatments are not significantly different. The highest a * value was in the P3 treatment of 41.98 and the lowest was at P0 of 15.33a. These results indicate that the higher the level of pasta, the redder the patty is produced. The value of b * in the table shows that the treatment of P1 and P2 is not significantly different but is significantly different for P0 and P3. These results indicate that a paste level of 5–10% gives a stable yellowish orange color but will experience a reddish color change at a 15% paste level. This is presumably because excessive carotene levels affect the change in the
yellowish degree of the patty. The $a^*$ value indicates the color tends to be red and the $b^*$ value indicates the color tends to be yellow [18]. Red fruit paste still contains carotene and tocopherol values which are quite high and these two compounds work together to form the color in the patty. Ranjith et al (2014) carotenoids are lipophilic yellow-orange-red pigments found in photosynthetic plants, algae and microorganisms [7]. Animals are not able to synthesis carotenoids denova, so their presence is due to dietary intake. In food, in addition to their function as the natural pigments and provitamin A, these compounds can be used as food additives for coloring [19] tocopherol and tocotrienol contents of chicken nuggets blended with red palm oils before and after frying showed the potential of utilising natural vitamin rich red palm oils as animal fat analogues in improving the nutritional quality of meat products [20]. Patty color added with red fruit paste looks more attractive, according to Winarno (2004) states that determining the quality of the ingredients depends on several factors including taste, color, texture and nutritional value [21]. But before those factors are considered, visually the color factor comes first and sometimes is decisive.

Table 2. The average values of L, $a^*$ and $b^*$ beef patty added RFP.

| Beef patty | L     | $a^*$   | $b^*$   |
|------------|-------|---------|---------|
| P0         | 18.32 | 15.33   | 12.59   |
| P1         | 25.38 | 35.67   | 31.34   |
| P2         | 26.42 | 35.23   | 31.23   |
| P3         | 28.19 | 41.98   | 23.66   |

Numbers followed by the same letter (a) in the same column mean significantly different at the Duncan test level of 5% ($P<0.05$).

3.3. Proximate chemical composition and carotene of patty
Table 3 Shows that the addition of red fruit paste in a burger patty before cooking has a significant effect on protein and fat variables but has no significant effect on carbohydrate and water and ash content. P0 treatment as control had higher protein and fat values before and after cooking compared to P3. The protein value in P3 is presumably lower because the red fruit paste which is dominant in fatty acids and fat derivatives such as carotene and tocopherol during the processing process attracts some of the non-polar protein due to the rupture of the hydrophobic protein bonds and has an effect on the stability of the P3 fat content value. But the value of protein and fat in this study is still in accordance with SNI 2002 [22] standards for burgers, namely 13% protein minimum and 20% maximum fat. The body contains large amounts of protein. Protein, the main building block in the body, is the primary component of most cells. For example, muscle, connective tissues, and skin are all built of protein [23]. Fat content at P0 decreased after cooking probably due to evaporation. according to Sugiyono (2014) several fatty acids that have a C atom of less than 12 are classified as volatile or volatile fatty acids [24]. Amany et al (2012) stated that the higher the cooking temperature will cause a product to become more porous and the emulsions can break, this causes the water content and fat content to decrease [25]. Fats are complex molecules composed of fatty acids and glycerol. The body needs fats for growth and energy. It also uses them to synthesize hormones and other substances needed for the body's activities such as prostaglandins [24].

The moisture, carbohydrate and ash content in the P0 and P3 treatments were generally non-significant, the water content tended to increase after cooking but the carbohydrates and ash decreased during cooking. according to SNI 2002 regarding quality requirements for burgers with a maximum water content of 60% and a maximum carbohydrate of 25% [22]. The water content and carbohydrate values of the two treatments in this study did not meet the SNI standards. Carbohydrates, proteins, and fats are digested in the intestine, where they are broken down into their basic units: Carbohydrates into sugars, Proteins into amino acids, Fats into fatty acids and glycerol. According to Claessens et al (2009)
in overweight and obese people, a high protein diet is considered to be more effective in weight loss and has a positive effect on glycemic control [26].

The carotene values in the two treatments were significantly different and decreased after cooking. Carotene in P0 is contributed by egg yolk as one of the ingredients in the composition of the patty and carotene in P3 from the accumulation of egg yolk carotene and red fruit paste.

| Table 3. Proximate chemical composition and carotene of patty burger. |
|---------------------------------------------------------------|
| Control (P0) | RFP 15% |
| water (%)    | 61.97<sup>a</sup> | 63.11<sup>a</sup> |
| ash (%)      | 4.06     | 3.99     |
| protein (%)  | 23.21<sup>a</sup> | 21.89<sup>a</sup> |
| fat (%)      | 10.45    | 10.27    |
| carbohydrate (%) | 0.31 | 0.74 |
| carotene (µg/g) | 1.26<sup>a</sup> | 165.27<sup>a</sup> |

Caption: Analysis of Food Technology Laboratory at Brawijaya University of Malang 2020. Numbers followed by the same letter (a) in the same line mean significantly different at the Duncan test level of 5% (P<0.05).

4. Conclusions

Red fruit paste from lowlands has higher carotene and tocopherol values than highland pasta. Based on the degree of brightness L* (lightness) and a* (redness), the highest value was on a patty with an RFP level of 15% while the degree of yellowness was the highest on a patty with an RFP level of 5%. The protein content of the patty before and after cooking the control treatment had a higher value than the patty with an RFP level of 15% but for the value of fat, carbohydrate, water, ash and carotene content in the patty with 15% RFP the value was higher than the control both before and after cooking.

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