*Advances in Engineering Research, volume 209*
**International Joint Conference on Science and Engineering 2021 (IJCSE 2021)**

# Effect of Milk on Physico-Chemical and Functional of Herbal Jelly Drink

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**ABSTRACT**

The COVID-19 outbreak has been declared a pandemic, several modern medical drugs of excellent quality, especially immunostimulants, are being and continue to be developed from secondary metabolites of herbal commodities. World Health Organization (W.H.O.) reports the dependence of 80% of the world's population on traditional therapies, some of which are ginger and temulawak. The effect of milk on the Physico-chemical, functional properties, and contamination of herbal jelly drink products based on ginger and temulawak has been studied. In general, the addition of milk in making ginger jelly drinks has reduced water content, ash content, total sugar, and pH. Conversely, the addition of milk has had an increased effect on protein, fat, and syneresis. The addition of milk has also affected on decreasing levels of phenolic and flavonoids, decreasing antioxidant, antimicrobial Salmonella Typhimurium activity ginger jelly drink products and antimicrobial Eschericia Coli activity ginger jelly drink products. The addition of milk in the manufacture of temulawak jelly drink products resulted in a number of the same impacts, such as decreased water content, ash content and increased protein, fat, syneresis, decreased phenolic content, flavonoids, antioxidant, antimicrobial Salmonella Typhimurium activity temulawak jelly drink products and antimicrobial Eschericia Coli activity ginger jelly drink products, several differences in Physico-chemical and functional properties, namely the increase in total sugar, and pH.

***Keywords:** Herbal, Jelly, Drink, Ginger, Temulawak.*

## 1. INTRODUCTION

The COVID-19 outbreak has been declared a pandemic, and at least 163 countries on six continents have experienced transmission of this virus [1-2]. Current evidence shows that people can catch COVID-19 regardless of age, gender, ethnicity, and health status [3]. Several modern medical drugs of excellent quality, especially immunostimulants, are being and continue to be developed from secondary metabolites of herbal commodities [4]. The absence of a specific anti-viral treatment for COVID-19 has increased the potential for the use of herbs as an alternative treatment [2]. Medicinal plants have a long history of use for mankind's purposes. The World Health Organization (W.H.O.) reports the dependence of 80% of the world's population on traditional therapies that involve the use of active substances in plant extracts [5].

Ginger is the rhizome of Zingiber officinale Roscoe in the family Zingiberaceae. Various advantages in aroma, nutrients, and pharmacological activities, make this commodity widely used as traditional medicine since 3000 years ago in various countries such as Arab, Burma, sChina, Congo, Germany, Greece, India, Indonesia, Japan, Sri Lanka, Tibet and United States [6]. Ginger contains many nutrients such as phenolic compounds (gingerol, paradol, and shogaol), which can reduce the risk of atherosclerosis, inflammation, angiogenesis, and oxidative stress [7]. Ginger also contains flavonoid and protease compounds which are known for high antioxidant activity and health function [8].

Curcuma zanthorrhiza Roxb or Javanese turmeric or "temulawak", is a native Indonesian plant belonging to the Zingiberaceae family [9]. This plant is known to have a long history as a medicinal and nutritional application, especially in Asian countries [10]. In the Curcuma zanthorrhiza Roxb rhizome, the main bioactive compound xanthorrhizol is contained [9]. This compound is known to have several functional properties, including antimicrobial, anti-inflammatory, antioxidants, and antihyperglycemic [9]. The spicy and slightly bitter taste typical of herbal commodities can greatly affect the level of preference. Therefore, it is important to make herbal preparations in the form of ready-to-serve drinks that not only have a high taste but also have a more attractive texture, such as jelly drinks. Jelly drink products are generally elastic with a consistent soft gel structure that overcome hunger.

Furthermore, as compensation for the appearance of unfavorable flavors, tamarind and palm sugar as well as cow's fresh milk were added. Tamarind with high content of functional compounds (phenolic, flavonoid, anthocyanidin, vitamin C, and carotenoids) has many benefits for the body, including for the treatment of lung disease, especially asthma. Javanese sugar with a low glycemic index (35) makes this herbal jelly drink product healthier for consumption. Brown sugar also contains thiamine, nicotine acid, riboflavin, niacin, vitamin C, vitamins B12, A, and E, folic acid, crude protein, and mineral salts. The high nutritional content of milk also has many benefits for enhancing body immunity. References [11] published the nutritional value of cow's milk, which includes 87.6% water;

3.8% fat; 3.3% protein; 4.7% lactose; and 0.6% ash. Thus, it is hoped that the use of these three ingredients will not only improve the taste of jelly drinks but also their nutritional content.

Making jelly drinks with high viscosity can be made from the basic ingredients of herbal rhizomes, accompanied by the addition of sugar, acid, water, and thickener. Several hydrocolloids can be used as a gel (thickener), such as agar, locust bean gum, pectin, gelatin, and carrageenan. Agar is a hydrocolloid obtained from Gracilaria sp. and composed of agarose and agaropectin components. Agar gel is strong, stable, and clear; but rigid. Meanwhile, gelatin is a water-soluble hydrolyzate with a high molecular weight (97 to 250 kDa), the characteristics of gelatin gel which are strong, stable, and elastic make this material potential to be added as a combination of agar materials.

## 2. MATERIAL AND METHOD

### 2.1. Material

Several main materials used for the preparation and use include ginger and temulawak (Keputran market). Other ingredients used are rice, pandan leaves (Keputran market), sugar, agar, gelatin (B-type bovine gelatin), milk (Delapan shop), ethanol, $Na_2CO_3$(Emsure), $AlCl_3$(Merck), Follin Ciocalteau reagent, gallic acid, DMSO solvent (Merck), potassium acetate, media NA (Himedia), equates, DPPH (Nitra Kimia), and chloramphenicol antibiotic discs (Conda Pronadisa).

### 2.2. Making of Ginger & Ginger-Milk Jelly Drink

To get the ginger extract, 100 g of ginger burned for 5 minutes and then removed the skin. Ginger root was cut to a thickness of 0.3 cm and then boiled in 1 L water for 3 minutes. Added 4 lemongrass stalks and 4 pandan leaves, then filtered. Sugar (13% from ginger extract), combination of agar (viscosity>21 mPs) [12] and gelatin (viscosity 1,5-7,5 MPs) [13] are added, then put in the cooler for 24 hours.

The same procedure is applied for the manufacture of ginger-milk jelly drink products. The only difference lies in the use of a volume of boiled water (500 mL). In the manufacture of this product, the addition of fresh cow's milk with a milk:ginger extract ratio of 1:1 is carried out after adding the thickening material.

### 2.3. Making of Temulawak & Temulawak-Milk Jelly Drink

To get temulawak extract, 50 g of temulawak and 5 g of turmeric are washed and then removed from the skin. After cutting to a thickness of 0.3 cm, it was crushed coarsely before boiling in 1 L of water for 3 minutes. One stalk lemongrass, 3 cloves, 1 cardamom that has been barked, 2 g of secang bark, 1 stick of cinnamon, ⅓ coarsely crushed nutmeg, 0.3 g of salt, 50 g of sugar, and the juice of ½ lime is added, then filtered. Sugar (13% from ginger extract), combination of agar (viscosity>21 mPs) [12] and gelatin (viscosity 1,5-7,5 MPs) [13] are added, then put in the cooler for 24 hours.

The adding of palm sugar sweetener and agar-gelatin thickener, as well as the cooling process, is carried out in the same procedure as temulawak jelly drink products. In the manufacture of this product, the addition of fresh cow's milk with a milk:ginger extract ratio of 1:1 is carried out after adding the thickening material.

### 2.4. Physical and Chemical Properties Determination

The physical and chemical properties of herbal products jelly drinks that are determined include proximate (water and ash), total sugar, protein as well as fat levels, acidity (pH), syneresis, sensory test that includes color, taste, aroma, and texture.

### 2.5. Total Flavonoid Determination

Total flavonoid determination is carried out in three-step, there is determining the maximum wavelength, determining the standard curve, and measuring the sample's total flavonoid. Total flavonoid determination is based on reference [14]. The resulting total flavonoid is calculated based on the equation 1:

$$Total\ flavonoid\ \left(\frac{mg}{100\ g}\right) = \frac{concentration\left(\frac{mg}{mL}\right) x\ sample\ volume\ (\mu g)}{sample\ weight\ (g)} x\ dilution\ factor \quad (1)$$

### 2.6. Phenolic Compound Determination

Phenolic compound determination is carried out in three steps, there is determining the maximum wavelength, determining the standard curve, and measuring the sample's phenolic compound. Phenolic compound determination is based on reference [14]. The resulting phenolic compound is calculated based on equation 2:

$$Phenolic\ \left(\frac{mg}{100\ g}\right) = \frac{concentration\left(\frac{mg}{mL}\right) x\ sample\ volume\ (\mu g)}{sample\ weight\ (g)} x\ dilution\ factor \quad (2)$$

### 2.7. Antioxidant Activity with DPPH

Antioxidant activity determination is carried out in two steps, there is determining the maximum wavelength and measuring the sample's antioxidant activity. Antioxidant activity determination is based on reference [14]. The resulting inhibitory activity is calculated based on the equation 3:

$$Inhibitor\ activity\ (\%) = \frac{Absorbance\ blank - Absorbance\ sample}{bsorbance\ blank} x\ 100\% \quad (3)$$

### 2.8. Antimicrobial Activity

The bacteria used for the test are rejuvenated first, then a microbial suspension is made. The ethanol extract of herbal jelly drink was made a solution with a concentration of 25% w/v using DMSO solvent. A 0.3 mL suspension of tested bacteria was put into a petri dish, then 15 mL of NA media were added, homogenized and then left to stand until solidified. 10 µL of test solution was taken and then dropped on disc paper, placed on the inoculum medium, and incubated for 24 hours at 37 ℃. Microbial growth was observed and the clear zone formed around the disc was measured using a caliper. For comparison, a blank disc dripped with 10 µL DMSO was used for negative control and positive control for 30 µg chloramphensicol antibiotic discs for bacteria [15].

## 3. RESULTS AND DISCUSSION

### 3.1. Physico-chemical Properties

The mean results of each parameter are shown in Table 1 and Table 2. Viscosity is a fluid property that is closely related to flow resistance [15]. The addition of milk had triggered an increase in viscosity. The addition of high-protein milk causes an increase in the density of the bonds formed between the protein and the gelling, ie. agar-gelatin, material.

Syneresis is an event of water discharge from the gel where the high syneresis number shows a decrease in the stability of the gel bond. Syneresis occurs due to the shrinkage of the three-dimensional (3D) structure of the protein network which leads to the reduced binding capacity of the protein. The factors that influence syneresis are acidity, percent protein, percent fat, and water adhesiveness. The protein content of 20% and 51% fat so that the addition of milk can result in better coagulation stability. In general, the pH of cow's milk ranges from 6.3-6.75. A decrease in the pH of milk has an impact on a slight decrease in its viscosity, but a more drastic decrease in pH causes an increase in viscosity due to aggregation, casein viscosity of milk is slightly affected by the homogenization process. Decreasing the level of acidity can reduce the binding of protein micelles in the tissue, thereby increasing the rate of syneresis. The effect of high-fat content is associated with better coagulation properties than from high protein content [16].

**Table 1**. Physico-Chemical Properties of Herbal Jelly Drink

| Properties | | Additional Milk | | | |
|---|---|---|---|---|---|
| | | ***A = Ginger, no milk*** | ***B = Ginger, with milk*** | ***C = Temulawak, no milk*** | ***D = Temulawak, with milk*** |
| Proximate Level (%) | Water | 86.58 | 78.74 | 79.66 | 75.01 |
| | Ash | 0.74 | 0.65 | 0.69 | 0.68 |
| Total Sugar (%) | | 8.72 | 4.85 | 10.78 | 14.37 |
| Protein (%) | | 1.90 | 2.25 | 1.46 | 2.45 |
| Fat (%) | | - | 1.03 | 0.02 | 0.81 |
| Syneresis (%) | | 22.68 | 15.77 | 17.67 | 15.38 |
| pH | | 5.70 | 4.80 | 4.66 | 5.54 |

### 3.2. Proximate Level

The results of proximal level analysis using the gravimetric method showed that the herbal jelly drink had a high water content, namely 75.01% -86.58%, due to the targeted soft and thin gel texture. More specifically, herbal jelly drinks with milk have a lower water content than those without milk. Milk is a colloid system that contains insoluble particles so that in the same volume, the amount of water in the herbal jelly drink with added milk is less than that without added milk. The increase in total solids in herbal jelly drink products causes a decrease in the percentage of water contained in the product so that the water content decreases [17].

Meanwhile, the results of the ash content analysis showed that the overall jelly drink herbal product had a low ash content. The process of filtering ginger and temulawak extracts before use in the manufacture of jelly drink herbal products is predicted to be the cause of this. The filtering process using a small pore filter allows more residue of material to be left behind. The minimal residual content has resulted in herbal jelly drink products with lower levels of inorganic compounds. Specifically, the addition of milk in the manufacture of herbal jelly drink products was detected to produce lower ash content than herbal jelly drinks without milk. This is predicted to be closely related to the volume ratio of the herbal raw material extraction to the added milk. The addition of milk was not able to compensate for the decrease in minerals caused by the use of herbal extracts which was only half compared to those without milk.

### 3.3. Total Sugar

The purpose of adding sweeteners is to improve the flavor (taste and smell) of food ingredients. Addition sweeteners can also improve the texture of food ingredients, increasing the quality of the chewable properties (mouthfeel) of food ingredients. Sucrose is the most sweetening ingredient widely used. Sugar functions as a sweetener and a source of energy, as well as a thickener that attracts free water molecules so that the viscosity of the solution will be binding.

Sucrose is a common natural sweetener used, it can function as a water binder and helps the formation of the junction zone on the hydrocolloid to form a gel. The sweetener used in making herbal jelly drinks is Javanese sugar. Higher and complete nutritional content, low glycemic index, which is 35, will make herbal jelly drink products accessible to everyone, including diabetes mellitus sufferers. Table 2 shows the comparison of macro and micro minerals, sugar, and palm sugar.

**Table 2.** Comparison of Macro and Micro Minerals, Sugar and Palm Sugar [18]

| Mineral Content | Unit | Palm Sugar | Sugar |
|---|---|---|---|
| ***Micro minerals in dry matter*** | | | |
| Manganese (Mn) | mg/L | 1.30 | 0.00 |
| Boron (B) | | 0.30 | 0.00 |
| Zinc (Zn) | | 21.20 | 1.20 |
| Iron (Fe) | | 21.90 | 1.20 |
| Copper (Cu) | | 2.30 | 0.60 |
| ***Macrominerals in dry matter*** | | | |
| Nitrogen (N) | mg/L | 2.02 | 000 |
| Phosphor (P) | | 790.00 | 0.70 |
| Potassium (K) | | 10.30 | 25.00 |
| Calsium (Ca) | | 60.00 | 60.00 |
| Magnesium (Mg) | | 290.00 | 10.00 |
| Sodium (Na) | | 450.00 | 10.00 |
| Chlorine (Cl) | | 4.70 | 100.00 |
| Sulfur (S) | | 260.00 | 20.00 |

The use of a larger mass of ginger in the manufacture of ginger-milk jelly drink triggers a higher water content adsorbed on the residue resulting in less ginger extract. Since the addition of sweetener follows the ratio of the resulting filtrate quantity (1: 2), the sweetener added is lower. This has resulted in the detection of lower total sugar content in ginger-milk jelly drink products, even though it has been compensated by the addition of fresh cow's milk with sugar content of 29% based on the sugar content contained in fresh cow's milk carbohydrates used, namely greenfields. The opposite phenomenon is shown by jelly drink products made from ginger, where the jelly drink curcuma-milk products show a higher total sugar content than those without milk. This is influenced by the use of a lower ratio of filtrate to sweeteners (1: 1) in the manufacture of jelly drink curcuma-milk products. The addition of fresh milk material with specific sugar content further increases the total sugar content of the Curcuma-milk jelly drink products.

### 3.4. Protein Level

The jelly drink herbal products have low protein content. According to the Food and Drug Supervisory Agency (BPOM) of the Republic of Indonesia, food or beverages will be categorized as protein sources if they contain 20% protein/100 grams. The low protein content in herbal jelly drink products is due to the use of various plants as raw materials so that the protein that dominates is vegetable protein and not animal protein. The protein content in the vegetable is much lower than that of the animal. The protein content was higher in herbal jelly drink products with milk than those without milk, this was due to the high protein content in the milk material added in the manufacture of jelly drink herbal products.

### 3.5. Fat Level

According to BPOM, a food product is categorized as a low-fat food product if it contains 0.5 grams of fat/100 grams. The herbal jelly drink without milk is classified as a low-fat food product. This can happen because the ingredients used in making herbal jelly drinks come from low-fat plants. On the other hand, herbal jelly drink with milk is included in the high-fat product category. This can happen because of the addition of milk that contains fat[19].

### 3.6. Syneresis

Syneresis is an event of decreasing solvation or water-binding on the gel constituent material. The para-casein rearrangement is one of the factors that influence syneresis. It causes the formation of more complex networks and increases the number of bonds, thus decreasing the total free energy and binding the water stronger so that the resulting syneresis rate decreases [20].

The factors that influence syneresis are acidity, percent protein, percent fat, and water adhesiveness. Milk is evidenced by the protein content of 20% and 51% fat so that the addition of milk can result in better coagulation stability. In general, the pH of cow's milk ranges from 6.3-6.75. A decrease in the pH of milk has an impact on a slight decrease in its viscosity, but a more drastic decrease in pH causes an increase in viscosity due to aggregation, casein viscosity of milk is slightly affected by the homogenization process. Decreasing the level of acidity can reduce the binding of protein micelles in the tissue, thereby increasing the rate of syneresis. Protein and fat content influence the stability of the coagulation texture formed where the effect of high-fat content is associated with better coagulation properties than from high protein content [16]. The syneresis ability of preparation is related to its viscosity where it occurs in reverse.

Factors that affect the viscosity of jelly drink products, one of which is the type of gelling agent used. In this study, a gelling agent was used that combined agar and gelatin from bovine skin. Herbal jelly drink products with the addition of milk produce a higher viscosity than those without the addition of milk due to the denaturation of milk protein. Heating triggers coagulation of milk protein (casein). In the process of cooking an herbal jelly drink with the addition of milk, Mailard reacts to lactose with free amino acid chains in milk. Maillard reaction is a reaction between amino acids (proteins) and sugars that involves condensation and rearrangement. This reaction is a complex reaction that usually occurs during the cooking and storage process.

Furthermore, the increase in acidity due to the addition of lime juice affects the viscosity of the herbal jelly drink product. The higher the concentration of lime juice, the lower the viscosity because it triggers the hydrolysis of sugar. Specifically, gel formation (hydrocolloid) is influenced by sugar, gelling agent, temperature, heating time, and pH.

### 3.7. Acidity (pH)

The degree of acidity (pH) affects the organoleptic properties of jelly drink products. Gel formed at low pH is softer and thinner, several functional compounds, such as phenolics and flavonoids, are also stable at low pH. The addition of lime juice to the manufacture of herbal jelly drinks not only contributes to an increase in taste but also optimizes the formation of gels and stabilizes the natural color of the product.

The results of pH indicate the tendency for the appearance of acidic properties because the basic ingredients contain phenolic compounds. Phenolic compounds are acidic compounds because they can release protons ($H^+$) in solution. The limit for the acidity of beverage products is at pH 3.5, so the herbal jelly drink still meets the requirements for consumption [21].

Compared to herbal jelly drink products without the addition of milk, herbal jelly drink products with the addition of milk have a higher acidity level. Protein and sugar content in milk is predicted to be closely related to this. The higher sugar content provides adequate growth nutrition for the growth of lactic acid bacteria. In these conditions, more acid will be produced, which triggers a decrease in pH. Thus, the higher the sugar content, the higher the acidity of the product. The permitted acidity limit for jelly drinks is 3.5-5.

### 3.8. Total Phenolic and Flavonoid Compound

Phenolic compounds are derived from aromatic rings with at least one hydroxyl group. Natural phenolic compounds isolated from plants are generally primary antioxidants. These phenolic compounds not only scavenge radicals by giving electrons to the medium but also stop radical reactions by giving hydrogen radicals to the media. Phenolic compounds also can scavenge singlet oxygen, which accelerates radical reactions. However, several phenolic compounds act as secondary antioxidants because of their ability to bind metals, thus triggering the formation of hydroxyl radicals through the Fenton reaction.

Flavonoids are a common and bioactive group of phenolic compounds. Flavonoids are low molecular weight compounds, consisting of 15 carbon atoms arranged in the C6-C3-C6 configuration. The structure consists of 2 aromatic rings, connected via 3-carbon bridges, often in the form of heterocyclic rings. This change in the heterocyclic ring substitution pattern results in six different subclasses, namely, flavonols, flavonols, flavones, flavanones, isoflavones, and anthocyanidins [22-23]. So far, more than 4000 flavonoid compounds have been isolated from natural sources. The different locations of the substituents of flavonoids and their ability to conjugate electrons trigger chelating activity and radical scavenging [24]. The antioxidant ability and mechanism of phenolic and flavonoid compounds have been reported in several articles [25].

The bioavailability of phenolic compounds and their derivatives, namely polyphenols, in this case, flavonoids, depends on various factors, one of which is the food matrix. In vivo and in vitro studies have shown that in general, the presence of protein, dietary fiber, and minerals can harm the bioavailability of phenolic compounds. A decrease in the bioavailability of phenolic compounds and their derivatives may occur due to the possibility of binding phenolic compounds to the food matrix, in this case, macronutrients, namely proteins. The protein content in the product increased due to the addition of greenfield milk which also contributed 8% of protein. Phenolic compounds and polyphenol are known to form complexes with proteins that can cause changes in the structural, functional, and nutritional properties of the two compounds. Phenolic compounds are chemically structured as a hydroxyl group bonded to an aromatic ring. They are secondary metabolites, not involved in growth and energy metabolism in the body. Additionally, the nutritional properties of proteins may be affected due to the modification of essential amino acids and through the inhibition of proteases. Based on the above literature, the addition of milk has no significant effect on phenolic and flavon1oid levels. The resulting total phenolic and flavonoid are shown in Table 3.

**Table 3**. Total Flavonoid and Phenolic Compound of Herbal Jelly Drink

| Additional Milk | Total Flavonoid (mg/100g) | Total Phenolic (mg/100g) |
|---|---|---|
| A | 102.82 | 85.24 |
| B | 17.51 | 57.43 |
| C | 81.21 | 59.46 |
| D | 10.02 | 36.91 |

### *3.9. Antioxidant Activity*

Antioxidants work by donating one electron to an oxidant compound so that the activity of these oxidant compounds can be inhibited. Antioxidants are needed by the body to protect the body from free radical attack. Antioxidants are chemical compounds or components which in certain levels or amounts can inhibit or slow down damage due to the oxidation process. Ginger contains several antioxidant agents such as β-carotene, terpenoids, polyphenols, and rutin [21], while temulawak contains curcuminoid antioxidant agents. The presence of free electron pairs and the high potential for hydrogen and singlet oxygen radical transfer by the antioxidant agents in ginger and temulawak allow them to scavenge radicals, stop and accelerate radical reactions.

The antioxidant activity was significant with total phenolics and flavonoids. Total phenolic and flavonoids are influenced by the presence of several food matrices, namely protein, dietary fiber, and minerals. The presence of protein can form a complex so that it can affect changes in structural, functional, and nutritional properties. In addition, the presence of protein also influences the modification of essential amino acids through protease inhibition. From there, it can be seen that the amount of protein content reduces antioxidant activity. The addition of milk to a product contributes an additional 8% protein from the product which will affect the resulting antioxidant activity later. The results of this study revealed that intake of blueberries enhanced the reducing and chain-breaking potential levels in plasma (+ 6.1%, $p < 0.001$; + 11.1%, $p < 0.05$). In case milk and blueberries were digested together, the plasma antioxidant capacity did not increase. The administration of blueberries together with milk, impaired the in vivo antioxidant activity of blueberries [26]. The resulting antioxidant activity is shown in Table 4.

**Table 4.** Antioxidant Activity of Herbal Jelly Drink

| Additional Milk | % Inhibition (%) | $IC_{50}$ | Antioxidant Properties |
|---|---|---|---|
| A | 65.34<br>68.98<br>76.79<br>82.11<br>86.98 | 0.0139 | Very Strong |
| B | 47.53<br>55.11<br>59.81<br>62.81<br>67.45 | 0.0420 | Very Strong |
| C | 47.98<br>52.21<br>61.22<br>70.17<br>77.09 | 0.0146 | Very Strong |
| D | 42.65<br>48.08<br>52.81<br>58.22<br>64.60 | 0.0539 | Very Strong |

### *3.10. Antimicrobial Activity*

Antimicrobials are compounds that even at low concentrations can provide therapeutic toxicity to microorganisms [22]. In recent times, the efficiency of modern medicine has decreased due to several failures, one of which is the increasing population of antibiotic-resistant strains. This increased resistance has become a threat to many fields, especially the food and beverage industry [22-23] and hospitals [22-25]. Most food and beverage products are a rich source of nutrients for microbial development. Microorganisms cause contamination, decay, and degradation. Problems in the supply chain and processing have the potential to trigger food environmental conditions that promote microbial growth. Apart from organoleptic changes, some microbes can even produce toxins. To overcome this problem, antimicrobial agents are widely used to suppress putrefaction and reduce the presence of pathogenic microorganisms.

A large number of biological effects, including antibacterial, have been reported to be produced by ginger constituents, namely monoterpene, sesquiterpenes, phenolics, diarylheptanoids, essential oils [6]. Not inferior to ginger, temulawak with the main bioactive constituent xanthorrizol, is also known to have antibacterial activity. Ginger contains more antibacterial functional compounds, in general, it has resulted in ginger and ginger-milk jelly drink products with better antimicrobial properties than temulawak and temulawak-milk jelly drink products. Furthermore, herbal-milk jelly drink products can provide better antibacterial activity than those without milk because of the additional antibacterial abilities presented by several proteins in cow's milk, including immunoglobulins, lactoferrin (LF), lactoperoxidase (LPO), lysozyme, and NAGase. The resulting antimicrobial activity is shown in Table 5 and Table 6.

**Table 5.** Inhibition Zone Diameter Antimicrobial Activity Salmonella Typhimurium of Herbal Jelly Drink

| Additional Milk | Salmonella Typhimurium (mm) | Control (-) (mm) | Control (+) (mm) |
|---|---|---|---|
| A | 12.38 | 8.10 | 15.35 |
| B | 15.77 | | |
| C | 15.05 | | |
| D | 14.25 | | |

**Table 6.** Inhibition Zone Diameter Antimicrobial Activity Eschericia Coli of Herbal Jelly Drink

| Additional Milk | Eschericia Coli (mm) | Control (-) (mm) | Control (+) (mm) |
|---|---|---|---|
| A | 12.33 | 7.15 | 14.60 |
| B | 15.75 | | |
| C | 12.73 | | |
| D | 13.40 | | |

## 4. CONCLUSION

Ginger and temulawak based jelly drink herbal products have been made. The addition of milk has resulted in a ginger jelly drink product with lower water content, ash, total sugar, and pH, but with a higher protein, fat, and viscosity. Furthermore, the addition of fresh cow's milk also affects decreasing levels of phenolic and flavonoids compounds as well as decreasing the antioxidant and antibacterial properties of ginger jelly drink products. Meanwhile, in temulawak jelly drink making, there were several opposite results, especially in increasing total sugar and pH.

## ACKNOWLEDGMENT

The author would like to thank the Ministry of Education and Culture of the Republic of Indonesia and the Department of Chemistry, Faculty of Mathematics and Natural Sciences Universitas Negeri Surabaya.

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