Mixed vegetable-fruit leathers properties on various proportions on several fruits with mustard greens (*Brassica juncea*)

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Abstract. Mustard greens (*Brassica juncea*) is highly produced lowland leafy vegetable in Sidoarjo, East Java, Indonesia. There has not been any other usage of mustard greens in this region besides for culinary purposes while leafy vegetable is perishable product. Leather is maybe the answer of product diversity in commercial utilizations. Leathers made by mixing mustard greens and fruits purees with proportions of 40% : 60%; 60% : 40%; and 80% : 20% using tropical fruits those are jackfruit, pineapple, and papaya. The physicochemical and sensory studied showed that mixing mustard greens with fruits increased crude fiber content, rendemen and hardness of vegetable-fruit leathers. The best treatment in this experiment is proportion of mustard greens with pineapple (60%:40%) with physicochemical and sensory properties were 11.57% moisture; 2.72% ash; pH 4.20; lightness 43.59; redness -4.69; yellowness 5.53; 1.02% fiber; yield 30.58%; hardness 503.15; sensory color 4.90 (neutral-rather like); sensory aroma (neutral-rather like); sensory texture 5.07 (rather like-like); and sensory taste 5.00 (rather like).

Keyword: mixed vegetable-fruit leather, mustard greens, proportions

1. Introduction

Mustard greens (*Brassica juncea*) is highly produced lowland leafy vegetable in Sidoarjo, East Java, Indonesia i.e about 61 tons in the year of 2017 (Statistics of Sidoarjo Regency, 2017 ). There has not been any other usage of mustard greens in this region besides for culinary purposes while leafy vegetable is perishable product. On the other side, average vegetable consumption in Indonesia is 73 kgs/ year below FAO recommendation for vegetable consumption 91.25 kg/capita/year. Vegetable consumption animo may be increased by processing vegetable into products, like vegetable-fruit leather. Fresh fruit and vegetables are known to be excellent sources of minerals, vitamins and fiber, and dried vegetables and fruits have been regarded as alternative fat free snacks (Suna et al., 2014). Fruit leather, also called a fruit bar or a fruit slab is chewy and flavorfull, naturally low in fat and high in fiber and carbohydrates (Diamante et al., 2014). Fruit leather is made by the dehydration of fruit.
which is increased shelf life of the product and can result in unique properties. The form of fruit leather is like a sheet with sweet taste, soft, gummy texture, water content ranged between 15 up to 25% and storage capacity up to 9 months (Fauziyah, 2017). The major challenge of drying process is to reduce moisture content of the material to the desired level without substantial loss of flavor, taste, color, and nutrients (Abdel Rahman et al., 2017).

Leather is a kind of product which is processed by drying fruit purees, mixed together with food additives which define the leathers intrinsic properties taste, texture, flexibility, color, and viscosity among others (Sánchez Riaño et al., 2018). Usually fruit leather is made from strong flavor and high pectin fruits. Several tropical fruit native Indonesia has been researched for fruit leather for instance jackfruit (Fitrianti et al., 2014), pineapple (Prasetyowati et al., 2014), mango and red dragon fruit (Ariadanti et al., 2015), red guava and soursop (Astuti et al., 2016); tamarind (Rahman et al., 2017); and papaya (Ahammad et al., 2016). Modification of fruit leather into vegetable leather in Indonesia also has been researched for several vegetables as carrot (Prasetyowati et al., 2014); squash and broccoli (Estiari et al., 2016); cucumber (Siburian and Dahang, 2018); mush yellow velvet leaf and chayote (Limpong et al., 2017). Flavor of mustard greens may become problems as mustard greens has strong herb flavor. Flavor problems may be solved by mixing mustard greens with fruits in a product of mixed vegetable-fruit leather. Papaya (Carica papaya), pineapple (Ananas comosus) and jackfruit (Artocarpus integra) are popularly fruits grown in the tropics and relatively have strong flavor.

2. Materials and Methods

2.1. Materials

Mustard greens, jackfruits, pineapples, and papayas were obtained from local market at Sidoarjo. Fruits of about ¾ ripeness and mustard greens of full freshness were selected for experiments. Citric acid, sugar, and carageenan food grade were also used in this experiments besides all chemicals for product analyzes.

2.2. Vegetable-fruit leather preparation

Mustard greens and fruits were washed and cut and mustard green then blanched on 70 ºC for 3 minutes. Mustard greens and fruits then destructed by domestic blender to make puree by adding water 50% of vegetable and fruits weights. Leathers then made by mixing mustard greens and fruits purees with proportions of 40% : 60%; 60% : 40%; and 80% : 20%. Those mixed vegetable-fruit purees then were added by 20% sugar, 1% carageenan and 0.2% citric acid and heated in temperature 100 ºC for 5 minutes. Mixed vegetable-fruit purees which were made of 300 g each then poured on same size trays and dried in cabinet oven with temperature 55 ºC for 18 hours.

2.3. Chemical properties analyzes

Moisture content of dried mixed vegetable-fruits leather were measured by gravimetry method using an air oven at 105 ºC. Moisture contents of samples were calculated on a percent of wet basis. Ash content were determined by using domestic furnace on temperature 400 ºC followed by 550 ºC. Samples of 1 g leather were burned on burner then heated in furnace. Ash content were calculated on a percent of burned samples weight. pH of vegetable-fruit leather were measured by domestic pH meter. Samples of 2 g were diluted in 18 ml aquades t and pH were measured. pH meter was calibrated first in buffer of pH 7 and buffer pH 4 for punctual read. Crude fiber of leather were measured by hydrolyzing samples with acid and base compound. Residues of those reactions is crude fiber.

2.4. Physical properties analyzes

Yield were measured by gravimetry method. Leather were weighed and were calculated on a percent of wet mixture puree. The color values of leathers were measured by domestic color reader. The instrument was calibrated before each measurement with a white and black ceramic tile. Measurement were done in three replications on different positions to obtain average values of L*, a* , and b*. Textural characteristic of vegetable-fruit leathers were determined by measuring the force needed to
restructure the leather using Brookfield Texture Analyzer CT3 equipped with a 1000 g load cell. Samples were prepared in size of 3 cm x 3 cm and was pressed twice by type TA 9 probe until 30% from initial height. Test speed were set to 10 mm/s, trigger load to 6.8 g and target of the probe to 8.0 mm. Collected data were comprised of hardness, cohesiveness, adhesiveness, springiness, chewiness, and gumminess.

2.5. Sensory evaluation of mixed vegetable-fruit leather samples
The hedonic tests of the mixed vegetable-fruit leathers were carried out using 30 members panelist selected from University community. The panelists were guided on how to carry out the tests. The sample was evaluated for characteristics such as color, aroma, texture, and taste. A 7-point hedonic scale was used. In the questionnaire distributed to the panelist, they were instructed to score 7 for really like and 1 for really dislike.

2.6. Statistical analysis
Randomized Completely Blocked Design were used in this experiment with three replications. Tukey Honesty Significant Difference test used as further test, based on significant difference of $p \leq 0.05$. Hedonic properties were analyzed by nonparametric statistics and Friedman test as further test, based on significant difference of $\alpha = 0.05$.

3. Results and Discussion
3.1. Physicochemicals properties of mixed vegetable-fruit leather
3.1.1. Chemical properties.
Table 1. shows that all variables observed were significantly difference on various proportions of mustard greens with fruits. Mustard greens has the lowest crude fiber. Mixing mustard green with fruits increased crude fiber content. Mixed vegetable leather with proportion of mustard green 40% with jackfruit 60% had highest crude fiber content.

| Proportions          | Crude fiber (%) | Moisture (%) | Ash (%) | pH       |
|----------------------|-----------------|--------------|---------|----------|
| Mustard greens 100% : fruits | 0.68±0.07 a      | 22.26±0.97 b  | 3.69±0.24 e     | 4.46±0.17 a   |
| Mustard greens 40% : Jackfruit 60% | 1.45±0.25 b    | 12.77±3.31 ab | 3.55±0.01 de   | 4.54±0.08 a   |
| Mustard greens 60% : Jackfruit 40% | 1.04±0.05 ab   | 11.24±1.21 a  | 3.34±0.375 cde | 4.55±0.02 a   |
| Mustard greens 80% : Jackfruit 20% | 0.76±0.54 ab    | 14.29±6.57 ab | 2.81±0.07 b    | 4.50±0.21 a   |
| Mustard greens 40% : Pineapple 60% | 1.29±0.12 ab    | 20.49±4.51 ab | 3.04±0.31 bc   | 4.33±0.17 a   |
| Mustard greens 60% : Pineapple 40% | 1.02±0.18 ab    | 11.57±1.67 a  | 2.72±0.10 b    | 4.20±0.09 a   |
| Mustard greens 80% : Pineapple 20% | 1.07±0.35 ab    | 12.46±2.63 ab | 2.15±0.11 a    | 4.37±0.19 a   |
| Mustard greens 40% : Papaya 60% | 0.75±0.12 ab    | 16.63±4.46 ab | 3.58±0.19 de   | 4.52±0.05 a   |
| Mustard greens 60% : Papaya 40% | 0.80±0.11 ab    | 16.02±0.35 ab | 3.14±0.26 bc   | 4.56±0.14 a   |
| Mustard greens 80% : Papaya 20% | 0.83±0.24 ab    | 12.07±0.94 a  | 3.04±0.27 bc   | 4.54±0.03 a   |

Figs those followed by the same character in the same column shows non significant difference ($p \leq 0.05$)
Table 2. Physical properties of mixed vegetable-fruit leather on various proportions of mustard greens 
(*Brassica juncea*) with fruits

| Proportions          | Yield (%) | Lightness | Redness | Yellowness |
|----------------------|-----------|-----------|---------|------------|
| Mustard greens 100% : fruits 0% | 25.58±3.25 ab | 44.14±2.26 | -4.68±0.42 b | 2.39±0.217 a |
| Mustard greens 40% : Jackfruit 60% | 34.04±2.66 d | 44.55±1.35 | -4.51±0.05 b | 4.36±0.14 abc |
| Mustard greens 60% : Jackfruit 40% | 30.31±2.82 bcd | 44.80±3.82 | -4.92±0.63 b | 3.94±1.00 abc |
| Mustard greens 80% : Jackfruit 20% | 23.49±2.11 a | 43.88±1.39 | -5.31±1.18 b | 2.64±1.24 a |
| Mustard greens 40% : Pineapple 60% | 31.98±2.99 cd | 46.12±5.45 | -4.15±0.65 b | 6.00±1.08 cd |
| Mustard greens 60% : Pineapple 40% | 30.58±1.70 bcd | 43.59±1.34 | -4.69±0.33 b | 5.53±0.09 bcd |
| Mustard greens 80% : Pineapple 20% | 24.81±2.44 ab | 45.30±2.72 | -4.85±0.73 b | 3.24±0.34 ab |
| Mustard greens 40% : Papaya 60% | 35.55±1.08 d | 44.21±1.84 | -1.39±1.12 a | 7.04±0.71 d |
| Mustard greens 60% : Papaya 40% | 32.44±0.34 cd | 42.94±0.67 | -4.82±0.50 b | 4.08±0.67 abc |
| Mustard greens 80% : Papaya 20% | 26.83±0.84 abc | 44.25±1.57 | -4.55±0.42 b | 4.09±1.65 abc |

Figures those followed by the same characters in the same column shows non significant difference (p≤ 0.05)

Leathers crude fiber content tent higher on treatments with increasing proportions of jackfruit or pineapple. This result was due to higher fiber contents of jackfruit and pineapple than mustard greens and papaya. Jack fruit fiber content is 1.58% (Winarsih and Sapandi, 2014), pineapple is 1.40% (Prasetyowati et al., 2014), while mustard greens and papaya are 0.70% (Department of Health, 2004).

Highest moisture was achieved by treatment of 100% mustard greens i.e 22.26% although it was not significant different from several treatments. Moisture content of mustard greens is 92.20%, highest from other fruits material which made the above result. Fruit leather moisture also affected by fruit or vegetable fiber content which was showed by treatment of proportion of mustard greens with pineapple (40%:60%). This might be of high fiber content of pineapple i.e 1.40% higher than mustard greens of 0.70% which gave 20.49% moisture on the treatment (Department of Health Republic of Indonesia, 2004), where fibers absorb moisture due to high existence of hydroxiles group in it which becomes polar (Lubis et al., 2014; Risti and Herawati, 2017; Sinaga et al., 2017).

Highest ash content of 3.69% was achieved by 100% mustard greens although was not significantly different with proportions of mustard greens and jackfruit (40% : 60%) and (60% : 40%), also mustard greens and papaya (40% : 60%), this was because mustard greens has highest ash that is 0.90% (Department of Health Republic of Indonesia, 2004). High ash content also due to carageenan which has 15.81% (Augustin et al., 2017).

Proportion of mustard greens with pineapple (60%:40%) tent to gave the lowest pH i.e 4.20, although was not significantly difference with all other treatments. Leather of other proportions of mustard greens with pineapple tent to have lower pH than other fruits, this may be due to highest total acid present in pineapple which was lowering leathers pH (Lubis et al., 2014).
3.1.2. Physical properties.
Table 2 shows that various proportions of mustard greens with fruits significantly affected rendemen, redness and yellowness, but not on lightness of mixed vegetable-fruit leathers.

Table 3. Texture profile of mixed vegetable-fruit leather on various proportions of mustard greens (Brassica juncea) with fruits

| Proportions          | Hardness (g) | Cohesiveness | Adhesiveness (mJ) | Springiness (mm) | Chewiness (mJ) | Gummyness (g) |
|----------------------|--------------|--------------|-------------------|------------------|----------------|----------------|
| Mustard greens 100%  | 234.82±       | a            | 1.49±0.          | 0.91±0.63        | a              | 6.55±1.05      | 21.20±1.5     | 489.90±       | d             |
| fruits 0%            | 41.00±        | 65           | 3                | ±52.31           | 1.49±0.63      | 6.62±0.98      | 22.71±1.3     | 471.33±       | cd            |
| Mustard greens 40%   | 300.52±       | ab           | 0.93±0.          | 0.23±0.09        | a              | 6.15±0.27      | 24.65±1.3     | 456.60±       | bc            |
| Jackfruit 60%        | 20.86±        | cd           | 0.98±0.          | 0.93±0.79        | a              | 6.55±1.05      | 21.20±1.5     | 489.90±       | d             |
| Mustard greens 60%   | 503.52±       | d            | 13.               | 9±45.56          | 5.96±1.06      | 14.59±1.8     | 255.23±       | a             |
| Jackfruit 20%        | 24.50±        | 30           | 0.12±0.          | 1.41±0.          | a              | 6.90±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Mustard greens 80%   | 365.80±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Pineapple 60%        | 300.52±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Mustard greens 60%   | 503.52±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Pineapple 40%        | 24.50±        | 30           | 9±45.56          | 1.31±0.          | 7.15±0.05      | 27.71±1.7     | 375.43±       | ab            |
| Mustard greens 80%   | 365.80±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Pineapple 20%        | 300.52±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Mustard greens 60%   | 503.52±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Pineapple 40%        | 24.50±        | 30           | 9±45.56          | 1.31±0.          | 7.15±0.05      | 27.71±1.7     | 375.43±       | ab            |
| Mustard greens 80%   | 365.80±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Pineapple 20%        | 300.52±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Mustard greens 60%   | 503.52±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Pineapple 40%        | 24.50±        | 30           | 9±45.56          | 1.31±0.          | 7.15±0.05      | 27.71±1.7     | 375.43±       | ab            |
| Mustard greens 80%   | 365.80±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |
| Pineapple 20%        | 300.52±       | ab           | 0.23±0.          | 1.60±0.          | a              | 6.09±0.94      | 15.50±2.3     | 344.63±       | ab            |

Yield of mixed vegetable-fruit leathers were the lowest in proportions of 100% and 80% mustard greens with any fruits. Moisture was changed into vapour in drying process and reduced leathers weight. Materials remained in greatest part maybe crude fiber in which mustard greens contains the lowest.

Leathers of proportions with pineapple showed brighter than others, this was because acids which present in pineapple influence brightness of color (Offia-Olua and Ekwunife, 2015). Differences in value of redness and yellowness were effected by pigment contained in fruits and mustard greens. Treatment on proportion of mustard greens with papaya (40% : 60%) has a highest redness and highest yellowness as papaya has anthocyanins (Addai et al., 2016). Sugar addition in processing leathers brings it to caramelization process in high temperature condition (Mulyani et al., 2015) then effected leathers appearance.

3.2. Texture profile. Table 3 shows that from six variables measured in texture profile, various proportions of mustard greens with fruits significantly effected hardness and gumminess.

Mixing mustard greens with fruits gave higher hardness and gumminess than other fruits. Fig 1. shows that there was correlation between hardness and moisture content in mixed vegetable-fruit leathers, 85.20% leathers hardness were effected in negative by moisture. The higher the moisture, the lower the hardness. Similar result was also observed in Patil et al. (2017) research on date and mango leather and Vijayanand et al. (2000) on mango and guava leather.
3.3. Hedonic properties of mixed vegetable-fruit leathers. Table 4. shows that various proportions of mustard greens with fruits significantly affected hedonic properties of color and texture of mixed vegetable-fruit leathers.

Table 4. Hedonic Properties of Mixed Vegetable-Fruit Leather on Various Proportions of Mustard Greens (Brassica juncea) with Fruits

| Proportions | Color | Aroma | Texture | Taste |
|-------------|-------|-------|---------|-------|
|             | Means Total Rank | Means Total Rank | Means Total Rank | Means Total Rank |
| Mustard greens 100% : fruits 0% | 4.10 45.00 abc | 4.27 42.50 | 4.13 48.50 abc | 4.10 42.00 |
| Mustard greens 40% : Jackfruit 60% | 4.30 54.00 abcd | 4.13 44.50 | 3.43 29.50 a | 4.40 58.00 |
| Mustard greens 60% : Jackfruit 40% | 4.50 60.50 cd | 4.67 57.00 | 4.00 53.00 bc | 4.17 44.50 |
| Mustard greens 80% : Jackfruit 20% | 4.37 57.50 bcd | 4.43 48.50 | 4.20 47.00 abc | 4.13 42.50 |
| Mustard greens 40% : Pineapple 60% | 3.93 44.00 abc | 4.37 43.50 | 3.83 41.00 ah | 4.20 51.00 |
| Mustard greens 60% : Pineapple 40% | 4.90 72.00 d | 4.97 70.50 | 5.07 78.00 d | 5.00 73.00 |
| Mustard greens 80% : Pineapple 20% | 4.90 74.50 d | 4.93 67.00 | 4.43 65.50 cd | 4.63 63.00 |
| Mustard greens 40% : Papaya 60% | 3.77 33.00 a | 4.23 41.50 | 4.30 53.50 bc | 4.10 43.00 |
| Mustard greens 60% : Papaya 40% | 3.90 36.50 ab | 4.80 67.00 | 4.87 68.00 cd | 4.80 66.50 |
| Mustard greens 80% : Papaya 20% | 4.93 73.00 d | 4.83 68.00 | 4.67 66.00 cd | 4.80 66.50 |

Figs those followed by the same character in the same column shows non significant difference by Friedman Test ($\alpha = 0.05$)

Colors of treatments of proportion of mustard greens with papaya (80%:20%); mustard greens with pineapple (60%:40%) and (80%:20%) were more being liked by panelist, evidently tent to have similar yellowness (Table 2.).

Panelist preferred several leathers aroma which were mixed with fruits especially for pineapple. Table 4. also shows that panelist more like leather texture formed by mixing mustard greens with pineapple and papaya in proportions of (60%:40%) and (80%:20%), those textures were mediocre in hardness and gumminess (Table 3.). Acids which is present in food, as pineapple in this experiment influence leathers flavor, brightness of color, stability and consistency (Offia-Olua and Ekwenife, 2015).

3.4. Best Treatment

Best treatment was calculated based on effectivity value procedure which preceded by procedure of determination of relative quality scale. Relative quality scale (0 – 1.00) was compiled based on consumers hedonic priority survey on selected variables measured which effected leathers quality. Relative quality scale in this experiment were hedonic taste (1.00); hedonic aroma (1.00); hedonic color (1.00); hedonic texture (1.00) color (1.00); texture (1.00); pH (0.90), fiber content (0.90), moisture (0.90), ash (1.00), and rendemen (0.90). Normal value then calculated by multiplying these Figs with each variables observed data. Table 5. presents normal data for all treatments applied, the highest is the best treatment.

The best treatment in this experiment is proportion of mustard greens with pineapple (60%:40%) with physicochemical and hedonic properties has 11.57% moisture; 2.72% ash; pH 4.20; lightness 43.59; redness -4.69; yellowness 5.53; 1.02% fiber; rendemen 30.58%; hardness 503.15; hedonic color 4.90 (neutral-rather like); hedonic aroma (neutral-rather like); hedonic texture 5.07 (rather like-like); and hedonic taste 5.00 (rather like).
Table 5. Normal value of treatments calculated for determining best treatment on mixed vegetable-fruit leathers

| Parameters       | M100 | MJ406 | MJ604 | MJ802 | MP406 | MP604 | MP802 | MA406 | MA604 | MA802 |
|------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Moisture         | 22.26| 12.77 | 11.24 | 14.29 | 20.49 | 11.57 | 12.46 | 16.63 | 16.02 | 12.07 |
| Ash              | 3.69 | 3.55  | 3.34  | 2.81  | 3.04  | 2.72  | 2.15  | 3.58  | 3.14  | 3.04  |
| pH               | 4.46 | 4.54  | 4.55  | 4.50  | 4.33  | 4.20  | 4.37  | 4.52  | 4.56  | 4.54  |
| Colour L*        | 44.14| 44.55 | 44.80 | 43.88 | 46.12 | 43.59 | 45.30 | 44.21 | 42.94 | 44.25 |
| Colour a*        | 4.68 | 4.51  | 4.92  | 5.31  | 4.15  | 4.69  | 4.85  | 1.39  | 4.82  | 4.55  |
| Colour b*        | 2.39 | 4.36  | 3.94  | 2.64  | 6.00  | 5.53  | 3.24  | 7.04  | 4.08  | 4.09  |
| Crude Fiber      | 0.68 | 1.45  | 1.04  | 0.76  | 1.29  | 1.02  | 1.07  | 0.75  | 0.80  | 0.83  |
| Rendemen         | 25.58| 34.04 | 30.31 | 23.49 | 31.98 | 30.58 | 24.81 | 35.55 | 32.44 | 26.83 |
| Texture 2        | 234.8| 390.52| 560.52| 365.80| 250.85| 503.15| 467.80| 285.13| 335.72| 470.47|
| Color            | 4.10 | 4.30  | 4.50  | 4.37  | 3.93  | 4.90  | 4.90  | 3.77  | 3.90  | 4.93  |
| Aroma            | 4.27 | 4.13  | 4.67  | 4.43  | 4.37  | 4.97  | 4.93  | 4.23  | 4.80  | 4.83  |
| Texture          | 4.13 | 3.43  | 4.00  | 4.20  | 3.83  | 5.07  | 4.43  | 4.30  | 4.87  | 4.67  |
| Taste            | 4.10 | 4.40  | 4.17  | 4.13  | 4.20  | 5.00  | 4.63  | 4.10  | 4.80  | 4.80  |
| Total            | 0.35 | 0.52  | 0.49  | 0.37  | 0.54  | 0.71**| 0.56  | 0.43  | 0.51  | 0.57  |

Note: ** best treatment

4 Conclusion
Processing mustard greens to be mixed vegetable-fruit leather is one of diversity product in commercial utilization. The physico-chemical and sensory studied showed that mixing mustard greens with fruits increased crude fiber content, rendemen and hardness of vegetable-fruit leathers. The best treatment in this experiment is proportion of mustard greens with pineapple (60%:40%) with physicochemical and hedonic properties has 11.57% moisture; 2.72% ash; pH 4.20; lightness 43.59; redness -4.69; yellowness 5.53; 1.02% fiber; rendemen 30.58%; hardness 503.15; sensory color 4.90 (neutral-rather like); sensory aroma (neutral-rather like); sensory texture 5.07 (rather like-like); and sensory taste 5.00 (rather like).

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