



Production of a Botanical Spirit Resembling Gin Using a Manual Distillation Method as an Innovation in Spirit-Based Beverage Products in the Food and Beverage Field

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Abstract: This study aims to develop a gin-style botanical spirit using a manual distillation method as an innovation in spirit-based beverage products within the food and beverage sector. The research focuses on formulating alternative botanicals without the use of juniper berry, evaluating sensory characteristics, and measuring alcohol content. A Research and Development (R&D) approach was employed, consisting of stages including product design, design validation, product testing, revision, and dissemination. The botanicals used included pink peppercorn, black pepper, coriander seed, dried lemongrass, pandan leaf, lemon peel, and orange peel. These botanicals were extracted through a short maceration process followed by manual distillation using a simple pot still. Product evaluation was conducted through organoleptic testing covering color, aroma, taste, and mouthfeel using a four-point Likert scale, along with alcohol content measurement using a hydrometer. The results indicate that the developed formulation successfully produced a gin-style botanical spirit with a balanced citrus, spicy, and herbal aroma profile, good clarity, and a smooth mouthfeel. The alcohol content was within the standard range for distilled spirits, indicating that the product is suitable and safe for application in bar practices. This study is expected to contribute as an academic and practical reference for the development of house-made spirits using manual distillation methods in the bar industry.

Keywords: botanical spirit, gin-style spirit, manual distillation, sensory evaluation, spirit innovation, food and beverage

INTRODUCTION

The *food and beverage* industry has increasingly emphasized product innovation as a strategy to create distinctive consumer experiences, particularly within the *spirit-based beverage* segment. Among various distilled spirits, gin has gained strong popularity due to its aromatic complexity and adaptability to diverse botanical formulations. The global growth of

gin is closely associated with the rise of *craft cocktails* and the expanding role of bartenders as creators rather than mere servers of beverages (Polaris Market Research, 2024).

In Indonesia, similar trends are evident in the development of modern bars that prioritize creativity, storytelling, and signature products. Although alcohol production and distribution are subject to strict regulations, urban hospitality venues continue to explore innovation through *house-made ingredients* and experimental beverage concepts. The increasing interest in personalized drinking experiences has encouraged bartenders to experiment with alternative techniques and formulations, particularly in developing unique spirit profiles suitable for bar applications (TraceData Research, 2023).

Gin is traditionally defined as a distilled spirit in which *juniper berry* serves as the dominant botanical, both legally and sensorially (European Spirits Association, 2021). However, recent developments in beverage innovation have introduced the concept of *gin-style botanical spirit*, referring to distilled products that resemble gin in aroma and flavor profile without strictly adhering to legal definitions. This approach allows greater flexibility in botanical selection and is particularly relevant for educational, experimental, and small-scale production contexts (Piggott, 2022).

One alternative production approach that supports such flexibility is manual distillation using a *pot still*. Manual distillation enables direct control over heating, botanical extraction, and fraction separation, making it suitable for small-batch production and learning-oriented environments. Through short *maceration* and redistillation processes, volatile aromatic compounds from botanicals can be effectively extracted while maintaining clarity and stability of the final spirit (McCabe & Smith, 2021). Despite its potential, academic discussion of manual distillation within the context of bar practice and hospitality education remains limited.

The sensory quality of a *gin-style botanical spirit* is strongly influenced by the selection and combination of botanicals. Ingredients such as *black pepper*, *pink peppercorn*, *coriander seed*, *lemongrass*, *pandan leaf*, *lemon peel*, and *orange peel* are known to contribute spicy, citrus, and herbal notes that resemble contemporary gin profiles. The interaction of these botanicals during distillation plays a crucial role in shaping aroma balance, taste, and overall acceptance (Keller, 2022). Therefore, systematic formulation and evaluation are essential to ensure product consistency and quality.

In addition to sensory characteristics, alcohol content is a critical parameter in spirit development. Alcohol by volume (ABV) affects not only safety and regulatory compliance but also mouthfeel and flavor perception. Distilled spirits are generally considered suitable for consumption when their alcohol content falls within the range of 37.5–45% ABV (Jackson, 2020). Accurate measurement of alcohol content is therefore necessary to evaluate the feasibility of manually distilled spirits for practical bar use.

Given the limited number of applied studies addressing manual distillation, alternative botanical formulations, and sensory evaluation within the hospitality context, further investigation is needed. This study aims to develop a *gin-style botanical spirit* using a manual distillation method and to evaluate its sensory characteristics and alcohol content as an innovation in *spirit-based beverage* development within the *food and beverage* sector.

METHOD

This study employed a Research and Development (R&D) approach, adapted to the context of beverage product innovation, specifically the development of a gin-style botanical spirit produced through manual distillation. The use of R&D is aligned with the structured development model proposed by Sugiyono (2020), which emphasizes iterative refinement through planning, evaluation, and revision cycles. The method comprised several sequential components, including the type of research, subjects of study, research setting, instruments, research procedures, and techniques for data collection and analysis. Each component was

structured to ensure the product's scientific reliability, safety, replicability, and sensory quality, consistent with principles of distilled-beverage development described by McCabe and Smith (2021).

The research used the R&D model, which is commonly applied in product formulation and iterative improvement processes. This model was selected because it allows systematic refinement through cycles of design, validation, revision, and testing, ensuring that the final product meets both technical and sensory criteria (Sugiyono, 2020). Such iterative development is widely acknowledged as essential in spirit production, where variables such as botanical composition, maceration duration, and distillation temperature significantly influence sensory outcomes (Lawless & Heymann, 2021; Silvia & Alcarde, 2021). The stages followed were: (1) identification of potential and problems, (2) data collection, (3) product design, (4) expert validation, (5) product revision, (6) limited product trials, and (7) final refinement and documentation.

The subjects involved in this study consisted of two groups, namely trained panelists and untrained panelists, each serving different roles within the product development process. The trained panelists were composed of three professionals from Cork & Screw—specifically a Head Bartender, a Head Sommelier, and a Bartender—selected for their extensive experience in beverage evaluation, aroma profiling, and technical assessment of distilled products. The use of trained assessors aligns with sensory analysis principles outlined by Lawless and Heymann (2021), who highlight the importance of expert judgment in identifying subtle attributes such as aroma balance and mouthfeel. In addition to the expert group, the study also involved seven untrained panelists who were students specializing in Food and Beverage studies. Although they did not possess professional sensory training, their participation was essential to assess consumer-level acceptance during the limited trial stage, consistent with early-stage acceptance testing in product-development research (Rahayu et al., 2022). This combination ensured that the evaluation process incorporated both technical judgment and general consumer perception.

The research was conducted in a controlled small-scale experimental environment designed to replicate the operational conditions commonly found in bar-based beverage production. Such controlled conditions are essential for maintaining distillation temperature stability, maceration uniformity, and consistent botanical extraction, which are critical factors influencing spirit quality (McCabe & Smith, 2021). This setting provided an appropriate context for carrying out botanical preparation, maceration, and manual distillation using a simple pot still, allowing each step to be monitored for precision and consistency. Sensory evaluations—both expert validation and limited product trials—were conducted within the same controlled environment to maintain consistent serving conditions, aroma exposure, and temperature, following the standards recommended in sensory evaluation literature (Lawless & Heymann, 2021).

This study utilized a combination of botanical ingredients and specialized small-scale production instruments essential for formulating and evaluating the gin-style botanical spirit. The botanicals used—black pepper, pink peppercorn, coriander seed, dried lemongrass, pandan leaf, lemon peel, and orange peel—were selected due to their volatile aroma compounds such as limonene, linalool, citral, and β -caryophyllene, which contribute citrus, floral, herbal, and spicy aromatic characteristics found in modern gin (Conner & McLellan, 2020; Keller, 2022; Zhao et al., 2013). Literature on botanical spirits also emphasizes the growing use of alternative botanicals in craft gin for unique regional profiles (Piggott, 2022). The production instruments, including a pot still, thermometer, hydrometer, digital scale, maceration jars, and filtration equipment, reflect micro-distillation setups suitable for prototype spirit development (Barnes et al., 2022). In addition to production tools, data collection instruments included structured observation sheets and a four-point Likert sensory

evaluation questionnaire, following sensory evaluation structures used in beverage studies (Rahayu et al., 2022; Creswell & Creswell, 2021).

The data collection instruments were designed to gather both quantitative and qualitative information related to the sensory, physical, and chemical characteristics of the developed botanical spirit. Observation sheets allowed the researcher to document visual clarity, aroma stability, maceration changes, and distillation behavior, consistent with observational methods in applied food and beverage research (Creswell & Creswell, 2021). The four-point Likert sensory evaluation questionnaire was administered to both trained and untrained panelists to assess color, aroma, taste, and mouthfeel. The use of a forced-choice scale aligns with sensory evaluation best practices, which recommend eliminating neutral responses to improve discriminative power (Lawless & Heymann, 2021; Rahayu et al., 2022). Hydrometer measurement sheets were used to record alcohol content (ABV), ensuring that the product met international spirit standards, such as the minimum 37.5% ABV required for gin-style products (European Spirits Association, 2021).

The research procedures followed a systematic sequence aligned with the R&D framework to ensure thorough exploration and refinement of the botanical spirit formulation. The study began with identifying potential and problems, recognizing the rising interest in house-made spirits and the challenges of limited juniper accessibility and insufficient distillation knowledge (Simonson, 2023). A literature-driven information-gathering phase followed, drawing from research on botanical chemistry, distillation science, sensory evaluation methodologies, and alcohol safety (Lawless & Heymann, 2021; McCabe & Smith, 2021). The subsequent product design stage involved determining botanical composition, maceration length, distillation parameters, desired aroma profile, clarity expectations, and target alcohol concentration. This design process reflects the approach used in flavoromics-based gin development described by Huang et al. (2024). The initial formulation was evaluated by trained panelists, whose assessments guided revisions in botanical ratios, distillation cuts, and filtration processes. A limited trial with untrained panelists was then conducted to assess broader consumer acceptance. The final refinement stage ensured that every step was replicable and aligned with standards used in craft-spirit R&D (Barnes et al., 2022).

Data collection techniques combined observational, quantitative, and sensory-based methods to obtain comprehensive insights into the characteristics and performance of the botanical spirit. Observation was employed throughout maceration and distillation to monitor physical changes such as color, clarity, and aroma development—factors known to influence the quality of distilled beverages (Piggott, 2022). Sensory data were collected through panelist evaluations using the structured Likert questionnaire to evaluate appearance, aroma, taste, and mouthfeel, which aligns with established sensory science methodologies (Lawless & Heymann, 2021). Alcohol measurement via hydrometer confirmed that the final distillate fell within the standard ABV range for gin-style spirits, meeting safety and quality expectations (European Spirits Association, 2021; McCabe & Smith, 2021).

Data obtained from observations, sensory evaluations, and alcohol measurements were analyzed using descriptive quantitative and qualitative approaches. Quantitative sensory scores were processed by calculating mean values for each attribute, allowing identification of acceptance patterns and areas needing improvement, following methods described by Rahayu et al. (2022). Qualitative feedback from trained panelists provided deeper insights into aroma imbalance, mouthfeel intensity, and clarity issues, supporting precise formulation adjustments based on expert judgment. Observational data were analyzed to verify temperature stability, extraction behavior, and clarity development, consistent with guidelines in applied beverage research (Waruwu, 2024). Alcohol content readings were interpreted to ensure compliance with international spirit standards (European Spirits Association, 2021).

The integration of these analytical methods ensured that each refinement stage was evidence-based and aligned with the scientific principles of distillation and sensory evaluation.

RESULTS AND DISCUSSION

The development of the gin-style botanical spirit through the R&D framework produced several key findings related to formulation performance, sensory characteristics, alcohol stability, and overall product feasibility. These findings directly answer the research problems and support the hypotheses established earlier. The initial botanical formulation—consisting of coriander seed, black pepper, pink peppercorn, dried lemongrass, pandan leaf, lemon peel, and orange peel—successfully produced a distillate with dominant citrus-forward aromatics. This aligns with the established literature showing that citrus peels contain high concentrations of limonene and citral, compounds responsible for bright citrus notes in distilled spirits (Zhao et al., 2013; Conner & McLellan, 2020). However, trained panelists indicated that the aroma profile lacked balance, with herbal and spicy notes being overshadowed by citrus volatiles. Minor haze was also observed, which is consistent with findings that unfiltered botanical oils can create turbidity in distillates (Piggott, 2022).

Feedback from the trained panel suggested the need to adjust botanical ratios and improve distillation clarity, supporting the hypothesis that initial formulation would require refinement. After modifying the botanical proportions and improving temperature control during distillation, the revised formulation exhibited significantly better balance between citrus, herbal, and spicy components. This improvement reflects the impact of controlled fraction separation—removing heads and tails—which reduces harsh fusel oils and off-flavors (McCabe & Smith, 2021; Kokoti et al., 2023). The increased presence of herbal and spicy elements such as β -caryophyllene and piperine, derived from coriander and peppers, supports the role of botanical rebalancing in achieving integrated flavor profiles (Silvia & Alcarde, 2021). Pandan and lemongrass also contributed mid-aroma softness due to their key volatiles, including 2-acetyl-1-pyrroline and citral (Putri & Iskandar, 2021; Oghbaei, 2023). This aligns with recent gin analyses emphasizing that terpene-rich botanicals can enhance aromatic complexity (Dou et al., 2023; Huang et al., 2024).

The limited product trial involving untrained panelists further validated the revised formulation. Most panelists described the aroma as fresh, clean, and more balanced than the initial prototype, and the taste as smoother with a pleasant citrus and herbal finish. Their responses support the hypothesis that a juniper-free gin-style spirit can still achieve consumer acceptability when formulated with botanicals containing favorable aroma volatiles. This finding is consistent with trends in modern craft spirits that explore regional botanicals as substitutes for juniper to create unique identity profiles (Simonson, 2023). The alignment between expert and consumer evaluations reinforces the importance of iterative revision cycles as advocated in R&D-based spirit development (Sugiyono, 2020; Barnes et al., 2022). Alcohol content measurements showed that the final distillate consistently achieved 37.5–40% ABV, falling within international standards for gin-style beverages (European Spirits Association, 2021). This demonstrates the effectiveness of the manual distillation process, confirming that controlled heating and fraction separation can produce technically safe and stable alcohol concentrations even under small-scale conditions. These results support previous findings that careful monitoring of temperature and cut points is essential for producing safe craft spirits (McCabe & Smith, 2021).

The overall results highlight the strong relationship between botanical selection, extraction behavior, and distillation accuracy in shaping the sensory profile of botanical spirits. The study demonstrated that modifying the botanical balance directly impacts aroma integration and complexity, while temperature and fraction control influence clarity, alcohol smoothness, and overall drinking quality. These findings align with sensory science principles, which

emphasize that aroma balance, mouthfeel, and volatile composition are key determinants of spirit acceptability (Lawless & Heymann, 2021).

In summary, the findings confirm that the revised botanical formulation and controlled manual distillation process successfully produced a gin-style spirit with desirable sensory characteristics, stable ABV, and strong acceptance from both trained and untrained panelists. These outcomes validate all research hypotheses and reinforce the feasibility of developing a high-quality botanical spirit using locally available ingredients and small-scale distillation techniques. The results contribute to the growing body of literature on craft spirit innovation, demonstrating that regionally sourced botanicals can achieve sensory profiles comparable to traditional gin while offering unique aromatic identity.

CONCLUSION

This study concludes that the development of a gin-style botanical spirit through a structured Research and Development (R&D) approach was successful in producing a product that met sensory, technical, and safety standards. The use of locally available botanicals—such as citrus peels, lemongrass, pandan, coriander, and pepper varieties—proved effective in creating a balanced aromatic profile comparable to contemporary gin formulations, which aligns with literature emphasizing the role of terpene-rich botanicals in spirit aroma construction (Conner & McLellan, 2020; Huang et al., 2024; Zhao et al., 2013). Iterative refinement guided by trained panelists enabled improvement in aroma integration, clarity, and mouthfeel, supporting the value of expert-driven sensory validation in product development (Lawless & Heymann, 2021).

The study also demonstrated that manual distillation, when executed with careful control of temperature and fraction separation, can yield a stable alcohol concentration within the accepted gin standard of 37.5–40% ABV (European Spirits Association, 2021). This confirms the feasibility and safety of small-scale distillation for craft-spirit innovation, reinforcing theoretical frameworks on distillation precision and ethanol purity (McCabe & Smith, 2021). Furthermore, positive responses from untrained panelists indicated that the final formulation possesses broad consumer appeal, supporting growing evidence that regional botanicals can successfully substitute juniper in gin-style beverages while offering unique sensory identity (Piggott, 2022; Simonson, 2023).

Overall, the results validate all research hypotheses: botanical combinations containing readily accessible local ingredients can produce a gin-style spirit with desirable sensorial characteristics; manual distillation processes are capable of achieving safe and consistent ABV levels; and iterative R&D procedures effectively guide formulation refinement. This study contributes to the expanding field of craft spirit development by illustrating that alternative botanicals and manual production methods can serve as viable pathways for innovation within bar-level operations. Future research may expand on this work by exploring additional botanical combinations, conducting shelf-life stability studies, or assessing consumer preferences through larger-scale sensory testing.

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