Development of functional beverages from herbs: aspect of nutrition, processing and safety

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Abstract. Indonesia has various herbal plants which potentially developed as functional food. Herbal plants such as ginger, lemongrass and pandan leaves can be processed into functional beverages as immune system booster. Functional beverages must fulfill two main functions, first having nutritional content and second, providing acceptable sensory functions such as good taste and texture. The processing of herbal plants into functional beverages requires knowledge of the bioactive compounds content, the ability of these compounds to boost the immune system and the safety of the resulting products. The safety of functional drinks products can be analyzed through the determination of the critical point (Critical Control Point) for the functional drinks processing.

Keyword: Herbs, Functional drinks, safety.

1. Introduction

Indonesia is known for its high local wisdom and potential for functional food in traditional drinks. Traditional drinks in Indonesia are usually made from herbal plants, and almost every region has a different type of traditional drink. The processing of herbal plants into functional drinks requires knowledge of active compound content and formulation techniques. Formulations or mixtures in functional drinks are an essential part of functional drinks so that the resulting taste can be well accepted by the community, and its function for health can be accounted for.

The trend of functional food is currently growing in Indonesia. Functional drinks are equipped with tertiary functions such as probiotics, increase the intake of certain vitamins and minerals, increase stamina, and reduce the risk of certain diseases [1]. The development of functional drinks currently uses natural ingredients such as tea leaves to spices known as herbal ingredients. The form of beverage products can be ready to drink, syrup, and powder. The effectiveness of functional drinks’ health benefits is said to be optimal if the bioactive components that play a role can be appropriately extracted from the raw materials or spices used. Herbal ingredients are the names for flower ingredients, leaves, seeds, roots, or dried fruit made into drinks. The way to serve this drink is quite easy, namely by boiling or brewing it.

2. The mechanism of antioxidants in counteracting free radicals

Free radical compounds arise as a result of various complex chemical processes in the body, which can be a byproduct of oxidation or cell combustion that takes place during breathing, cell metabolism,
excessive exercise, inflammation, or when the body is exposed to environmental pollutants such as motor vehicle fumes, cigarette smoke, pollutants, and solar radiation or cosmic radiation. In protecting the body from free radical attack, the body needs antioxidants to reduce these compounds' negative impact. There are antioxidants in our body, such as SOD (Superoxide Dismutase), glutathione, and catalase. Antioxidants are also found in nature, such as beta-carotene, vitamin E, vitamin C, and phenolic compounds. Many studies have been carried out on various types of plants that contain phenolic compounds because they can act as antioxidants and in abundance.

Phenolic compounds have long been used as medicines. Phenolics have aromatic rings with one or more hydroxyl (OH-) groups and other accompanying groups. The largest phenolic group is flavonoids. Many flavonoids are found in plants. Furthermore, some of them can absorb visible light, thus making flowers and other parts of plants become colored [2]. Many spices also contain phenolic compounds, which are combined into traditional drinks.

The antioxidative properties of spices persist after heating. This stability property is absent in some other antioxidants. This antioxidant effect is also found synergistically in the combination of these spices. Therefore, it is necessary to conduct research to determine each of these plants' antioxidant ability and the formula made from a combination of these types of spices [3].

3. Potential of Herbal Plants as Functional Beverages

3.1. Ginger

Ginger (Zingiber officinale) is a prevalent plant as a spice and medicinal ingredient. Ginger rhizome also has many health benefits, including a carminative, stimulant, aroma or spice agent, blood circulation, lower cholesterol, blood pressure, diaphoretic, and anti-vomiting (antitussive), anti-inflammatory anti-inflammatory), and increase appetite. Ginger has active substances, including gingerol, shagaol, zingerone, zingiberol, and paradol. The antioxidant activity of ginger is found in more than 50 components, including gingerol, shogaol, and diarylheptanoids.

Another study on the antioxidant content of extracted ginger. Extraction is one method that is often used in functional food processing. The extraction process will affect the bioactive compounds contained in these herbs. In this study, various methods of extraction were carried out on various kinds of herbal plants. In the ginger extraction process, the problem faced in making ginger extract is the low yield produced. Several studies have shown that fresh ginger extract yields in the range of 52-58%. Optimization of the ginger extraction process aims to obtain extracts with high yield and functional value. The ginger extraction treatment blanched with hot water had the highest value because it gave higher total phenol (2297.4 ppm GAE) and yield (61.1%) and was significantly different from other treatments. The blanching process is carried out by watering and soaking in hot water (90-95°C) for 3 minutes before grated and squeezed [4].

Apart from being antioxidants, it turns out that ginger contains antibacterial properties [5]. This study tested ginger extract as an antibacterial against Porphyromonas gingivalis in vitro using the disc diffusion method. The result is that ginger extract (Zingiber officinale Roscoe) has antibacterial potential against Porphyromonas gingivalis at a 6.25% concentration with an average inhibition zone diameter of 10.6 mm and is categorized as weak according to the classification of Ahn et al.

Ginger has various types. This diversity of ginger will make the bioactive content in it different. One type of ginger that is often used besides white ginger is red ginger. The phytochemical content of red ginger was examined with several parameters, such as flavonoid compounds, antioxidant compounds, and isolate compounds. The method used in each test is different, including the identification of flavonoids using the vacuum liquid chromatography (KCV) method, while the identification of antioxidants uses the DPPH method, then measured using a UV-vis spectrophotometer. The identification of the isolates was carried out using a UV-Vis spectrophotometer. The results of this study indicate that the highest flavonoid content of red ginger is 0.0068% using 96% ethanol and 12 N HCl as a solvent with a ratio of 98:2. Besides that, red ginger also contains high antioxidants. The red ginger extract contains flavonoids, tannins, and alkaloids. All of these structures have hydroxyl groups that can donate hydrogen to interact with the DPPH radical. The IC50 value of the red ginger rhizome extract
was 57.14 ppm. IC50 values less than 200μg / mL indicate that red ginger extract is a strong antioxidant category [6].

3.2. Lemongrass

Lemongrass (Cymbopogon citratus) is an annual plant that belongs to grasses. Lemongrass plant stems are upright or inclined, forming clumps, short, massive, round (cylindrical), often under the knuckles, the cross-section of the stem is red, and has deep and very strong roots. This plant can grow in areas that have an altitude of 50-2700 meters above sea level. In Indonesia, this plant is widely available in Java with an altitude of 60-140 meters above sea level. The main compounds in lemongrass consist of citronellal (32-45%), geraniol (12-18%), citronellol (12-15%), geraniol acetate (3-8%), citronellyl acetate (2-4%), L- Limonene (2-5%), Elemol and other Sesquiterpenes (2-5%), Element and Cadinen (2-5%). In addition, there are several bioactive compounds in lemongrass, such as saponins, flavonoids, alkaloid polyphenols, and essential oils.

Research on the antioxidant activity of lemongrass and stevia extract drinks to see the total phenol of the Folin Ciocalteu method, the flavonoid content using quercetin standard solution, the antioxidant activity of the DPPH method [7]. The result is that lemongrass leaf extract and stevia leaf extract have the lowest levels of total phenol, flavonoids, antioxidative activity, and total sugar in 100 percent lemongrass leaf extract and 0 percent stevia leaf extract, respectively, namely 0.46 mg GAE / mL (each mg sample equivalent to 0.46 mg gallic acid), 0.07 mg QE / mL (each mg sample equivalent to 0.07 mg quercetin), 16.07 percent, and 0.05 mg / mL. Whereas in lemongrass and stevia extract drinks, the highest levels of total phenol, flavonoids, antioxidative activity, and total sugar were found in drinks with 95 percent lemongrass leaf extract and 5 percent stevia leaf extract, respectively, namely 1.06 mg GAE / mL (each mg of sample equals 1.06 mg gallic acid), 0.2 mg QE / mL (each mg sample equivalent to 0.2 mg quercetin), 41.03 percent, and 0.250 mg / mL. Lemongrass leaf extract and stevia leaf extract with varying ratios of fresh lemongrass leaf extract and dry stevia leaf extract showed a significant effect on total phenol levels, flavonoids, antioxidative activity, total sugar, and sensory quality (aroma, sweetness, and taste) [7].

3.3. Pandanus

Fragrant pandanus (Pandanus amaryllifolius Roxb.) is a native Indonesian plant originating from Bangka and widespread in Southeast Asia. Fragrant pandanus plants can easily be found in the tropics and are widely planted in yards, gardens, yards, and grows wild on shady gutters’ edges. This plant can also grow wild on the banks of rivers, swamps, and other places where the soil is slightly moist and can thrive from coastal areas to areas with an altitude of 500 meters above sea level.

Pandanus amaryllifolius Roxb. contains alkaloids such as norpandamarilacton A, -B, pandamarilactam-3x, -3y, pandamarilactone-1, pandamarilactonine-A, -B, -C, 7 pandamarine, pandanamine, flavonoids such as rutin, catechins, epicatechin, camferol, and gumioid quercetin narinig, tocopherols, tocotrienols, terpenoids, steroids, saponins, tannins, polyphenols, phenylpropanoids, glycosides, and dyes. These compounds have potential as natural antioxidants.

Research on the antioxidant content of pandanus (Pandanus amaryllifolius) by analyzing the antioxidant activity of ethanol extract and fractions contained by pandanus to see the phytochemical content using several test methods such as flavonoid test, alkaloid test, terpenoid test, steroid test, and phenolic test. The measurement of antimicrobial activity using the DPPH and FTC methods was carried out by Suryani et al. [8].

The ethanol extract's phytochemical content from pandan leaves contains flavonoids, alkaloids, phenolics, steroids, and terpenoids. The results showed that the ethyl acetate fraction obtained from the ethanol extract of pandan leaves had a higher reducing ability than the ethanol extract, but the DPPH radical capture power was low. The antioxidant activity test experiment results with the FTC method were that the ethyl acetate fraction had almost the same antioxidant activity as BHT and vitamin E. The hexane fraction had the lowest antioxidant activity. This is thought to be related to the lowest levels of phenolic and flavonoid hexane fractions. BHT had the highest peroxidation inhibition activity until day 4. The inhibition of vitamin E peroxidation was high. It was concluded that the reducing ability of the commercial ethyl fraction > ethanol extract > hexane fraction > vitamin E. The antioxidant activity in
linoleic acid from ethyl acetate fraction > ethanol extract > hexane fraction while the DPPH radical capture power from BHT > ethanol extract > hexane fraction was similar to ethyl acetate fraction > vitamin E. The ethyl acetate fraction had an EC50 value of 0.90 mg/ml so that potential as a source of natural antioxidants [8].

Research on other antioxidant activities has also been carried out by Margaretta [9]. This study studied the effect of temperature and time of extraction of phenolic compounds from pandan leaves on extract yield and levels of phenolic compounds (Total Phenolic Content: TPC), determining the antioxidant activity of pandan leaves extract obtained in the most extensive phenolic yield condition. The method used was pandan leaf extraction, extract yield determination, and Total Phenolic Content (TPC) test using the Folin-Ciocalteu method and antioxidant activity using the DPPH method. The results of extraction of phenolic compounds from pandan leave with 96% ethanol solvent, the longer the extraction time is in the range of up to 5.5 hours in the 30-70 °C range and the higher the extraction temperature, the more the extract yield value, phenolic compound content, and phenolic yield high anyway. However, the phenolic yield will be constant after 5.5 hours. The extraction temperature of 70°C and extraction time of 5.5 hours resulted in the largest yield of phenolic compounds. The pandanus extract's best antioxidant activity was at an extract temperature of 50°C with an extraction time of 5.5 hours, where the scavenging activity was 93.21%. When the extracted temperature was 70 °C, the% scavenging activity obtained was only 90.74%. From some of these studies, pandanus has the opportunity to be a good antioxidant that can ward off free radicals in the body.

4. The Food Safety of Functional Beverages
Safe food is the main focus of the food production process, even though it is sophisticated and up to date. Quality assurance in the food production process is a demand that must be met by all producers. There is currently an agreement for food safety by applying a risk management system known as HACCP (Hazard Analysis and Critical Control Point). HACCP is a management system in which food safety is handled through analysis and control of biological, chemical, and physical hazards from the production of raw materials, procurement, and handling, to processing, distribution, and consumption of finished products. Food products for consumption. Prerequisite programs such as Good Manufacturing Practices (GMP) are essential for HACCP development and implementation [10].

In practice, the HACCP system is essential to be applied in the spice-based beverage processing model. HACCP can be applied to the entire food chain from primary products to final consumption, and its application must be guided by scientific evidence against human health risks in SNI No. 01-4852-1998, which is SNI for hazard analysis system and critical point control (HACCP) and its implementation guideline.

Things that need to be done in analyzing the application of HACCP in functional beverage products are: first, the analysis of raw materials, raw materials in the manufacture of functional drinks, is analyzed from the contaminants to the dangers of toxicity. Usually, the problem in receiving raw materials is a high impurity, especially those from the soil, early harvest, cuts, and defects in the glands such as cuts and bruises; second, the next step is to determine the CCP. This activity also aims to determine control points (CP) and critical control points (CCP) in functional drinks production. The determination of CP and CCP is essential for HACCP certification (hazard analysis and critical control points). CP and CCP are evaluated based on processing steps. Raw material acceptance is a very important control point for checking the conformity of raw materials to specifications. Sorting is a control point for removing all subgrade roots marked by cuts and bruises as well as excess and premature roots. Filtration using a filter cloth must be well controlled to ensure that no dirt contaminates the filtrate. The stages that exist during the production process are included in the control points that do not pose a risk to food safety but affect the product’s characteristics [11].

Fourth, critical limit determination. This critical limit determination must be done if the products we produce have CCP. Determination of critical limits (critical limit) is essential for consistency and analysis of food safety and the processes involved. The determination of this critical limit is required at the CCP. Because in the instant ginger drink production process, there is no CCP, there is no critical
limit determination. However, if this is not done, then functional drinks must be tested according to SNI. SNI 01-4320-1996 concerning traditional drink pollen and SNI 3719-2014 concerning fruit juice.

Furthermore, to ensure that the resulting product is free from contamination, laboratory tests must be carried out at an accredited laboratory. The ginger functional drink test results showed that the instant ginger drink product met the SNI requirements for microbial and heavy metal contamination, including total plate numbers and coliform, as well as Pb, Cu, Zn, Sn, Hg. As metals. All of these contaminants are below the maximum allowable limits. The fifth is monitoring, taking corrective action on the results of the previous stages. The sixth is documentation, and the last one is an evaluation to measure whether the HACCP system is running perfectly and consistently.

Research on the quality of functional drinks has been conducted by Estiasih et al. [11]. In this study, the implementation of quality assurance in instant ginger drink production in small and medium scale industries. The IKM studied were IKM DIA in Malang City, which had implemented quality assurance in their production process and had been certified. The method used was the review of HACCP stages, which included 7 HACCP principles. As a result, IKM DIA has tried to implement quality assurance in producing instant ginger drinks. The application of quality assurance includes the implementation of GMP and HACCP. The fulfillment of the prerequisites in the 18 scope of the GMP has been carried out. Although it cannot be perfect, most of the GMP prerequisites have been met. Improvements continue to be made to meet the scope of GMP. In the framework of HACCP certification, IKM DIA has tried to apply the seven principles of HACCP even though some principles related to CCP cannot be implemented because in the instant ginger drink production process, there is no identified CCP. The HACCP audit results indicate the need for several improvements. After making all the improvements suggested by the auditors, IKM DIA has been successfully certified by HACCP.

5. Conclusion
Various benefits can be obtained from functional drinks, especially in pandemic conditions like now. The intake of nutritious food and drinks is a mandatory value for consumption every day so that a disease does not attack the body. Consuming food or drinks that have functional properties becomes an alternative to healthy living because the bioactive compounds contained in these foods can ward off free radicals both produced in the body (endogenous) and external (exogenous) influences. Apart from being nutritious, these foods and drinks must be free from physical, chemical, and microbiological contamination to get food that is healthy and safe for the body.

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