



Application of Infrared with Different Waves and Its Effect on Organoleptic of Dairy Milk

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Abstract

Infrared applications have been widely used to reduce microorganisms in a product and food preservation. Milk is a food product that quickly decomposes, where the changes can be observed organoleptically. This study aimed to test infrared with various wavelengths of milk and observe changes in the organoleptic of milk. The method used was that the dairy milk samples were treated with infrared (IR) exposure of 880 nm and 940 nm. Observation of the changes in milk organoleptic, namely color, taste, and smell. The effectiveness of IR 880 nm has a better ability than IR 940 nm for smell and taste, while for IR 940 nm, color is better than IR 880 nm at 1 - 4 hours, and at 5 hours with 940 nm IR it changes white-brownish.

Keywords: infrared, organoleptic, microorganisms, dairy milk

A. Introduction

Milk is complete in nutritional content. Milk contains a complete chemical composition consisting of protein, carbohydrates, fats, vitamins, and minerals (Azis et al., 2020; Barth, 2020). Milk is a potential vehicle for the growth of microorganisms in milk which causes milk to be easily damaged (Tsenkova et al., 1999; Verraes et al., 2015). The quality of milk can be observed in several ways, namely by observing its organoleptic properties. Organoleptic observation can be done by observing organoleptic characteristics (color, taste, and smell). Post-harvest handling of milk after milking is carried out in several ways: pasteurization, sterilization, and cold storage to maintain the shelf life of milk (Barth, 2020; Verraes et al., 2015). Methods of sterilization and cold storage can cause damage to milk components. Based on this condition, milk preservation requires new technology that works specifically against the target bacteria (lactic acid bacteria). It does not damage the nutritional components of milk, one of which is infrared technology (Malek et al., 2012).

Infrared technology has the characteristic of being easily absorbed by organic materials through a photodynamic process (Grelet et al., 2015). The photodynamic process occurs electron excitation to a higher energy level, and then the absorption process will stabilize itself back to the ground state through fluorescence and phosphorus radiative transitions (Grelet et al., 2015; Jawaaid et al., 2013). As a result of photochemical reactions, it happened between photosensitizer molecules and other molecules. It was either directly or indirectly. It produces free radicals and singlet oxygen which are toxic to the cell membrane. Bacterial cell death due to damage to the cell membrane is maximally determined by a specific wavelength (Tsenkova et al., 1999). Specific wavelengths under the photosensitizer spectrum (as targets) produce active molecules that are toxic in bacterial cells (Grelet et al., 2015; Jawaaid et al., 2013).

Infrared technology with the ideal wavelength could be applied in preserving milk in the future. This research aims to determine the effective and optimal wavelength in reducing milk bacteria and its effect on the organoleptic of dairy milk.

B. Methodology

1. Dairy Milk Sample

The milk sample used in this study was fresh cow's milk produced in the morning. Fresh cow's milk is from lactating cows 2-6 months with lactation periods 1-4. Dairy management is given the same feed and the same location. The equipment used in this study was measuring cups, Erlenmeyer, pipettes, and milk bottles installed in the infrared exposure test.

2. Light Emitting Diode (LED) Infrared

There are two types of infrared Light Emitting Diode (LED) used in this study, distinguished by the wavelength of the infrared LED. The wavelength emitted by the LED used is 880 nm and 940 nm.

3. Milk Organoleptic Testing Procedure

The work procedure in this study is to use infrared LEDs 880 nm and 940 nm. The first step is the preparation of tools and materials. The tools used to test the milk samples were fitted with 880 nm and 940 nm infrared LEDs. Make sure the tool is turned on first by pressing the on or off button. The instrument is declared lit when the indicator light is on; in addition to the infrared LED indicator light, it is confirmed to be lit through the Smartphone camera. The next step is to prepare the milk sample to be tested. The milk sample was put into a 1-liter beaker and then fortified to make it homogeneous. after the milk sample is fortified, it is put into a measuring cup measuring 50 ml, then put into a testing milk bottle and closed tightly. The cap of the sample milk bottle contains Infrared LED, which is ready for Infrared exposure.

4. Milk Sample Analysis Techniques

Organoleptic testing on milk samples using infrared LEDs with a wavelength of 880 nm and 940 nm was observed periodically, namely 1, 2, 3, 4, and 5 hours with three repetitions. The criteria observed were the color, smell, and taste of milk exposed to the 880 and 940 nm infrared LEDs. The criteria for milk were measured by a team of panelists who were experts in milk organoleptic. A scale determines the criteria for milk for each criterion, namely the Color criteria, with a scale of 1. White, 2. White +, 3. Yellowish white, 4. Brownish white. Odor criteria with a scale of 1. Typical milk, 2. Typical milk + savory, 3. Typical milk + fishy, 4. Typical milk + sour, 5. Typical milk + sour + alcohol. Taste criteria are on a scale of 1. Bland, 2. Savory, 3. Savory, sweet, 4. A little sour, 5. Sour. Each criterion is tested every hour with a duration of 1 - 5 hours.

C. Result and Discussion

The organoleptic test results for milk with exposure time to infrared 880 nm and infrared 940 nm (1 hour, 2 hours, 3 hours, 4 hours, and 5 hours) are as follows (Table 1).

Organoleptic test results of milk exposed to Infrared (IR) 880 nm and 940 nm consisted of color, smell, taste, and texture, as shown in Table 1. The color test results with IR exposure of 880 nm at 1 and 2 o'clock, the color of milk was included in category 3 (yellowish white), while the next 3, 4, and 5 produce colors with category 2 (white +). The color results with IR 940 nm produce color category 3 (brownish white) until the 4th hour, while at the 5th hour, the color of the milk changes to brownish white. The IR 880 was significantly different from IR 940 at hours 3, 4, and 5 (Figure 1).

Table 1. Organoleptic Test of dairy milk

Characteristics	Treatment									
	IR: 880 nm					IR: 940 nm				
	1	2	3	4	5	1	2	3	4	5
Color	3	3	2	2	2	3	3	3	3	4
Smell	2	2	2	2	2	2	2	2	4	4
Taste	3	3	2	2	1	3	1	4	4	4

The information**Color**

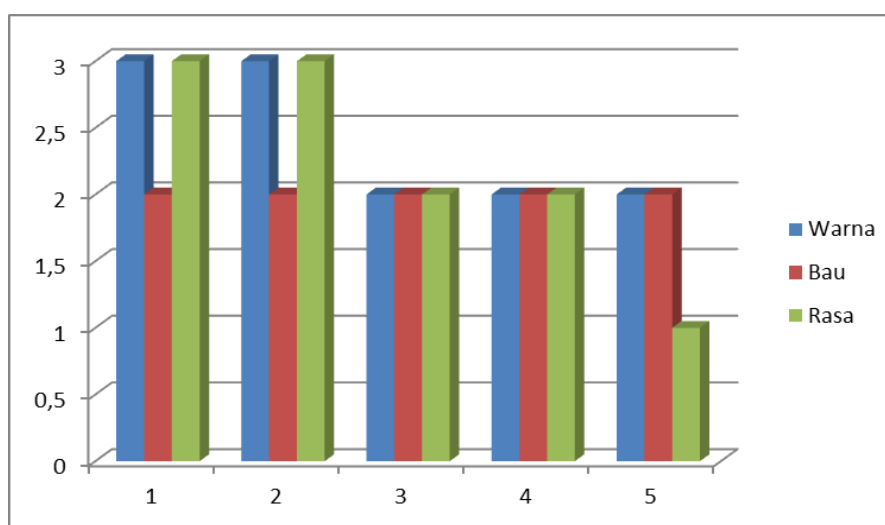
1. White
2. White +
3. White yellowish
4. White brownish

Smell

1. Typical of milk
2. Typical of milk + tasteful
3. Typical of milk +fishy
4. Typical of milk +acid
5. Typical of milk +acid +alcohol

Rasa

1. taste
2. tasteless
3. tasteful
4. savory sweet
5. acid

**Figure 1. Organoleptic test results of milk by exposure to 880 nm infrared LED**

The Color changes in milk can be caused by changes in casein milk (Dony, 2009). The color of packaged cow's milk follows the standard of milk according to the Decree of the Directorate General of Animal Husbandry No.17 / Kits / DJP / Deptan / 1983. The color of the casein in milk is snow-white, where casein is a colloid dispersion that is not translucent, so that this can cause the color of the milk to turn white (Dony, 2009; Ehirim & Onyeneke, 2013). The spread of colloidal fat granules causes the white color of milk because the main ingredients that give it a yellowish color are carotene and riboflavin (Maitimu et al., 2013). Another color in milk is sometimes yellowish due to carotene (Benchaar et al., 2007; Ehirim & Onyeneke, 2013). Carotene is the main yellow pigment of milk fat, which, when metabolized in the human body, will form two molecules of vitamin A. Carotenoids are synthesized only by plants. Therefore they must be present in dairy cows' feed. The amount of carotene in milk (yellow color) depends on the breed, species, individual, age, lactation period, and the forage eaten by dairy cows (Barth, 2020; Ehirim & Onyeneke, 2013). All the odors and tastes of packaged cow's milk are normal (typical smell of cow's milk), and the milk taste is not deviant (slightly sweet and slightly salty).

The odor test results at IR 880 nm did not change; the smell of milk remained delicious from 1 to 5 hours, while the smell of milk with IR 940 nm changed from savory to acidic from the 4th and 5th hours. The taste test results on IR 880 nm of taste at 1 and 2 hours with category 3 (sweet and savory), changing at 3 and 4 hours with category 2 (savory) and changing at 5 hours with category 1 (tasteless). While the results of the tasted of milk with IR 940 nm at the 1st hour with a sweet-savory turn out to be blanded at the 2nd hour and the 3rd, 4th, and 5th hour it becomes slightly sour (Figure 2).

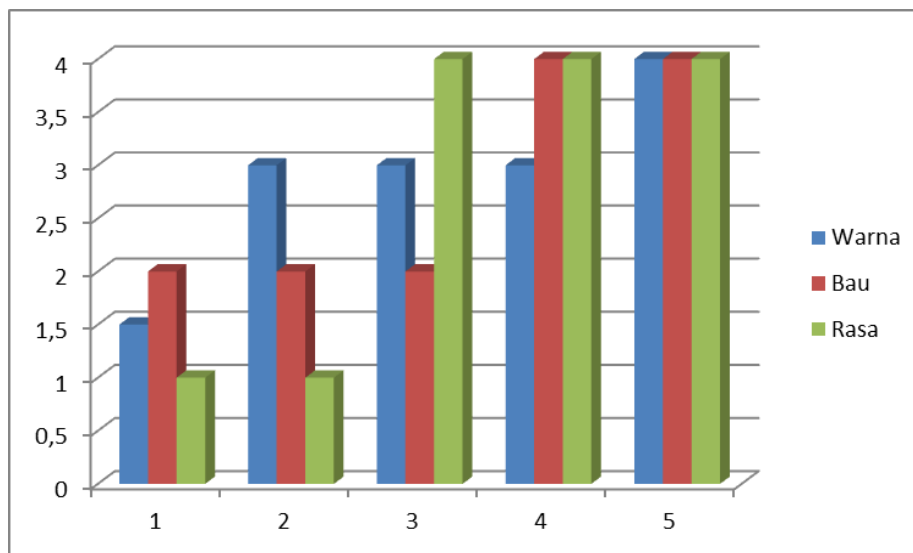


Figure 2. Organoleptic test results of milk by exposure to 940 nm infrared LED

Changes in smell and taste in milk can be caused by *Bacillus lactic saponaceous* and *E. Coli* bacteria (Malek et al., 2012; Verraes et al., 2015). The bacteria can survive in milk or do not die by IR exposure. The texture of the milk with IR 880 nm and IR 940 nm there was no differences from the 1st hour to the 3rd hours, namely the 1st and 2nd hours of milk with category 1 (watery), then 3rd hours on IR 940 nm there was watery + coagulation while at the stage then (4 and 5 hours) coagulation occurs. The smell and taste of packaged cow milk follow the standard of milk according to the Decree of the Directorate General of Animal Husbandry No.17 / Kits / DJP / Deptan / 1983. Changes influence milk taste in milk components, such as fats, protein, and minerals found in milk. Whole milk has a distinctive smell, taste, and texture. If there is a deviation from smell, taste, and other organoleptic in milk, it is likely caused by changes in the main components of milk (Dony, 2009; Maitimu et al., 2013).

D. Conclusion

Treatments with IR 880 and 940 nm treatment affected the organoleptic properties of dairy milk. Long IR 880 nm changes color faster, while IR 940 nm remains consistent with brownish white color until the 4th hour. The 3rd hour and the next turned slightly sour. The effect of IR 880 nm treatment on taste changes from savory to tasteless, while IR 940 nm changes from savory to slightly sour from 3 - 5 hours. The effectiveness of IR 880 nm has a better ability than IR 940 nm for smell and taste; meanwhile, the 940 nm IR color was better than the 880 nm IR at the 1st - the 4th hours, and at the 5th hours with 940 nm IR there was a drastic change (brownish white).

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