Jobs Tears (Coix lacryma-jobi L.): the potentials of Indonesian under-utilized grains for herbal tea production

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Abstract. Jobs Tears (Coix lacryma-jobi L.) is one of the potential local food resources which contains highly nutritional and therapeutic values. Owing to its health beneficial compound, Jobs Tears can be considered as a nutraceutical. However, the utilization of this species is still limited due to a lack of awareness and attention from society. To promote utilization of Jobs Tears, by introducing its new acceptable and easy-to-eat products, this study aims to make new Jobs Tears-based herbal tea. Roasting is the critical stage in producing a high quality herbal tea. Roasting temperature and roasting duration treatment will affect the sensory qualities of the tea product. In this study, the different roasting temperatures (80, 100, 120°C) and roasting time (0.5, 1.0 and 1.5 hours) were combined to assess their effect on the organoleptic properties of Jobs Tears herbal tea. The organoleptic properties analysis showed that the best Jobs Tears herbal tea was achieved under a roasting temperature of 100°C for 1 hour. The result obtained in the present study could allow Jobs Tears as a new potential alternative food source.

1. Introduction
Food diversification is one of the most important issues in Indonesia today. Ariani et al. [1] explain that the definition of food diversification is the effort to expand upon various staple foods in order to not primarily have one source of a basic ingredient, which is rice in Indonesia. Indonesia, like other developing countries, is faced with the problem of maintaining food diversification itself. One alternative solution that can be used for a variety of staple foods is Jobs Tears.

Jobs Tears (Coix lacryma-jobi L.) is one of the promising local food resources which contains highly nutritional and therapeutic values. Jobs Tears plant originated from Southeast Asia and has long been developed in China and India because of its nutritional contents. This is a cereal-based plant with high carbohydrate content and rich in other nutritional values as well [2].

Due to its health-beneficial compound, Jobs tears seeds can be considered as a nutraceutical. However, the utilization of this species is still limited due to a lack of awareness and attention from society. Currently, Jobs Tears in Indonesia is still not used as an alternative material because farmers think that Jobs tears is a plant that is difficult to harvest. Farmers think this way because it requires a long harvesting time [3]. However, according to Nurmala [4], Jobs Tears are still rarely utilized, and up until now, people have used Jobs Tears not as a staple food ingredient but only as a type of material for accessories. In order to promote the utilization of Jobs Tears, this study was aimed to make new Jobs tears-based herbal tea by introducing its new acceptable and easy-to-eat products.
2. Material and methods

2.1. Time and location
Organoleptic tests were done in Baratimur Coffee Shop at Malang City. Due to the COVID-19 pandemic, the organoleptic test was unable to be performed at a food quality testing lab. However, certain circumstances were still made to make the café’s condition similar to that of a lab testing’s condition. The research was done for 11 months, from July 2020 to June 2021. In this study, the organoleptic assessment of Jobs Tears herbal tea used a preference test (Hedonic Scale Scoring). In this test, the panellists were given nine Jobs Tears herbal tea samples, each containing 15 ml of herbal tea. Panellists were asked to provide feedback regarding the Jobs Tears herbal tea, which was served. In this organoleptic test, a preference level value or a hedonic scale was given from 1-5, where the number will interpret from extremely disliked to extremely liked. From this value, a scale of preference level will be obtained between the different herbal tea treatments. The number of panellists used was 60 untrained panellists. The rating of Jobs Tears herbal tea itself was based on the colour, aroma, and flavour of the herbal tea.

2.2. Materials
Jobs Tears seeds were obtained online from an online marketplace that originated from Central Java, Yogyakarta. Other materials and tools that were used for experimenting were done at home. The method of creating Jobs Tears herbal tea was based on a modified version.

2.3. Sample preparation
100 grams of Jobs Tears seeds were first cleaned in order to remove any excess dirt on the surface of the seeds using cold tap water and rinsed afterward. This step was repeated 3 times until the water produced as a by-product of cleaning was clear in colour.

2.4. Steaming and drying
Seeds were then placed in an open container and partially steamed for 5 minutes with a temperature of 100 °C to open up the pores of the surface of the seeds to make them softer using a steamer. Naturally, the seeds have a rough and hard texture and thus need to be steamed first to make them softer and create a better texture in the final product. After that, the seeds were then cleaned once more using cold tap water once.

Jobs Tears seeds then go through a drying process where the seeds were placed on a baking tray with enough spacing to have an even spread of seeds and not have the seeds stack up on one another. The oven was prepared beforehand and was set to a temperature of 100°C and dried for 1 hour. Drying time and temperature factors in the drying stage have a very significant effect on yield, moisture content, ash content, and colour brightness [5]. Carabajal [6] emphasizes that the higher the temperature and the drying time, the lower the yield, water content, and ash content for the specified beverage.

2.5. Roasting
After drying, Jobs Tears seeds were taken out of the oven and cooled at room temperature for 10 minutes. Roasting was then prepared by setting up an electric stove and a stainless steel frying pan. Jobs Tears seeds were then placed in the frying pan and roasted with a temperature of 80, 100, and 120°C for a duration of 0.5, 1.0, and 1.5 hours respectively. Roasting is the critical stage in producing a high-quality herbal tea. Roasting temperature and roasting duration treatment will affect the sensory qualities of the tea product [7].

2.6. Grinding
The final step was the grinding process, where Jobs Tears seeds were first cooled down at room temperature and then placed in a high-powered blender for 1-3 minutes until it produced an even powdered texture. The seeds produced must have a powder size of 70 to 160 mesh size.
2.7. Sensory analysis of herbal tea
After the seeds have gone through all the processes above, final assembly can now be done. Jobs Tears herbal tea used a ratio of 5 grams of powdered seeds to 100 ml of boiling water. After many trials, using a ratio of fewer than 5 grams produced an herbal tea that does not have a bold and distinct flavor and is similar to just hot water. Meanwhile, using a ratio of above 5 grams produced an herbal tea that was difficult to blend with the hot water due to the number of powdered seeds within it, and thus using a ratio of 5 grams produced an optimal amount of flavor profile and pleasantry for the average consumer. Each Jobs Tears herbal tea variation was then placed in individual cups with 5 grams of powdered jobs tears and 100 ml of boiling water and stirred to be homogeneous. The herbal tea was then allowed to brew for 2 minutes before drinking. An amount of 1.5 ml was then taken from each sample and placed in small cups ready for organoleptic testing.

3. Results and discussion
3.1. The effect of roasting on colour of herbal tea
The physical colour in herbal tea is a sensory attribute that will be first observed when consumers see the product [8]. Colour is also a factor that determines the quality of food [9]. According to Pinto et al. [7], this is what makes colour an important attribute in the sensory evaluation as it is correlated to a panellist’s attractiveness towards the product itself. Treatment with roasting time combined with roasting temperature is expected to produce products with colours that are preferred by the average consumer. The average level of panellist’s preference for the colour produced by Jobs Tears herbal tea ranged from 2.25 to 3.67. The effect of roasting time and roasting temperature on the panellist’s preference level on the colour attribute of Jobs Tears herbal tea is presented in Figure 1.

![Figure 1](image)

**Figure 1.** Level of panellist’s preference on colour attribute.

Based on the results of analysis using the Friedman test, the results showed that the roasting time (0.5, 1.0, and 1.5 hours) and roasting temperature (80, 100, and 120°C) had a significant effect on the level of preference for the colour attribute of Jobs Tears herbal tea (p<0.05). The results of the average level of preference for colour attribute due to roasting time and roasting temperature can be seen in Table 1.

Results show that the roasting duration of 0.5 hours and 1.5 hours with a roasting temperature of 80°C and 120°C were the most disliked. This could be due to the fact that the colour of the herbal tea was too light or too dark for the average consumer. This indicates that the treatment with a roasting time of 1 hour and a roasting temperature of 100°C was the most preferred amongst the rest. The colour produced by this treatment was a caramel browned colour. The longer the duration of roasting and the higher temperature used, the darker the herbal tea that was produced. Albertini [10] explains that this was caused by the oxidation of the seeds during the roasting process where the higher temperature
contributed to adding additional oxygen towards the surface of the seeds and resulting in a darker coloured seed.

Table 1. Average level of preference for colour attribute.

| Roasting time | Roasting temperature | Average preference (1-5) | Colour          | Notation | Post hoc significance       |
|---------------|----------------------|--------------------------|-----------------|----------|-----------------------------|
| 0.5 hours     | 80°C (aa)            | 2.25                     | Chalky White    | a        | Significant Difference      |
|               | 100°C (ab)           | 2.89                     | White grey      | b        | Significant Difference      |
|               | 120°C (ac)           | 3.18                     | Light Brown     | b        | No Significant Difference   |
| 1.0 hours     | 80°C (ba)            | 3.54                     | Light Brown     | bc       | Significant Difference      |
|               | 100°C (bb)           | 3.67                     | Caramel Brown   | bcd      | Significant Difference      |
|               | 120°C (bc)           | 3.58                     | Dark Brown      | cde      | Significant Difference      |
|               | 80°C (ca)            | 3.45                     | Dark Brown      | cde      | No Significant Difference   |
| 1.5 hours     | 100°C (cb)           | 3.12                     | Black           | de       | Significant Difference      |
|               | 120°C (cc)           | 2.43                     | Black           | e        | Significant Difference      |

3.2 The effect of roasting on the aroma of herbal tea

The aroma of herbal tea is another important aspect that can determine the quality of the overall product itself. The aroma of a certain product is able to determine whether the tea can be accepted or rejected before being flavoured. Aroma compounds will also depend on the manufacturing process such as enzymatic oxidation and drying [9]. The average preference value for the aroma of Jobs Tears herbal tea is around 2.68 – 3.24. The effect of roasting time and roasting temperature of Jobs Tears herbal tea based on the panellists’ preference level on the aroma attributes of herbal tea is presented in Figure 2.

Based on the Friedman test, it was found that the level of preference for aroma on the length of roasting time (0.5, 1.0, and 1.5 hours) and roasting temperature (80, 100, and 120°C) had a significant effect on the level of preference for the aroma attribute of Jobs Tears herbal tea (p<0.05). The results of the average level of preference for Jobs Tears herbal tea for aroma attributes with the effect of roasting time and roasting temperature can be seen in Table 2.

![Figure 2](image-url)
Table 2. Average level of preference for aroma attribute.

| Roasting Time | Roasting Temperature | Average preference | Notation | Post Hoc Significance |
|---------------|----------------------|--------------------|----------|-----------------------|
| 0.5 hours     | 80°C (aa)            | 3.12               | a        | No Significant Difference |
| 0.5 hours (a) | 100°C (ab)           | 2.83               | a        | No Significant Difference |
|               | 120°C (ac)           | 2.63               | b        | Significant Difference |
|               | 80°C (ba)            | 3.17               | b        | No Significant Difference |
| 1.0 hours     | 100°C (bb)           | 2.87               | bc       | Significant Difference |
| 1.0 hours (b) | 120°C (bc)           | 2.68               | bc       | No Significant Difference |
|               | 80°C (ca)            | **3.24**           | bcd      | Significant Difference |
| 1.5 hours     | 100°C (cb)           | 2.96               | cd       | Significant Difference |
| 1.5 hours (c) | 120°C (cc)           | 2.72               | d        | Significant Difference |

Results show that the roasting duration of 0.5 hours and 1 hour with a roasting temperature of 80°C and 100°C produced were the most liked variation. Meanwhile the variation with a higher temperature of a longer duration of roasting was the most disliked due to the fact that the roasting time of 1.5 hours and a roasting temperature of 120°C created a burnt aroma. Some panellists preferred this darker aroma compared to the lighter alternative but most of those panellists just had a higher preference for darker beverages such as black coffee. As a result, the most liked variation was 1.5 hours with 80°C with an average preference of 3.24.

3.3 The effect of roasting on flavour of herbal tea

Flavour is considered the most important factor in consumer acceptance. The flavour of food products consists of six basic sensations, namely sweet, bitter, astringent, salty, sour and umami [9]. In tea, the balance of flavour sensations is very important. According to the data obtained, the average result of the level of flavour preference in Jobs Tears herbal tea is around 2.13 – 3.87. Treatment with roasting time combined with roasting temperature is expected to produce Jobs Tears herbal tea that is most likely preferred by consumers. The effect of roasting time and roasting temperature of Jobs Tears herbal tea on the level of preference for the flavour can be seen in Figure 3.
Based on the Fried\mann test conducted, the results showed that the length of roasting time (0.5 hours, 1.0 hours, and 1.5 hours) and roasting temperature (80°C, 100°C, and 120°C) had a significant effect on the level of preference for the flavour attribute of Jobs Tears herbal tea ($p<0.05$). The average results of the level of preference for flavour attributes caused by the treatment of roasting time and roasting temperature are shown in Table 3.

Table 3. Average level of preference for flavour attribute.

| Roasting Time | Roasting Temperature | Average preference | Notation | Post Hoc Significance |
|---------------|----------------------|---------------------|----------|-----------------------|
| 0.5 hours (a) | 80°C (aa)            | 2.13                | a        | Significant Difference |
|               | 100°C (ab)           | 2.73                | b        | Significant Difference |
|               | 120°C (ac)           | 2.91                | b        | No Significant Difference |
|               | 80°C (ba)            | 2.96                | b        | Significant Difference |
| 1.0 hours (b) | 100°C (bb)           | 3.87                | bc       | Significant Difference |
|               | 120°C (bc)           | 3.56                | bcd      | Significant Difference |
|               | 80°C (ca)            | 2.93                | bcd      | No Significant Difference |
| 1.5 hours (c) | 100°C (cb)           | 3.16                | cd       | Significant Difference |
|               | 120°C (cc)           | 3.39                | d        | Significant Difference |

Results on the flavour attribute showed the most varied response from all the panellists compared to the other sensory attributes due to the fact that every panellist had their personal preference on which variation they liked or disliked the most. But the consensus between all the panellists was that the variation with a roasting time of 0.5 hours and a roasting temperature of 80°C was the most disliked because the feedback from the panellists were that this variation was the variation that had the least amount of flavour profile compared to the stronger variations and resembled an herbal tea which tasted only like hot water.

3.4 Best treatment selection

Selection of the best treatment in Jobs Tears herbal tea research uses the effectiveness index method [11]. The selection of the best treatment was based on sensory attributes. This basis is obtained from the weighting of the level of importance according to the panelist’s response towards the organoleptic attributes (colour, flavour and aroma) where the highest weight obtained was on the organoleptic attributes. In calculating the selection of the best treatment variation based on organoleptic parameters, the organoleptic properties analysis showed that the best Jobs Tears herbal tea was achieved under the roasting temperature of 100°C for a duration of 1 hour.

4. Conclusions

This study shows that the best variation based on organoleptic analysis was the variation with a roasting time of 1 hour and a roasting temperature of 100°C. For both the color and flavor attribute, the preferred variation was the roasting time of 1 hour with a temperature of 100°C. Meanwhile, the variation with a roasting temperature of 80°C for a duration of 1 and a half hours was the most preferred. The result obtained in the present study could allow Jobs Tears as a new potential alternative of food source.
Evaluation of its physical and chemical characteristics of Jobs Tears seeds is needed such as antioxidant analysis, polyphenol analysis, etc.

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