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Ethnobotany of robusta coffee (*coffea canephora* pierre ex a. froehner) as a spiced coffee drink of the indigenous people of bale village on halmahera island

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ABSTRACT

A study on inherited local knowledge of spiced coffee ethnobotany in processing coffee by the people of Bale Village is necessary to depict the sub-system coffee processing. Bale Village is situated on Halmahera Island. It is one of the villages in the Oba Sub-district, Tidore Kepulauan Regency. The village is known as a producer of coffee bean and coffee powder. This study on local knowledge is an initiative to acquire information on spiced coffee. The research design is a survey design to investigate and document the knowledge of the utilization of spice plants in coffee drinks as a traditional beverage of people in Bale Village. Data are analyzed in a qualitative-thematic manner to describe respondents' ethnobotanical knowledge and are independent of the researcher's assessment. The research results indicate that spiced coffee made by the villagers uses six spice plants, namely clove (*Syzygium aromaticum* (L.), red ginger (*Zingiber officinale* Roscoe.), cinnamon (*Cinnamomum verum* J. Presl.), *kara benguk* (*Mucuna pruriens* (L.) DC.), nutmeg (*Myristica fragrans* Houtt.), and pandan (*Pandanus amaryllifolius* Roxb.). Stages in the making of spiced coffee with the 5M method include: 1) determine the composition of spiced coffee, 2) grind spiced coffee beans into powder, 3) prepare water, 4) stir the spiced coffee and 5) enjoy the spiced coffee.

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INTRODUCTION

Coffea robusta (*Coffea canephora* Pierre ex A. Froehner) is a species from Rubiaceae Family (Gentianales Order) originating from central and west sub-Saharan Africa. It is a native plant of tropical forests around Victoria Lake in Uganda. It is introduced to Southeast Asia in 1900. Currently, 36% of the robusta coffee production in the world is in tropical areas including Indonesia, Vietnam, and Brazil (Campuzano-Duque et al., 2021). Robusta coffee is one of the most cultivated coffee species in Indonesia and is a superior plantation commodity. It is resistant to disease attack and has characteristics of a bitter taste and slightly sour and contains a higher level of caffeine compared to Arabica coffee (Budi et al., 2020) (Hakim & Septian, 2011). The caffeine compound is one of the compounds naturally found in coffee beans that plays a role as a freshener and non-alcoholic stimulant. It tastes bitter, is soluble in water, and has a benefit as an analgesic drug that can reduce pain (Arwangga et al., 2016).

Robusta coffee plants are spread all over Indonesia with more than 90% of coffee growing areas in Indonesia being robusta coffee (Kementerian Perindustrian RI, 2017). Four robusta coffees (of 17 geographical indications of coffee in Indonesia), at present, that have been registered as a geographical indication (GI) are robusta coffee of Lampung, robusta coffee of Empat Lawang, robusta coffee of Pinogu Gorontalo, and robusta coffee of Semendo. Further study on the quality and taste of coffee from coffee plant centers will likely find other places with typical coffee plants that suit their geographical indications.

Robusta coffee is traditionally known by the communities as a bitter and tasteful coffee. People utilize robusta coffee beans to create various coffee drinks and modify their bitter taste by adding spices into the drinks. The traditional coffee drink processing methods are different for every ethnicity. One of the ethnicities that has local knowledge of utilizing coffee beans to make spiced coffee drinks is the people of Bale Village of Tidore Kepulauan City on Halmahera Island. Bale Village is known as a producer of coffee beans and coffee powder to be marketed on Halmahera Island, Ternate Island, and their surrounding areas. The village has the potential of spice plants such as nutmeg, clove, and red ginger. Some of the villagers work as home-based coffee entrepreneurs using a traditional system processing method. The knowledge and skills of the villagers in processing coffee are passed down from generation to generation. It is an ethnobotanical local knowledge in processing coffee plant resources in a subsystem manner. The information will construct knowledge and local tradition with biology into a series of mutually supporting information and reveal the traditional knowledge system of a community group in utilizing plants in their surroundings (Nolan & Turner, 2011). Traditional knowledge provides perspectives on various plant utilizations that refer to the shape of culture in every area (Saisor et al., 2021)(Susandarini et al., 2021). The current research provides a depiction of ethnobotanical local knowledge in brewing coffee beans and spices into a healthy coffee drink.

METHODS

Research Design

The research was conducted from May to December 2022 using a survey research design. Data were collected through participatory observations, semi-structured interviews, and household surveys (Mann, 2016). The research focused on investigations and documentation of ethnobotanical knowledge of the utilization of spice plants in coffee drinks as a traditional beverage of Bale Village people. The community was chosen since they use Robusta coffee beans and spice plants to make spiced coffee in their daily life. Primary data collection was carried out by identifying key informants based on information gathered from the community. The community assissted in collecting beans and spice plants.

Research Informants

Snowball sampling was employed to locate key informants who possess ethnobotanical local knowledge of spiced coffee. The research's key informants were determined following information from the village head as a liaison. Once the key informants were interviewed, they would recommend another informant, which is a recommendation informant. The activity was carried out until data were collected and stopped when the data were repeated and saturated.

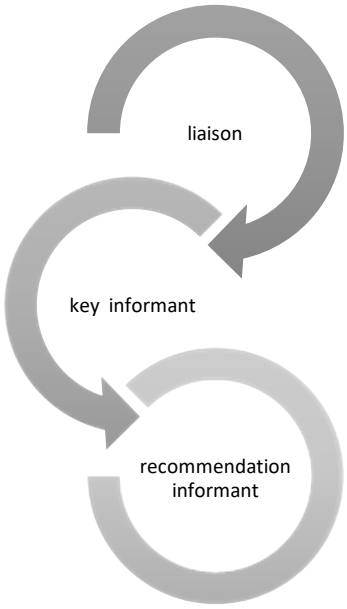

Figure 1. Informant Selection Technique (Source; Mann, 2016)

The Procedure of ethnobotanical data collection

The ethnobotanical survey was done by training a survey team to perform interviews with the people who live in Bale Village Halmahera Island. The ethnobotanical data were collected using a questionnaire. They were asked to provide their knowledge and habit of using spice plants and methods in making spiced coffee. The main questions emphasized (1) the name of plants used as the main ingredients in making spiced coffee, (2) parts of plants used as mixed ingredients in spiced coffee, and (3) methods in formulating spiced coffee.

Ethical consideration

Prior to the research, we held a meeting with the village head, traditional leaders, and women figures in the village to explain the survey objectives. The number of respondents was 10 people aged over fifteen years and we received a written agreement from each of the participants before the interview on a signed voluntary agreement form. All informants actively participated in the interview and had no objection until the interview was completed. An identification number was used replacing the participant name and information collected to guarantee the confidentiality of the informants. A dissemination meeting was held after the survey as feedback to the research population.

Data Analysis Technique

The thematic data analysis used in the research was qualitative. The meaning of every peace of information about spiced coffee was described according to the original knowledge of the local people. Information on types of coffee and spice plants and the process of making spiced coffee was merely based on the respondents' ethnobotanical knowledge and independent from the research assessment. Data on spice plants used was schematically recorded using Excel 2010 software. The collected data were tabulated in an information table that contained the family name, local name, botanical name, and parts of plants used. The plants were identified at the Laboratory of Biology Universitas Khairun.

RESULTS AND DISCUSSION

Spice plants and their traditional use that have been utilized by people in Bale Village in making spiced coffee consisted of six plants (Table 1). The list of plant types was in an alphabetical order that outline the family name, local name, scientific name, and parts used. The Bale Village people in North Maluku Province make spiced coffee using traditional methods (Table 2). The process of making spiced coffee starts by drying all the ingredients, especially coffee beans and the main spice ingredients (Figure 2). Women serve spiced coffee in the morning and evening and during customary events in the village such as weddings, housewarmings, etc. Spiced coffee is usually the main beverage at these events.

Table 1. Spice Plants in Coffee Drinks

No	Family	Local name	Indonesian Name	Scientific Name	Parts of Plants Used
1	Myrtaceae	Odai	*Cengkih*	*Syzygium aromaticum* (L.)	Fruits and leaves
2	Zingiberaceae	Guraka	*Jahe merah*	*Zingiber officinale* Roscoe.	Rhizomes
3	Lauraceae	Kayu manis	*Kayu manis*	*Cinnamomum verum* J.Presl.	Bark
4	Fabaceae	Kopi tali	*Kara benguk*	*Mucuna pruriens* (L.) DC.	Beans
5.	Myristicaceae	Pala	*Pala*	*Myristica fragrans* Houtt.	Nutmegs and leaves
6.	Pandanaceae	Pondak	*Pandan wangi*	*Pandanus amaryllifolius* Roxb.	Leaves

Spice plants (Table 1) are the main additional ingredients in making spiced coffee. Parts of the spice plants used are leaves, fruits, bark, rhizomes, beans, and flowers. The parts of the plants contain phytochemical compounds produced by the plants as a part of their metabolisms (Hakim et al., 2015). Spice plants, such as clove leaves and flowers, are aromatic. The clove's chemical content has been studied by experts for its potential. Clove is known as one of the sources of phenolic compounds, which are flavonoids, hydroxybenzoic acids, hydroxycinnamic acids, and hydroxyphenyl propane. Most of the respondents stated that there are five stages in the making of spiced coffee as indicated in Table 2.

Table 2. Stages in making spiced coffee

Stage	Process
1. Determine the composition of the spiced coffee.	A standard composition is a ratio of 2 tablespoons of spiced coffee to 6 oz of water or less. A cup of spiced coffee is usually added with 1-2 teaspoons of sugar.
2. Grind the spiced coffee into powder	Spiced coffee must be ground more finely to produce a delightful cup of coffee. You can have coarser coffee powder if you want a satisfying bitter taste. Make sure your cup is clean.
3. Prepare water	Prepare hot water/boiled water 30 seconds before soaking the spiced coffee powder or boil the spiced coffee powder in a clean container and let it boils at a temperature of 90-100^0.
4. Stir the spiced coffee	Let the coffee grounds absorb water for approximately 30 seconds before stirring. A few gentle stirs, using the back of a spoon around the top layer of the mixture and along the sides, to submerge any remaining residue.
5. Enjoy the spiced coffee	The taste of the spiced coffee will change when the cup is cold but it depends on the preference of each coffee lover whether they like it hot or cold.

Source: Primary Data, 2022

Figure 2. Main ingredients in making spiced coffee

The making of spiced coffee starts by breaking the bean skin and sorting the beans to remove broken, abnormal, or defective coffee beans, dirt, and foreign objects using "*sosiru*" container (Figure 2). The process aims to ensure that the coffee beans to be processed are clean and of good quality that will produce spiced coffee flavors that the customers like. The sorting process is vital since consumers mostly prefer a good quality Robusta coffee; therefore, the selection of healthy and relatively uniform-size coffee beans is deemed an imperative procedure by farmers. The quality characteristics of coffee agricultural products can be identified from the color, performance, and size uniformity. Coffee beans are then washed and submerged before roasting to produce cleaner beans and prevent the likelihood of the presence of defective beans unsorted in the previous stage. The submersion of coffee beans will bring the abnormal beans to float; thus, it is an advanced sorting process. Next, the coffee beans are dried for 5-10 minutes before roasting.

The process of roasting coffee beans uses pottery with a long wooden bean stirrer with a wider end. The roasting is conducted by heating the pottery using firewood and coffee beans are put in the pottery once it is hot. The use of firewood is believed to add flavor and aroma to the beans. Continuous stirring is conducted to prevent the beans from burning and the beans are ready to be removed from the pan if the color turns black and the aroma is out. The roasting aims to increase specific flavors and reduce water level until below 4%. People in Bale Village make spiced coffee by roasting and mixing the coffee beans with spices that enrich the coffee flavor.

Figure 3. Drying Coffee Beans (a), Sorting Process (b), Roasting Coffee Beans (c), Cleaning of Coffee Beans (d), *Benguk* nut as a mixed ingredient for Coffee (e), and Stone Mortar to Grind Coffee Beans (f)

Spice plants are the source of essential compounds, triterpenes, and various phenolic compounds. Additionally, the water extract of nutmeg leaves is a needed property from a promising anti-cancer agent (Akinboro et al., 2011). Numerous secondary metabolites of nutmeg indicate biological activities that likely support their utilization in traditional medicine (Abourashed & El-Alfy, 2016). Ginger is an aromatic plant that has higher anti-oxidant activities and is an alternative to synthetic medicine to manage oxidative stress (Ismaeel & Usman, 2021).

Cinnamon bark, as a mixed ingredient for spiced coffee, contains essential oil serving as an anti-bacterial. The natural existence of benzoic acid in cinnamon is commonly used as a preservative in food products (Anggraini et al., 2015). Cinnamon is one of the spice plants frequently used as a medicine and herb due to its specific smell and taste. The plant smells good and tastes sweet; thus it can be used as an ingredient in making drinks and its spicy taste brings warmth to the body (Sulistyaningtyas et al., 2018). The largest chemical components in cinnamon are cinnamic alcohol, coumarin, cinnamic acid, cinnamaldehyde, anthocyanins, and essential oil containing sugar, protein, simple fat, pectin, and others.

Mixed ingredients of spiced coffee used by the Bale Village people are velvet bean/*kara benguk* seed (*Mucuna pruriens* L.), and nutmeg (*Myristica fragrans* Houtt.) that have the potential for medicine. *Kara benguk* seeds have high protein content and are often used as a raw material for making *benguk* tempeh. The *kara benguk* content can be used as a medicine. Its seeds contain levodopa substance, which is an aphrodisiac, and it can also be used by Parkinson's sufferers and reduce stress. Its content of 5-HTP, DMT, DMT-n-oxide, N, N-DMT, 5-MeO-DMT-n-oxide, nicotinebufotenine, bufotenine, beta-carboline, nicotine, and 5-hydroxytryptamine can provide psychedelic effects (Mulyani et al., 2016). *Kara benguk* provides an additional strong bitter sensation and specific aroma in coffee drinks similar to soybean aroma (Ruma et al., 2021). The alkaloid, coumarins, flavonoids, metionins, tyrosines, and alkylamines content can increase anti-oxidant. Nutmegs contain natural ingredients as an alternative for anti-bacterial that has a bacteriostatic ability and as a bactericide (Vitarisma et al., 2022) (Sun et al., 2021). Nutmeg is a spice with a specific taste (Jonassen et al., 2021).

The skill of brewing spiced coffee is a cultural heritage of indigenous people in Bale Village. Coffee drinks are intangible cultural heritage component (Yildirim & Karaca, 2022). Spiced coffee is a traditional coffee drink from Indonesia. Consuming coffee can reduce fatigue and stress levels (Tumanggor et al., 2022). Many coffee lovers deem wet-processed coffee as superior to unwashed dry coffee (natural; dry-processed coffee). However, it is a matter of preference. When someone wants the spiced coffee to be more natural, then during the roasting stage, the spice ingredients must be roasted along with the coffee beans or separately. Each roasting process has an advantage. The process of roasting coffee removes most of the humidity in the coffee beans and it is the beginning of a series of chemical reactions known as pyrolysis. It is the chemical reaction that changes the chemical composition of the coffee beans and develops coffee compounds that are related to the taste and aroma of the coffee brewed. Spiced coffee roasting products from a good roasting process are known as an expertise in concocting spice ingredients into a healthful spiced coffee drink. The remaining spices in dry-processed coffee create a more tasty brewed coffee drink, even though wet-processed coffee tends to have a more desirable level of acidity.

The spiced coffee taste depends on the amount of water used to stir the coffee with the spice ingredients or the amount of water used to make a cup of spiced coffee. Water temperature is a vital aspect of coffee taste. A lower water temperature will extract less of the spice aroma in the coffee and produce less of a spice taste yet a more bitter taste. If the water temperature is higher, however, the coffee aroma will be stronger. This is a hydrolysis process to blend the different compounds in the spiced coffee made. The primary thing in making coffee is water quality. The fewer minerals in the water, the better, but the quality of tap water is varied from one city to another. Never re-boil water that has gone through the heating process in making a coffee. If you want to know the pH of the water to be used, test the water to ensure that the pH is in the range of 7. Hence, water quality affects the taste of spiced coffee. In addition, coffee composition, spice composition, water temperature, spice grinding process, and the making process are important stages in the process of preparing spiced coffee (Figure 3).

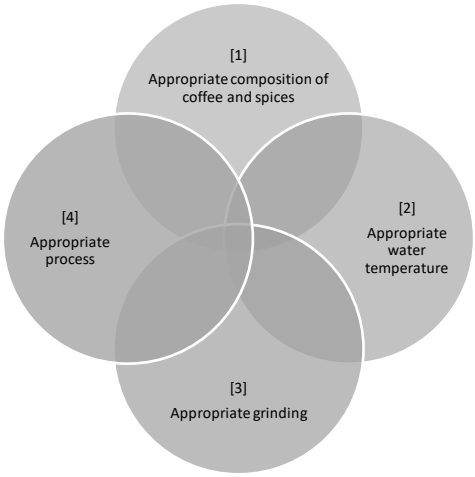

Figure 4. Process of preparing spiced coffee

Spiced coffee to be consumed in five days after the roasting date is an optimum time to make spiced coffee. Quality spices will produce a consistent-quality taste for one month after the roasting date. The spices' aroma will disappear from time to time due to the decrease in the quality of the spices and coffee powder that react to water temperature. To find out whether the roasted spiced coffee is damaged or not, pour the coffee into a cup and if no small bubbles of foam at the top of the cup, then the spiced coffee has low quality. Another method is by its aroma. If the coffee aroma has diminished or changed then it has low quality. Therefore, coffee composition, spice ingredients, water temprature, the grinding process, and the making process are the key to the process of making spiced coffee. Loss of carbon dioxide and oxidation of unsaturated fats in coffee is assumed to be the cause of the change in taste. The change is observable in a regular temperature on the fourth or fifth day; however, if dry coffee is stored at a lower temperature, the changes are not fast (Lasztity, 2009). Robusta coffee and spice plants cultivated by the community have become an integral part of their culture. Environmental conditions, such as rich volcanic soil minerals, tropical high land, and climate conditions affect coffee quality.

CONCLUSION

Spiced coffee made by the community uses six spice plants, namely clove (*Syzygium aromaticum* (L.), red ginger (*Zingiber officinale* Roscoe.), cinnamon (*Cinnamomum verum* J.Presl.), *kara benguk* (*Mucuna pruriens* (L.) DC.), nutmeg (*Myristica fragrans* Houtt.), and *pandan* (*Pandanus amaryllifolius* Roxb.). The stages in making spiced coffee are 1) determine the composition of the spiced coffee, 2) Grind the spiced coffee into powder, 3) prepare water, 4) stir the spiced coffee, and 5) enjoy the spiced coffee. Spiced coffee is a local knowledge product that can be developed for entrepreneurs. Specific spice taste creates a prospect for spiced coffee that has economic value. Development of spiced coffee products in the future is necessary that includes design for education tourism of spiced coffee with orientation to the collaboration-based economy.

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