ABSTRACT

Cancer has become a leading cause of mortality worldwide, with approximately 8.2 million deaths attributed to the disease in 2012. Antioxidants have demonstrated potential in combating cancer, and natural sources rich in vitamins, such as fruits and vegetables, are believed to be beneficial. This study aims to assess the chemical and organoleptic qualities of fruit and vegetable juice (tomatoes, Pontianak oranges, and carrots) as functional food for cancer patients. The study used an experimental design with a Complete Randomized Design (CRD) approach, with distinct processing techniques for each treatment level, and three replications were conducted. Data collection involved hedonic scale tests by 20 panelists to evaluate organoleptic quality, spectrophotometric tests to measure vitamin C levels, and DPPH tests to assess antioxidant activity. The results show that the processing of fruit and vegetable juice does not significantly influence vitamin C levels, aroma, or texture (p = 0.50). However, it has a significant effect on antioxidant levels, color, and taste of the juice (p=0.007).

Keywords: antioxidants, fruits and vegetables, functional foods, cancer

INTRODUCTION

Cancer is a complex disease characterized by the uncontrolled growth and spread of abnormal cells throughout the body. It encompasses a wide range of anatomical and molecular subtypes, each requiring specialized treatment approaches (WHO, 2018). As one of the leading causes of death globally, cancer claimed approximately 8.2 million lives in 2012. Among the most prevalent and fatal types of cancer each year are lung, liver, stomach, colorectal, and breast cancer. Alarmingly, it is projected that cancer cases will increase from 14 million in 2012 to 22 million within the next two decades. In Indonesia, the prevalence of cancer was reported as 1.4 per 100 residents, affecting around 347,000 individuals, according to Basic Health Research data from 2013 (Ministry of Health, 2017). By 2018, it was estimated that cancer-related deaths reached a staggering 9.6 million worldwide. The most common cancers in men include lung, prostate, colorectal, stomach, and liver cancer, while breast, colorectal, lung,
cervical, and thyroid cancer are prevalent in women (WHO, 2018).

Traditionally seen as an ailment of the elderly, cancer poses a risk to individuals of all age groups, from infants to the elderly (Ministry of Health, 2015). However, significant progress has been made in the fight against cancer, with antioxidants emerging as potential fighters against this deadly disease. Besides their role in cancer prevention, antioxidants are vital for combating oxidative stress, a process occurring in degenerative conditions. Research has shown that both synthetic and natural antioxidants are essential for preventing oxidative stress (Werdhasari, 2014). Studies have demonstrated the impact of tomato antioxidants on breast cancer (Fitricia, Winarni, & I.B.R. Pidada, 2012) and their potential to reduce the risk of prostate carcinoma (Novaldy & Iyos, 2016). Natural ingredients rich in antioxidant, such as fruits and vegetables, have shown promise in preventing and inhibiting cancer cell growth. In line with this research, Dina Amalia (2020) explored the antioxidant activity of Moringa leaves (Moringa Oleifera) in cancer prevention, emphasizing its potential as a preventive and anticancer agent due to its abundant antioxidants, bioactive compounds, β-carotene, flavonoids, and other beneficial components.

Considering this body of research, the present study aims to develop functional food for cancer patients by creating fruit and vegetable juices. The combination of tomatoes, oranges, and carrots, which are rich in Vitamin C, has been chosen to provide a potent source of antioxidants. Oranges, in addition to their high vitamin content, contain various bioactive compounds functioning as antioxidants, combating free radicals and cancer cells within the body. Carrots, known for their β-carotene content, have been linked to a reduced risk of prostate cancer in men (Nurani, 2012). Due to their exceptional nutritional value, carrots are suitable for regular consumption.

**RESEARCH METHODS**

**Study design**

This research employed an experimental design using a completely randomized design (CRD) with three treatment levels: fruit transformed into powder, boiled fruit followed by drying, and direct blending of the fruit. Each treatment was replicated three times. The study was conducted at Malang Health Polytechnic’s Food Ingredients Science Laboratory, Organoleptic Laboratory, Biochemical Laboratory, and the Herbal Materia Medica Laboratory in Batu City.

**Data Source**

The production of fruit and vegetable extracts in powder form (T1) involved weighing and washing the ingredients (tomatoes, Pontianak oranges, carrots). The ingredients were cut into 0.5 cm slices and dried by exposing them to sunlight for 24 hours. The dried ingredients were then pulverized. The fruit and vegetable powder was steeped in boiling water.

The production of fruit and vegetable extracts through boiling (T2) involved weighing and washing the ingredients (tomatoes, Pontianak oranges, carrots). The ingredients were cut into 1x1 cm pieces and boiled for 3 minutes using a ratio of 1:12 between the ingredients and water. The resulting fruit and vegetable broth was poured into a basin.

For the production of fruit and vegetable extracts without boiling (T3), the ingredients were weighed and washed. The ingredients were then cut into smaller pieces and blended.

Vitamin C analysis was performed using the spectrophotometric method based on the Proceedings of the National Chemistry Seminar and Learning in 2017. Antioxidant activity analysis was done using the spectrophotometric method based on the Proceedings of the National Chemistry Seminar and Learning in 2017.
conducted using the DPPH method with spectrophotometry (Blois, 1985 in Hanani et al., 2005).

A DPPH solution was prepared in methanol with a volume of 1 mL each. The extract concentration was varied by dissolving 0.01-0.6 mg in 5 mL of methanol. The varied extracts were then mixed with the prepared DPPH solution, vortexed, and incubated at 37°C for 30 minutes. The absorbance was measured using a spectrophotometer at a wavelength of 517 nm, and a pure methanol solution served as the blank.

The antioxidant activity test was conducted in duplicate. Organoleptic quality assessment was performed using a 4-point hedonic scale questionnaire.

**Development of Data Collection Instruments and Techniques**

The assessment of organoleptic quality involved conducting nutritional value calculations at the biochemical laboratory of Malang Health Polytechnic. Organoleptic evaluations were carried out utilizing a Hedonic Scale Test questionnaire form, specifically targeting attributes such as color, taste, and texture. A panel of 20 sophomore D-III students from the Department of Nutrition at Malang Health Polytechnic actively participated in these evaluations.

To determine the vitamin C levels in the fruit and vegetable juices, the spectrophotometric method was utilized. This process involved a series of steps. It was started with the filtration of the packaged drink. Next, 0.5 mL of the filtered sample was carefully pipetted and added to a 100 mL volumetric flask filled with distilled water. The mixture was thoroughly homogenized, and the absorption was measured at a maximum wavelength of 265 nm using a spectrophotometer.

The vitamin C levels were calculated using the following formula: (concentration of vitamin C in the sample x 100%) / sample concentration. This enabled the accurate determination of the vitamin C content, expressed as a percentage, in the fruit and vegetable juices.

The assessment of antioxidant activity was performed using the DPPH method with the fruit and vegetable juices as samples. A DPPH solution was prepared in methanol (1 mL each), and the concentration of the extract was varied by dissolving 0.01 – 0.16 mg in 5 mL of methanol. The sample was then mixed with the prepared DPPH solution, vortexed, and incubated at a temperature of 37°C for 30 minutes. The absorbance of the solution was measured using a spectrophotometer at a wavelength of 517 nm. The methanol solution served as the blank. The antioxidant activity test was conducted in duplicate. The formula for calculating percent inhibition (%) was: (absorbance of the blank - absorbance of the sample x 100%) / absorbance of the blank.

**Data analysis technique**

The effect of data processing on organoleptic quality was assessed using statistical analysis, the Kruskal-Wallis test at a 95% confidence level. If the obtained conclusion yields a significance value of ≤ 0.05, indicating an effect of processing on organoleptic quality, the analysis is followed with the Mann-Whitney multiple statistical test at a 95% confidence level. This additional test aimed to identify specific treatment pairs that exhibit significant differences.

To evaluate the effect of processing on vitamin C levels, the one-way ANOVA statistical analysis was employed at a confidence level of 95%.

For analyzing the antioxidant activity, the one-way ANOVA statistical analysis was utilized at a 95% confidence level. In drawing the conclusions, if the results indicate a significance value of ≤ 0.05, representing an effect of processing.

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on organoleptic quality, the analysis is followed by the Post Hoc LSD test at a 95% confidence level. This post hoc test is conducted to determine the specific treatment pairs that display significant differences.

**Antioxidant Activity**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average Percent Inhibition Level per 100 ml (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>66.16</td>
</tr>
<tr>
<td>T2</td>
<td>73.93</td>
</tr>
<tr>
<td>T3</td>
<td>87.02</td>
</tr>
</tbody>
</table>

Table 1 presents the variations in percentage inhibition observed among different treatments of fruit and vegetable extracts. The T3 treatment level (non-boiling and direct blending fruit and vegetable extract production) showed the highest percentage inhibition at 87.02%, while the lowest inhibition level was observed in the T1 treatment level (the production of fruit and vegetable extracts through sunlight exposure and soaking in boiled water) with a value of 66.16%.

**Vitamin C**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average Level of Vitamin C per 100 ml (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>0.105</td>
</tr>
<tr>
<td>T2</td>
<td>0.006</td>
</tr>
<tr>
<td>T3</td>
<td>0.030</td>
</tr>
</tbody>
</table>

Table 2 presents the vitamin C content of fruit and vegetable extracts, indicating that the highest concentration was observed in the T1 treatment group with a value of 0.105%, while the lowest concentration was found in the T2 treatment group (boiling), with a value of 0.006%.

**Organoleptic Quality of Z Fruit and Vegetable Extract Color**

Panelists demonstrated a strong preference for the color of fruit and vegetable juices produced in the T3 treatment level (direct blending without powder or boiling). With an average preference score of 3.4, indicating a highly favorable response, it is evident that the bright color of the juice at this treatment level was well-received by the panelists, as seen in Figure 1.

**Figure 1.** The average level of preference of panelists for the color of fruit and vegetable juices

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**Organoleptic Quality of Aroma of Fruit and Vegetable Juices**

The panelists showed a strong preference for the aroma of fruit and vegetable juices in both the T1 treatment level (powdered form) and the T3 treatment level (no powder or boiling) with a score of 2.65, indicating a strong liking, as shown in Figure 2.

![Figure 2. Average Level of Panelists' Likedness of Fruit and Vegetable Juice Aromas](image)

**Organoleptic Quality of Fruit and Vegetable Juice Taste**

The panelists expressed their preference for the taste of fruit and vegetable juices in the T2 treatment level (boiling and using the boiled water) with a score of 2.65, indicating a strong liking, as seen in Figure 3.

![Figure 3. The average level of preference of panelists for the taste of fruit and vegetable juices](image)

**Organoleptic Quality of Fruit and Vegetable Juices**

The panelists demonstrated their utmost preference for the texture of fruit and vegetable juices at the T1 treatment level (using powdered material) with a score of 2.95, indicating a strong liking, as shown in Figure 4.

![Figure 4. Average Level of Panelists' Liked Texture of Fruit and Vegetable Juices](image)

**DISCUSSION**

**Antioxidant Activity**

The data presented in Table 1 indicates variations in the average percentage inhibition levels among
different treatment levels. These variations can be attributed not only to the different treatment methods employed but also to the varying amounts of materials used, while maintaining the same ratio. As shown in Table 7, fruit and vegetable juice processed through drying and powdering exhibited the lowest inhibition levels. This can be attributed to the fact that antioxidants are susceptible to damage when exposed to high temperatures (> 60°C) (Haijun Y, et al., 2010). On the other hand, fruit and vegetable juices that were directly blended exhibited the highest percentage of inhibition, likely due to the absence of high-temperature processing in this method.

The one-way ANOVA statistical analysis conducted at a 95% confidence level revealed a significant effect (p=0.007) of processing on the antioxidant activity of the fruit and vegetable juices. This finding aligns with the research conducted by Felicia, et al. (2017), which also demonstrated the significant impact of processing methods on antioxidant activity. It is important to note that heating during the processing can lead to a decrease in antioxidant activity (Pokorny, 1986 in Anggraeni, Santoso, & Cahyanto, 2015). In this study, the fruit and vegetable juice products exhibited inhibition percentages ranging from 66.16% to 87.02%. The serving portion of the fruit and vegetable juices was standardized at 200 ml.

**Vitamin C levels**

The data in Table 2 shows that the average levels of vitamin C for each treatment level are different. It is because in addition to different processing, the amount of material used for each treatment level varies, but still in the same ratio. Fruit and vegetable juices processed by boiling have the lowest levels of vitamin C, as vitamin C is destroyed when exposed to high temperatures. In addition, the treatment level carried out by boiling was only taking boiled water, not using fruits and vegetables. Meanwhile, fruit and vegetable extracts processed into powder have the highest levels of vitamin C. This is due to the large amounts of material required during drying (2 kg of tomatoes, 2.4 kg of oranges, and 4 kg of carrots), which resulted in a smaller yield of powder (50 g tomatoes, 100 g oranges, and 280 g carrots).

The results of the one-way ANOVA statistical analysis at the 95% confidence level showed no significant effect (p=0.50) of processing on the levels of vitamin C in the fruit and vegetable juices produced. This contradicts the research results of Fadil, et al (2016), which suggested a significant effect of the heating method on vitamin C levels. The fruit and vegetable juice products in the study contained 0.006 – 0.105% vitamin C. The serving portion of fruit and vegetable juices was 200 ml.

**Organoleptic Quality of Color**

The results of the Kruskal-Wallis analysis conducted at a 95% confidence level revealed a significant effect (p=0.001) of the processing methods on the produced fruit and vegetable juices. Further analysis using the Mann-Whitney post-hoc test indicated significant differences between the T1 and T3 treatment levels, as well as between the T2 and T3 treatment levels. However, no significant difference was observed between the T1 and T2 treatment levels.

At the T1 treatment level, where fruit and vegetable extracts were used, the resulting color of the juice was observed to be dark brown. On the other hand, the T2 treatment level, involving boiling, produced a transparent yellow color, while the T3 treatment level resulted in an orange color. The dark brown color observed at the T1 treatment level can be attributed to the damage of carotenoids, particularly β-carotene, due to the heating
process (Farrel, 1990 in Dendang, N., et al., 2016).

The variation in color among the treatment levels can be attributed to the different ingredient proportions used in each treatment level. These findings contradict the results of Firdamayanti’s research (2017), which suggested that the distinct orange color of the juice can be maintained even after undergoing certain processing methods involving heating.

**Aroma Organoleptic Quality**

Panelists expressed a tendency to dislike the aroma of fruit and vegetable juices at the T1 treatment level. However, it is important to note that aroma assessment can vary due to individual differences influenced by psychological and physiological factors.

Analyzing the results using the Kruskal-Wallis test at a 95% confidence level found no significant effect (p=0.374) of the processing methods on the aroma of the produced fruit and vegetable juices.

**Organoleptic Quality of Taste**

The results of the Kruskal-Wallis analysis at a 95% confidence level revealed a significant effect (p=0.000) of the processing methods on the taste of the fruit and vegetable juices produced. Subsequent Mann-Whitney tests indicated significant differences in taste between the T1 and T2 treatment levels, as well as between the T2 and T3 treatment levels. However, no significant difference was observed between the T1 and T3 treatment levels.

It is important to note that panelists generally did not prefer the taste of the resulting fruit and vegetable juices. This could be attributed to the absence of added sugar in each treatment level. However, it is essential to acknowledge that individual taste evaluations may vary due to the influence of psychological and physiological factors.

**Texture Organoleptic Quality**

Figure 4 illustrates the effect of different processing methods on the panelists’ preference for the texture of the fruit and vegetable juices. It can be observed that at the T2 treatment level, the resulting texture tends to be thinner compared to the T1 and T3 treatment levels.

Considering the percentage of panelists and the mode of preference level, it becomes evident that the panelists generally enjoy the texture of the fruit and vegetable juices produced. However, it is important to note that individual preferences may vary.

The results of the Kruskal-Wallis analysis at a 95% confidence level revealed no significant effect (p=0.505) on the texture of the fruit and vegetable juices produced.

**CONCLUSION**

In conclusion, the study revealed that the variation in processing methods for fruit and vegetable juices did not significantly affect vitamin C levels (p=0.50). However, it had a significant impact on the antioxidant levels (p=0.007) present in the juices. These findings highlight the importance of selecting processing techniques in preserving the antioxidant properties of the juices.

Furthermore, different processing methods exhibited a significant influence on the color and taste profiles of the fruit and vegetable juices. However, no significant effects were observed in terms of aroma and texture. This suggests that the selection of processing methods can play a crucial role in achieving desired sensory characteristics, particularly in terms of color and taste.

It is noteworthy that tomatoes, a key ingredient in the juice, contain lycopene, an antioxidant known for its potential in reducing the risk of cancer. Therefore, the consumption of tomato-based juice may provide significant health benefits due to its lycopene content.
These findings emphasize the importance of considering processing techniques in fruit and vegetable juice production to optimize antioxidant levels, sensory attributes, and potential health benefits for consumers.

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REFERENCES


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