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Characteristics of Bailey's-Style Liqueur Using Arak, Cocoa, and Charcoal as a Substitute for Whiskey: An Organoleptic Evaluation

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A B S T R A C T

Baileys Irish Cream is a cream-based liqueur combining milk cream, Irish whiskey, cocoa, and vanilla to produce a distinctive sweet and creamy flavor. This study aims to examine the characteristics of a Baileys-style liqueur by substituting whiskey with arak and cocoa with charcoal. A qualitative method was used through organoleptic and descriptive tests with five trained panelists and six indicators: sweetness, color, aroma, flavor, length, and overall product. Results showed the liqueur has a semi-dry to sweet taste, grey color, smoky-charcoal aroma, sweet and creamy flavor, medium to long aftertaste, and was generally rated as good. It is suggested to reduce sugar, increase arak dosage, measure alcohol content, and improve visual presentation and packaging.

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INTRODUCTION

According to Graham (2022), Baileys Irish Cream is a cream-based liqueur produced from a blend of fresh dairy cream and Irish whiskey, enriched with cocoa and vanilla, resulting in a uniquely sweet and smooth flavor profile. One of the primary ingredients in Baileys liqueur is whiskey, which is generally defined as a distilled alcoholic beverage made from fermented cereal grains. The most well-known type is Scotch whisky, which must be produced in Scotland using malted barley and other grains, and aged for a minimum of three years before being exported. Distillation practices in Scotland date back to 1494, with the resulting spirit historically referred to as uisge beatha, or "the water of life," by ancient Celts. Besides Scotland, whiskey is also produced in Ireland, Canada, and the United States, each adhering to distinct regulations and production techniques. For instance, Scotch whisky must be distilled and matured in oak casks for at least three years in Scotland. Other variants, such as Japanese, Irish, Canadian, and American whiskies, follow different standards in terms of ingredients and distillation processes. Common grains used include barley, maize, rye, and wheat, which are rich in starch content.

Whiskey types are typically classified by their country of origin and production method. For example, Scotch whisky is known for its characteristic smoky flavor due to a peat-smoking process, whereas Irish whiskey is often smoother and less smoky, as the smoke is absorbed using a device called a kiln during the drying process.

The second key ingredient in Baileys liqueur is cocoa powder. Cocoa powder is a food product derived from cacao beans that have undergone fermentation, drying, roasting, and grinding into cocoa paste. This paste is then separated into two main components: cocoa butter and cocoa solids. The resulting cocoa solids are dried and finely ground into cocoa powder. Cocoa powder is rich in a distinctive chocolate flavor and contains a variety of nutrients, including antioxidants such as flavonoids, as well as small amounts of fat, protein, fiber, and essential minerals like magnesium and iron. Due to its rich flavor and nutritional properties, cocoa powder is widely used as a base ingredient in the production of various food and beverage products, including chocolate, cakes, biscuits, ice cream, and hot chocolate drinks. Moreover, its nutritional value has been associated with several health benefits, such as improving cardiovascular health and enhancing mood (Martínez-Pinilla et al., 2015).

In this study, the primary ingredient being substituted in Baileys liqueur is whiskey, which is replaced with arak, with the aim of exploring innovative possibilities for Baileys-style liqueurs while also transforming the traditional local arak into a more modern and globally appealing beverage. Arak Bali is a traditional distilled alcoholic drink originating from the Balinese community, produced through a process of fermentation and distillation. The main raw material for producing arak Bali is sap extracted from coconut trees (Jessica, as cited in Kerta Negara, 2021).

Historically, arak Bali was not only consumed as a beverage but also played a vital role in Hindu religious ceremonies as a sacred offering. Over

time, the role of arak has evolved, and contemporary bartenders and mixologists increasingly experiment by blending arak with various ingredients such as fruits, flowers, spices, coffee, and charcoal. These combinations are intended to enhance the drink's flavor profile, aroma, and color—making it more attractive and commercially viable, especially among younger consumers and international tourists visiting Bali.

The second ingredient being substituted in this study is cocoa powder, which is replaced with edible charcoal powder. The charcoal referred to here is not the conventional charcoal used for fuel, but a food-grade, activated charcoal powder that is safe for human consumption. According to Dr. Karin Widarma (as cited in Manoppo, 2019), activated charcoal has no strict consumption limit; even intake up to 100 grams reportedly causes no adverse side effects. Although it is not absorbed by the body, charcoal is known to bind toxins, oils, and waste in the digestive tract, aiding in detoxification.

Food-grade charcoal powder has increasingly been used in culinary innovations, such as in baked goods and ice cream, not only for its detoxifying properties but also for its unique aroma and striking black color, which appeals to modern consumers. Due to its proven safety and growing popularity in the food and beverage industry, this study seeks to incorporate charcoal into a liqueur formulation as a novel innovation. The product developed is a liqueur made from traditional arak, blended with charcoal powder, cream, and sugar—drawing inspiration from Baileys Irish Cream, which traditionally combines Irish whiskey, cream, sugar, and cocoa.

The substitution of whiskey with arak is motivated by the intention to transform this traditional local beverage into a more modern product that appeals to both international tourists and local consumers. The type of arak used in this study is oak barrel arak, a local spirit that has been infused with oak chips using a cheap oak barrel medium for approximately 3–4 days.

Although originating from different cultural traditions and possessing distinct flavor profiles, arak and whiskey share several fundamental similarities in their production processes, particularly in fermentation, distillation, and maturation techniques. Both beverages are characterized by a high alcohol content and have historically played important roles in cultural and ceremonial contexts. Similarly, the replacement of cocoa powder with charcoal powder is based on the idea that both ingredients, despite their differing functions and nutritional benefits, are flavorful powders commonly used in food and beverage products. Cocoa and charcoal powders are both derived from natural sources, processed into fine powder form, and offer various health-related properties. Their widespread use and consumer appeal in the culinary industry make them suitable for experimentation in innovative beverage formulations.

This study aims to explore the potential for innovation in Baileys-style liqueur by substituting whiskey with arak and cocoa powder with edible charcoal, assessed through organoleptic evaluation. The findings of this research are expected to contribute to the development of innovative products within the alcoholic beverage industry, offering an alternative formulation that may appeal to consumers seeking unique and distinctive flavor experiences.

Given the novel combination of traditional arak and food-grade charcoal, further investigation into the sensory characteristics of the resulting liqueur product is considered both relevant and timely.

LITERATURE REVIEW

Beverages are generally defined as liquids intended for human consumption, whether for hydration, enjoyment, or ritual purposes. They are broadly categorized into two main types: non-alcoholic beverages such as water, tea, coffee, and juices; and alcoholic beverages that contain varying levels of ethanol derived through fermentation and distillation. According to Indonesian Presidential Regulation No. 74/2013 and Irmayanti (2015), alcoholic drinks are classified into three categories: Group A (≤5%), Group B (>5%–20%), and Group C (>20%–55%). Liqueurs, a subcategory of Group C alcoholic beverages, are known for their sweet and flavorful profiles, typically made by blending distilled spirits with sugar, cream, fruit extracts, and other flavorings (Walton, 2017; Encyclopaedia Britannica, 2023). A prominent example of a cream-based liqueur is Baileys Irish Cream, made from Irish whiskey, fresh cream, cocoa, and vanilla, resulting in a rich, sweet, and smooth taste (Graham, 2022; Simonson, 2023).

Inspired by the popularity of Baileys, this study explores an innovative formulation by substituting Irish whiskey with Balinese arak and cocoa powder with edible charcoal. Arak, a traditional Balinese spirit produced through the fermentation and distillation of coconut sap, has deep cultural and ceremonial significance (Jessica in Kerta Negara, 2021). Recently, arak has gained renewed attention from bartenders and mixologists who infuse it with ingredients such as fruits, herbs, and spices to modernize its flavor and appeal. For this research, oak barrel–infused arak was used, which shares production similarities with whiskey—both involving fermentation, distillation, and aging. The substitution of cocoa with activated charcoal, which is widely recognized as safe for consumption and frequently used in food and beverages for its visual and detoxifying appeal (Manoppo, 2019), introduces a contemporary twist aimed at young consumers and international visitors.

The purpose of this research is to assess the sensory characteristics of a modified Baileys-style liqueur made with arak and charcoal through organoleptic testing. This qualitative study involved five trained panelists who evaluated six indicators: sweetness, color, aroma, flavor, aftertaste (length), and overall impression. The findings revealed that the beverage possessed a semi-dry to sweet profile, a grey hue, a smoky and creamy aroma, a sweet yet slightly charcoal-influenced flavor, a medium to long-lasting aftertaste, and was rated positively overall. These results suggest that such ingredient substitutions can create a modernized version of a traditional drink while maintaining consumer appeal. Further product refinement is suggested, particularly in adjusting sugar levels, enhancing the arak aroma, measuring alcohol content, and improving visual presentation and packaging.

METHODOLOGY

This study aims to explore the sensory characteristics of a Baileys-inspired liqueur formulated by replacing traditional whiskey with arak and cocoa with edible charcoal. The research adopts a qualitative descriptive approach through organoleptic testing, involving five trained panelists. These panelists evaluated the beverage based on specific sensory indicators, including sweetness, color, aroma, flavor, aftertaste (length), and overall impression. According to Sugiyono (2018), qualitative research is rooted in post-positivist philosophy, focusing on natural settings with the researcher as the key instrument, supported by triangulated data collection techniques. Descriptive sensory analysis, as outlined by Cardello (2016), enables trained panelists to deliver detailed profiles of product attributes and assess their intensity levels. This methodology offers nuanced insight into how ingredient substitution influences sensory appeal.

The production process involved blending 250 ml of oak barrel-aged arak, 100 ml of whipping cream, 150 grams of granulated sugar, 1 teaspoon of charcoal powder, and 100 ml of full cream milk. These ingredients were gently heated, stirred, and filtered before being bottled and served in shot glasses for testing. Testing was conducted in May–June at two locations: the panelists' residences and Okuzono Japanese Dining Bali, Seminyak. Prior to testing, the research team prepared all necessary tools and materials, including stoves, saucepans, spatulas, and glassware. The panelists were asked to complete a standardized scoring form that captured both primary descriptors (e.g., sweet, dry, creamy) and additional subjective notes. Data were collected through observation, documentation (photo and video), and scoring to ensure the richness and credibility of findings.

The analysis process consisted of three phases: planning, action, and evaluation. In the planning phase, the researcher outlined the tools and ingredients needed, followed by the formulation and testing process in the action phase. During evaluation, descriptive statistics were applied to summarize and interpret the panelists' assessments. Rather than seeking broad generalizations, this approach emphasized in-depth understanding of how alternative ingredients such as arak and charcoal influence the sensory identity of a familiar liqueur concept. Ultimately, the study contributes to beverage innovation by proposing a localized reinterpretation of Baileys Liqueur, potentially appealing to consumers seeking novel and culturally rooted flavor profiles.

RESEARCH RESULTS

Baileys Irish Cream is a globally recognized liqueur known for its rich and smooth taste, created by blending Irish whiskey, fresh dairy cream, cocoa, sugar, and vanilla. The combination of these ingredients results in a sweet and creamy beverage with a distinct flavor profile. In this study, an innovative reformulation is explored by replacing the key ingredient—whiskey—with arak, a traditional Balinese distilled spirit. Additionally, cocoa powder is substituted with activated charcoal to introduce a novel sensory profile while

maintaining the liqueur's creamy texture and visual appeal. This reformulation reflects an effort to localize and modernize a classic product using indigenous and functional ingredients.

Arak, particularly the oak-barrel-infused variety used in this research, is a distilled alcoholic beverage traditionally made from fermented coconut sap. While arak has long held cultural and ceremonial significance in Bali, recent trends have seen it creatively incorporated into modern mixology. The choice to replace whiskey with arak is motivated not only by its similar alcohol content and production methods—such as fermentation, distillation, and aging—but also by the potential to elevate arak's status through its integration into a premium-style liqueur. Infusing the arak with oak chips during fermentation lends it complexity, mimicking some of the smoky, woody notes associated with aged whiskeys.

The substitution of cocoa powder with activated charcoal further enhances the innovative aspect of the formulation. Activated charcoal is widely recognized for its detoxifying properties and has gained popularity in the culinary world as a functional food additive. Unlike traditional charcoal used for fuel, food-grade activated charcoal is safe for consumption and has been incorporated into a variety of food and beverage products for its deep black color and subtle earthy flavor. According to Dr. Karin Widarma (in Manoppo, 2019), charcoal poses no risk even at high levels of consumption and is not absorbed by the body. Its inclusion in the liqueur offers not only visual intrigue but also aligns with modern consumer trends favoring wellness-oriented and aesthetically appealing products.

This research aims to examine the sensory characteristics of the newly formulated liqueur using organoleptic testing. The evaluation involved five expert panelists and assessed attributes such as sweetness, aroma, color, flavor, aftertaste, and overall impression. The beverage, composed of arak, whipping cream, milk, sugar, and charcoal powder, was prepared under controlled conditions and served in uniform portions. The results indicated a sweet, creamy taste with a medium-to-lingering aftertaste, and a unique greyish color influenced by the charcoal. Although the flavor deviated from the chocolatey notes of the original Baileys, the product maintained a dessert-like profile with a new layer of complexity from the arak and charcoal infusion.

In conclusion, the reformulated liqueur demonstrates strong potential as an innovative product that bridges traditional ingredients and modern consumer preferences. The use of local arak not only honors cultural heritage but also presents opportunities for market expansion, particularly among younger consumers and international tourists seeking novel experiences. Meanwhile, the integration of activated charcoal reflects contemporary trends in food aesthetics and functionality. Through organoleptic assessment, this study contributes valuable insights to the development of alternative alcoholic beverages that prioritize originality, local identity, and sensory appeal.

Table 1. Organoleptic Test Results: Additional Descriptive Data from Panelists

Indicator	Panelist 1 (P1)	Panelist 2 (P2)	Panelist 3 (P3)	Panelist 4 (P4)	Panelist 5 (P5)
Sweetness	Intensely sweet	Overly sweet; needs slight reduction	Close to Baileys' sweetness	Unique character with mild sweetness from whipped cream	Less sweet compared to Baileys
Color	Would be more appealing in beige/brown tone	Slightly cloudy	–	Attractive color; suitable for cocktail mixing	Darker shade; more intense color
Aroma	–	Notes of condensed milk	–	Pleasant charcoal aroma followed by smoky scent	Charcoal enhances color but does not produce overpowering smell
Fruit Aroma	None	None	None	None	None
Non-Fruit Aroma	None	Condensed milk	None	None	None
Other Aroma	None	Skim milk	None	Rich charcoal scent, followed by smoky nuance	Charcoal contributes depth without strong aroma
Flavor	None	Slightly too sweet	Close to liqueur taste	Well-combined flavors; delicious	Flavor is somewhat reminiscent of Baileys

Fruit Flavor	None	None	None	None	None
Non-Fruit Flavor	None	Slightly too sweet	Close to liqueur taste	–	–
Other Flavor	None	None	None	Well-balanced; pleasant to taste	Slightly similar to Baileys
Length (Aftertaste)	None	None	None	Long-lasting flavor; mild alcoholic aftertaste	Cream and charcoal create a smoky, arak-based finish
Product in General	–	–	–	Good	Good

Source: Organoleptic Test, 2024

DISCUSSION

Based on the results presented in Table 1, the sweetness level of the liqueur sample ranges from "semi-dry" to "sweet." The term "semi-dry" in this context refers to a relatively low sweetness intensity, with one panelist noting that the sweetness was insufficient compared to the original Baileys liqueur. This suggests that the product may not fully replicate the characteristic flavor profile of Baileys in terms of sweetness. The remaining four panelists, however, evaluated the sweetness level as "sweet," indicating a generally pleasant but not overwhelming sweetness perception across most evaluations. The sweet flavor in this liqueur formulation is primarily derived from added sugar, with a total sugar content of 150 grams. This amount contributes to the overall sensory balance of the beverage, enhancing its palatability and masking potential off-flavors from other ingredients such as arak or charcoal. The variability in panelists' responses suggests that individual taste sensitivity and preferences may influence sweetness perception, highlighting the importance of refining sugar concentration to achieve broader consumer acceptability. These findings serve as a basis for further product development and formulation optimization.

With regard to the colour indicator, the organoleptic evaluation revealed that the visual appearance of the beverage ranged from “grey” to “dark grey.” One panelist specifically noted that the drink had a distinctly dark grey hue, which can be described as an intense and concentrated grey tone. This coloration is primarily attributed to the use of food-grade charcoal powder as one of the main ingredients. Charcoal, being deep black in colour, significantly influences the final appearance of the beverage, especially when combined with other light-

coloured components such as whipped cream and milk, which are white. The combination of these contrasting ingredients results in a blended shade that visually manifests as grey. The darker grey shades observed are likely due to a higher proportion of charcoal in the mixture, whereas lighter grey tones may result from a more dominant presence of dairy ingredients. The colour of the beverage plays a critical role in shaping consumer perception, as visual attributes often contribute to expectations of taste and quality. Therefore, understanding the impact of ingredient combinations on colour is essential for developing visually appealing liqueur formulations.

Based on the aroma evaluation, panelists unanimously reported the absence of any fruit-related aroma characteristics in the beverage. This is consistent with the formulation, as none of the ingredients used in the production of this liqueur—such as charcoal powder, whipped cream, full cream milk, or sugar—contain any fruit-derived elements. Therefore, no fruit character could be detected in the aroma profile. However, within the non-fruit aroma category, panelists identified notes such as “sweet and creamy,” “condensed milk,” and “charcoal with a slightly smoky scent.” The presence of sweet and milky aromas can be attributed to the significant use of sugar, whipped cream, and full cream milk, which are known to produce such sensory notes during olfactory assessment.

In addition, the identification of “charcoal with a smoky scent” is a direct result of using food-grade charcoal powder, which is derived from burnt coconut shells. This ingredient contributes a unique smoky nuance to the overall aroma profile. Under the category of "other character" aromas, panelists further described notes such as “milk,” “skim milk,” “smoky,” and a combination of “cream and charcoal.” Interestingly, none of the panelists reported the presence of an arak-specific aroma, despite arak being the primary alcohol component replacing whiskey in the formulation. This may be due to the dominance of stronger aromatic ingredients such as milk, whipped cream, and charcoal, which were used in larger quantities compared to arak, thus overpowering its subtle aroma during evaluation.

Based on the results shown in Table 1, panelists reported no detection of fruit character in the flavor profile of the beverage. This finding is consistent with the formulation, which does not include any fruit-based ingredients. The absence of fruit character can thus be attributed to the exclusive use of non-fruit components such as arak, charcoal powder, sugar, full cream milk, and whipped cream in the modified Baileys liqueur. The combination of these ingredients, particularly the substitution of whiskey with arak and cocoa powder with charcoal, inherently limits the presence of fruity notes in the beverage.

However, within the non-fruit and other character categories, panelists identified a variety of notable sensory attributes, including “sweet and bold,” “creamy, sweet,” “condensed milk,” and “cream, sweet, smoky.” These descriptors suggest that the dominant flavor characteristics are largely shaped by the high presence of sugar, whipped cream, and full cream milk. These ingredients contribute to the creamy and sweet taste profile experienced by the panelists. Additionally, the use of arak as the main alcoholic base contributed to a

"bold" flavor, with one panelist describing it as "close to liqueur." This suggests that the distinctive taste of arak remains perceptible, even when combined with other dominant ingredients, reinforcing its suitability as a substitute for whiskey in creating a modernized version of the traditional Baileys liqueur.

In terms of the length indicator, the majority of panelists described the beverage as having a "medium" aftertaste, indicating that the flavor lingers moderately in the mouth after consumption. Specifically, four out of five panelists noted that the taste was neither fleeting nor excessively persistent. This medium-level aftertaste suggests a balanced flavor profile in which the sensory elements of the beverage remain momentarily perceptible without becoming overwhelming. Such a result reflects the effective combination of cream, sugar, charcoal, and arak, where no single element dominates excessively in the mouthfeel experience.

One panelist, however, reported a more prolonged finish, stating, "I can taste the product at first sip and it could stay a bit long at the end of the palate." This observation supports the classification of the beverage's aftertaste as long, especially in relation to the presence of arak, which appears to impart a lasting impression. This finding highlights arak's potential as a whiskey substitute in liqueur formulation, as its distinct characteristics persist even when mixed with strong complementary ingredients such as cream and charcoal. The combination of a medium to long aftertaste is favorable for a liqueur product, as it adds to the complexity and overall drinking experience.

Based on the results presented in Table 1, panelists generally evaluated the modified Baileys liqueur—produced by substituting whiskey with arak, and cocoa with charcoal—as a well-developed and favorable product. Three out of five panelists rated the product as "good," with one assigning a score of 85 out of 100 and another assigning 95 out of 100, indicating a strong positive reception. These scores reflect that, from a sensory perspective, the beverage successfully delivers a pleasant and balanced taste profile that aligns with consumer expectations for a liqueur-style drink. The use of local arak, combined with dairy components and charcoal, appears to create a harmonious flavor experience that is both innovative and enjoyable.

Despite the overall positive evaluation, one panelist offered constructive feedback, suggesting that future improvements could focus on enhancing the visual aspects of the product. The comment, "Good to taste & know how much is ABV, next improvement could be more appealing in terms of colour, bottling & visual," highlights the potential for further product development, particularly in packaging and aesthetic appeal. This feedback underscores the importance of visual presentation in influencing consumer perceptions and purchasing decisions, especially in the competitive alcoholic beverage market. Addressing these aspects could increase marketability and help differentiate the product as a modern reinterpretation of traditional arak-based drinks.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results and discussion presented in Chapter IV, it can be concluded that the sensory characteristics of Baileys liqueur—formulated by

replacing whiskey with arak and incorporating cocoa and charcoal—demonstrate promising attributes across six key indicators. Regarding sweetness, the five panelists consistently rated the beverage from "semi-dry" to "sweet," indicating a moderate level of sweetness attributed primarily to the addition of sugar and dairy ingredients. In terms of colour, the product exhibited hues ranging from "grey" to "dark grey," a result of the combination of black charcoal powder with white milk and whip cream, yielding a distinctive and deep grey tone. For the aroma, the panelists detected prominent notes such as "creamy," "charcoal," and "smoky," which reflect the influence of the full cream milk, whip cream, and burnt coconut shell-based charcoal used in the formulation. Regarding flavour, all five panelists described the beverage as having "sweet," "creamy," "charcoal," and "smoky" taste characteristics, alongside a perceptible alcoholic flavor resulting from the arak used as the primary base. On the length indicator, the product was rated "medium" to "long" in aftertaste, suggesting a lingering flavor impression consistent with the presence of alcohol and charcoal. Finally, under the Product in General indicator, the overall assessment from all panelists was "good," with scores and comments reflecting satisfaction with taste quality, while also suggesting room for improvement in visual presentation and packaging. These findings collectively highlight the potential for further product development and market exploration for an arak-based cream liqueur alternative.

ADVANCED RESEARCH

This research did not incorporate any chemical analysis or alcohol content (ABV) testing, which is a critical factor in the characterization of alcoholic beverages. Therefore, future research should integrate laboratory-based analyses to determine chemical composition, alcohol levels, and product stability over time. Additionally, visual aspects such as bottle design and product appearance could be explored further to enhance the overall appeal and market readiness of the arak-based Baileys liqueur formulation.

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