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G-valley fusion coffee: The potential of golden valley dates (*phoenix dactylifera*) as an alternative antihypertensive coffee substitute

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ABSTRACT

Hypertension remains one of the leading global health problems and is strongly associated with excessive caffeine consumption from conventional coffee, creating the need for safer alternative beverages with functional health benefits. This study aimed to analyze the potential of Golden Valley dates (*Phoenix dactylifera*) as a potassium-rich antihypertensive alternative beverage through the development of G-Valley Fusion Coffee. This experimental study employed laboratory testing and sensory evaluation methods. Laboratory analyses were conducted to determine potassium content, moisture content, ash content, and pH value, while organoleptic testing involved panelists aged 13–40 years to assess color, taste, aroma, and texture preferences across three formulations: 100% date seed (FA), 100% date flesh (FB), and a combination formulation (FC). The results showed that date flesh contained the highest potassium level (2141 ppm), indicating strong potential as a functional antihypertensive beverage ingredient. Sensory evaluation revealed that formulation FA achieved the highest acceptance levels in taste (93%), aroma (90%), texture (87%), and color (68%). These findings suggest that G-Valley Fusion Coffee has promising potential as an alternative functional beverage with antihypertensive benefits and acceptable sensory characteristics for consumers.

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INTRODUCTION

Hypertension is a serious medical condition that significantly increases the risk of cardiovascular disease, stroke, kidney failure, and other chronic health complications (Marlizah et al., 2026). According to the World Health Organization (WHO), hypertension often develops without noticeable symptoms, although some individuals may experience nonspecific or unexpected clinical manifestations (Wulandari et al., 2023). Based on measurement results from the Indonesian Health Survey, the prevalence of hypertension among individuals aged 18 years and above reached 34.1%, with the highest prevalence reported in South Kalimantan (44.1%) and the lowest in

Papua (22.2%). Nationally, hypertension affects approximately 63,309,620 people and contributes to 427,218 deaths. The prevalence increases markedly with age, particularly among individuals aged 35–44 years (27.2%), 45–54 years (39.1%), and 55–64 years (55.2%) (Lestari & Saraswati, 2022). These findings indicate that hypertension remains a major public health concern in Indonesia and requires preventive strategies through dietary modification and functional food development.

Hypertension is strongly associated with lifestyle-related risk factors such as physical inactivity, excessive alcohol consumption, smoking habits, and dietary intake patterns (Rajkumar & Romate, 2020). One increasingly common lifestyle habit is coffee consumption. According to national consumption data reported by HonestDocs, Indonesian women consume an average of one cup of coffee per day, while men generally consume two to three cups daily (Rezkisari, 2019). Coffee contains caffeine which stimulates adrenaline secretion and may increase blood pressure levels, particularly among older adults and individuals with cardiovascular risk factors. Although coffee also contains beneficial compounds such as chlorogenic acid with pharmacological effects (Sofyanita & Maulana, 2024), excessive caffeine intake remains a concern for individuals with hypertension because long-term uncontrolled blood pressure may lead to complications such as cardiovascular disease, kidney damage, and stroke (Sari et al., 2022). Therefore, the development of alternative caffeine-free beverages that maintain the sensory characteristics of coffee but provide additional health benefits is increasingly important.

One potential strategy to support blood pressure control is increasing dietary potassium intake. Potassium plays a crucial role as the primary intracellular cation involved in cellular metabolism and cardiovascular regulation (Castro & Sharma, 2026). Imbalances in potassium levels (dyskalemia) may disrupt cardiac electrical activity and worsen outcomes among patients with cardiovascular disease (Fan et al., 2024). Adequate potassium intake contributes to reduced vascular resistance and improved blood pressure regulation (Octarini et al., 2023), and fruits and vegetables represent major natural dietary sources of potassium (Widiany et al., 2023). Consequently, several international health organizations, including WHO, Hypertension Canada, and the American Heart Association/American College of Cardiology, recommend increasing potassium intake as part of hypertension prevention and management strategies (Chan et al., 2024). Previous studies have also demonstrated that potassium intake is significantly associated with blood pressure regulation, particularly when sodium intake is relatively high (Huang et al., 2024). In addition, potassium contributes to electrolyte stability, fluid balance, acid–base homeostasis, and vasodilation that reduces peripheral vascular resistance and improves cardiac output (Stone et al., 2016).

Date fruits (*Phoenix dactylifera*) are widely recognized as natural sources of potassium and bioactive compounds such as phenolic acids and tocopherols that contribute to antioxidant and cardioprotective effects. Identified phenolic compounds include hydroxytyrosol, gallic acid, protocatechuic acid, tyrosol, caffeic acid, *p*-coumaric acid, oleuropein, 3,4-dihydroxyphenylacetate, α-tocopherol, δ-tocopherol, and γ-tocopherol, while steroid compounds include cholesterol, campesterol, β-sitosterol, 5-avenasterol, stigmasterol, and 5,2,4-stigmastadienol. Among various cultivars, Golden Valley dates represent an Egyptian cultivar that is widely distributed in Indonesia and preferred due to its large fruit size, soft texture, and sweet taste profile consistent with local consumer preferences. Despite these advantages, scientific evaluation of the mineral composition—particularly potassium content—and physicochemical characteristics of Golden Valley dates remains limited, especially in relation to their utilization as functional beverage raw materials.

Previous initiatives by the Indonesian Ministry of Agriculture Library Center demonstrated the feasibility of producing coffee substitutes from date seeds. However, most previous studies have focused only on date seed utilization without comparing the functional contribution of date flesh components or evaluating combined formulations of seed and flesh as potential functional beverages (Kiesler et al., 2024). Furthermore, laboratory-based potassium

analysis specifically targeting Golden Valley date formulations as antihypertensive alternative coffee beverages has not been systematically investigated. This limitation indicates a clear research gap regarding the comparative functional potential of different anatomical parts of Golden Valley dates as caffeine-free coffee substitutes.

Therefore, this study introduces a formulation-based approach through the development of G-Valley Fusion Coffee using three variants consisting of 100% date seed powder, 100% date flesh powder, and a combination of both components. The novelty of this research lies in the comparative physicochemical evaluation and potassium content analysis of Golden Valley date seed and flesh formulations as indicators of antihypertensive functional beverage potential. Accordingly, this study aims to analyze the physicochemical characteristics and potassium content of Golden Valley dates and to evaluate their feasibility as a functional alternative coffee product for individuals with hypertension.

RESEARCH METHOD

This study employed a laboratory-based experimental research design using a Completely Randomized Design (CRD) consisting of three treatment formulations of G-Valley Fusion Coffee prepared from Golden Valley dates (*Phoenix dactylifera*), namely FA (100% date seed powder), FB (100% date flesh powder), and FC (a combination of date seed and date flesh powder at a 1:1 ratio). The experimental design aimed to evaluate the physicochemical characteristics of raw materials and to determine the most acceptable formulation based on sensory evaluation results.

The research was conducted from July 15 to September 8, 2024, at the Laboratory of UIN Maulana Malik Ibrahim Malang and the Central Biotechnology and Chemistry Laboratory of Universitas Muhammadiyah Malang, Indonesia.

The materials used in this study consisted of Golden Valley date flesh and Golden Valley date seeds as the primary raw materials. Supporting equipment included cleaning brushes, blender/chopper, roasting pan, stove, airtight containers, and empty tea filter bags. Laboratory equipment used during physicochemical analysis included an analytical balance, drying oven, furnace, crucibles, desiccator, filtration apparatus with Whatman filter paper, pH meter, and Atomic Absorption Spectrophotometer (AAS).

The preparation of G-Valley Fusion Coffee began with separating the date flesh from the seeds followed by washing and sun-drying procedures. Date seeds were dried under direct sunlight for approximately 3 days, while date flesh was sliced thinly and dried for approximately 7 days until completely dehydrated. To ensure consistency of the initial moisture content prior to analysis, both materials were dried under similar environmental exposure conditions and further processed through controlled roasting treatment. After drying, both materials were coarsely ground using a blender and roasted separately for 45–60 minutes until a characteristic aroma developed and the color changed to dark brown. The roasted materials were cooled at room temperature and packed into empty tea filter bags according to formulation ratios. All samples were stored in airtight containers in a dry place protected from direct sunlight prior to analysis.

Three experimental formulations were prepared as treatment groups in this study as shown in Table 1.

Table 1. Formulation of G-valley fusion coffee samples

Sample Code	Composition
FA	100% Golden Valley date seeds
FB	100% Golden Valley date flesh
FC	Golden Valley date seeds + 50% date flesh

Sample preparation and preliminary infusion appearance testing were conducted at the Laboratory of UIN Maulana Malik Ibrahim Malang, while physicochemical laboratory analyses

were performed at the Central Biotechnology and Chemistry Laboratory of Universitas Muhammadiyah Malang.

Primary data were obtained through laboratory experimentation involving physicochemical characterization of the prepared formulations. Potassium content analysis was performed using a dry-ashing preparation followed by Atomic Absorption Spectrophotometry (AAS). Samples were first dried at 110°C, then incinerated in a furnace for approximately 2.5 hours until ash formation occurred. The ash residue was dissolved using concentrated nitric acid and diluted with aqua regia solution before filtration using Whatman filter paper. The filtrate was diluted up to 100 times prior to analysis. Calibration curves were prepared using standard solutions with concentrations ranging from 1–5 ppb according to the expected concentration range of the samples prior to absorbance measurement using an atomic absorption spectrophotometer. All physicochemical measurements were performed in triplicate to ensure measurement reliability.

Moisture content determination was carried out using the gravimetric oven-drying method at 105°C for 4 hours, while ash content determination was performed using the gravimetric incineration method at 550 ± 10°C until constant weight was obtained. The pH value of brewed G-Valley Fusion Coffee samples was measured using a calibrated digital pH meter with standard buffer solutions at pH 4.01 and pH 10.01 prior to sample measurement.

Sensory evaluation was conducted using a hedonic organoleptic test involving 40 semi-trained panelists aged between 13 and 40 years who were familiar with coffee consumption. Panelists were selected using a purposive sampling technique, with inclusion criteria consisting of individuals who regularly consumed coffee beverages and were willing to participate in sensory evaluation testing. Each panelist evaluated three formulation samples based on taste, aroma, color, and texture using structured hedonic evaluation sheets under similar testing conditions.

Instrument validity in the sensory evaluation was ensured through content validity assessment based on standard organoleptic testing indicators commonly used in beverage preference studies, while reliability testing of the hedonic instrument showed consistent response patterns across panelists during the evaluation session. Each sample was coded using random three-digit numbers and presented in randomized order to minimize evaluation bias.

Secondary data were obtained from government statistical reports, previous research publications, and relevant scientific literature to support interpretation of experimental findings. All collected data were analyzed using descriptive statistical analysis and presented in tables and graphical forms to describe the physicochemical characteristics and sensory acceptability of the developed G-Valley Fusion Coffee formulations.

RESULTS AND DISCUSSIONS

Result

Laboratory Analysis Results of Golden Valley Date Samples

This study employed an experimental laboratory design using three formulation treatments consisting of FA (100% date seed powder), FB (100% date flesh powder), and FC (a combination of date seed and date flesh powder). Physicochemical characterization of the raw materials was conducted prior to formulation development to determine their suitability as functional beverage ingredients. All laboratory measurements were performed in triplicate to ensure analytical reliability, and calibration curves used in potassium determination were prepared within concentration ranges corresponding to the actual sample measurements.

To ensure consistency of the initial moisture content prior to physicochemical analysis, both date seeds and date flesh samples underwent standardized sun-drying followed by roasting treatment under controlled time conditions before laboratory testing. These procedures were applied uniformly across all samples to minimize variability in water content between treatments.

The laboratory analysis results of Golden Valley date seeds and date flesh are presented in Table 2. The analyzed parameters included potassium content, ash content, moisture content, and pH value.

Table 2. Physicochemical characteristics of golden valley date seeds and date flesh

No	Sample	Potassium (ppm)	Ash Content (%)	Moisture Content (%)	pH
1	Date seeds	1505	99.9	2.65	4.938
2	Date flesh	2141	97.75	11.1	4.609

Based on Table 2, Golden Valley date flesh showed higher potassium content (2141 ppm/50 g) compared to date seeds (1505 ppm/50 g). Date seeds exhibited slightly higher ash content (99.9%) than date flesh (97.75%). Meanwhile, moisture content differed substantially between the two materials, with date flesh showing higher moisture content (11.1%) compared to date seeds (2.65%) after drying treatment. The pH values of both samples were within the acidic range, where date seeds showed slightly higher pH (4.938) compared to date flesh (4.609). These results indicate measurable physicochemical differences between Golden Valley date seeds and date flesh as raw materials used in the formulation of G-Valley Fusion Coffee.

Hedonic Test Results

Sensory evaluation was conducted using a hedonic preference test involving three formulation treatments: FA (100% date seed powder), FB (100% date flesh powder), and FC (a combination of date seed and date flesh powder). The evaluation assessed four sensory indicators, including color, taste, aroma, and texture. The reported percentages represent the proportion of panelists selecting the preference categories *like*, *very like*, and *extremely like*. The results of the hedonic evaluation are presented in Table 3.

Table 3. Percentage of Panelists' Preference Levels for Sensory Attributes

Indicator	Sample FA	Sample FB	Sample FC
Color	68%	47%	60%
Taste	93%	10%	66%
Aroma	90%	33%	50%
Texture	87%	33%	50%

Based on Table 3, Sample FA showed the highest preference percentage across most evaluated sensory indicators, particularly taste (93%), aroma (90%), and texture (87%). Sample FC demonstrated moderate acceptance levels across all indicators, with preference percentages ranging from 50% to 66%. In contrast, Sample FB showed the lowest preference levels among panelists, especially in taste (10%), although color acceptance remained relatively higher compared to other attributes (47%).

These findings indicate that formulation FA achieved the highest level of sensory acceptance among panelists compared to the other tested formulations, followed by formulation FC, while formulation FB showed the lowest preference levels across most evaluated sensory indicators.

Discussion

Discussion of Laboratory Analysis Results

The laboratory analysis results showed that Golden Valley date flesh contained higher potassium levels (2141 ppm/50 g) compared to date seeds (1505 ppm/50 g). Potassium is an essential intracellular cation that plays a crucial role in maintaining cellular homeostasis, particularly in muscle contraction and nerve impulse transmission (Frasetto et al., 2023). Adequate potassium intake is widely recognized as an important dietary factor in supporting cardiovascular health and regulating blood pressure. Therefore, the relatively high potassium content found in

both date flesh and date seeds indicates their potential as natural potassium sources, especially for individuals who regularly consume coffee but require alternatives with lower caffeine exposure.

Compared with conventional coffee, the potassium content of Golden Valley date flesh is considerably higher. According to USDA Food Data Central, Arabica coffee contains approximately 20 ppm potassium, which is substantially lower than the 2141 ppm detected in date flesh samples in this study (USDA FoodData Central, 2019). This suggests that date-based coffee substitutes such as G-Valley Fusion Coffee may provide additional dietary potassium intake without caffeine-related effects. Furthermore, the potassium content identified in this study contributes meaningfully toward the recommended daily potassium intake range suggested by the World Health Organization (WHO), which is approximately 2628–3510 mg/day. However, potassium intake should remain balanced because excessive consumption may negatively affect renal function in susceptible individuals (Yamada & Inaba, 2021). Thus, the potassium-rich characteristics of date-derived coffee substitutes highlight their functional potential as supportive beverages for maintaining electrolyte balance and cardiovascular health.

The ash content analysis showed high mineral residue values in both samples, with date seeds presenting slightly higher ash content than date flesh. Ash content reflects the total inorganic mineral composition remaining after complete combustion, indicating the presence of essential minerals such as calcium, magnesium, and potassium (Kristiandi et al., 2021). A relatively high ash value suggests that both raw materials contain substantial mineral components that may contribute to the nutritional quality of the final beverage product. In herbal infusion–type preparations such as coffee substitutes packaged in tea filter bags, mineral availability is particularly relevant because soluble inorganic components may partially diffuse into the brewed solution during preparation.

Moisture content analysis revealed that date seed powder contained 2.65% moisture, while date flesh powder contained 11.1% moisture. Low moisture content is an important quality indicator for dried food materials because it reduces the risk of microbial growth and prolongs storage stability (Nurfitriyani et al., 2024). Although the ideal moisture content for dried food powders is generally below 10% (Kristiandi et al., 2021), slightly higher values may still be acceptable in herbal beverage preparations depending on particle structure and drying characteristics (Salamah et al., 2019). Therefore, the relatively low moisture content observed in date seed powder indicates good storage stability, while the slightly higher moisture level in date flesh powder suggests the importance of proper packaging using airtight containers to maintain product quality during storage.

The pH measurement results showed that date seed powder had a pH value of 4.9, while date flesh powder had a pH value of 4.6, indicating mildly acidic characteristics. This acidity range remains within acceptable limits for beverage-based herbal preparations and may contribute to improved microbiological stability during storage. Previous studies have reported that food products with pH values between 4.5 and 7.5 are generally considered safe for consumption and relatively resistant to rapid microbial growth under appropriate storage conditions (Saidi and Wulandari, 2019). Therefore, the observed acidity levels support the suitability of both raw materials for use in functional beverage formulations.

Discussion of Hedonic Test Results

The hedonic test is a sensory evaluation method used to measure consumer preference levels toward a product based on organoleptic perception, including taste, aroma, color, and texture (Su et al., 2021). In this study, panelists assessed three formulation samples using sensory responses involving visual perception, smell, and taste sensations. Such organoleptic evaluation plays an important role in determining the acceptability of newly developed functional beverage products (Tiyani et al., 2020).

Color evaluation represents the first sensory attribute observed by consumers and strongly influences initial product acceptance. The results showed that Sample FA obtained the highest color preference score (68%), indicating that formulations dominated by date seed composition

produced a brewed appearance that was more visually acceptable to panelists compared to other formulations. Visual similarity to conventional coffee beverages may contribute to higher acceptance levels in coffee substitute products.

Taste evaluation is considered the most critical factor influencing consumer preference. In this study, Sample FA achieved the highest taste preference level (93%), indicating strong panelist acceptance compared to Sample FB and Sample FC. This result suggests that roasted date seed composition produced a flavor profile closer to conventional coffee characteristics than formulations dominated by date flesh.

Aroma evaluation also showed the highest preference level in Sample FA (90%), reflecting the contribution of roasting reactions in generating volatile aromatic compounds that influence beverage attractiveness. Aroma perception is subjective and depends on individual sensitivity as well as processing conditions such as roasting duration and temperature.

Texture evaluation, which includes mouthfeel characteristics influenced by particle size and infusion properties, also showed the highest acceptance in Sample FA (87%). This indicates that the formulation produced a brewed beverage consistency perceived as more acceptable compared to the other formulations tested. Overall, the hedonic evaluation results consistently demonstrate that Sample FA achieved the highest sensory acceptance across all evaluated indicators, suggesting that formulations based predominantly on roasted date seeds provide the most favorable organoleptic characteristics among the tested G-Valley Fusion Coffee variants.

CONCLUSION

This study aimed to evaluate the physicochemical characteristics of Golden Valley date seeds and date flesh and to determine the most acceptable formulation of G-Valley Fusion Coffee as a functional beverage alternative. The results showed that Golden Valley date flesh contained higher potassium levels (2141 ppm) compared to date seeds (1505 ppm), indicating its potential contribution as a natural antihypertensive-supporting ingredient. Physicochemical analysis further demonstrated that both raw materials met acceptable quality parameters in terms of ash content, moisture content, and pH values, supporting their feasibility for use in functional beverage formulation. Sensory evaluation results revealed that Sample FA (100% date seed formulation) achieved the highest panelist acceptance across all evaluated attributes, including color (68%), taste (93%), aroma (90%), and texture (87%), indicating that this formulation represents the most preferred variant among the tested formulations. Scientifically, these findings provide preliminary evidence supporting the utilization of Golden Valley date by-products, particularly date seeds, as potential ingredients for caffeine-free functional beverage development with antihypertensive-supporting nutritional properties. However, this study was limited to laboratory-scale physicochemical characterization and sensory evaluation without comparative analysis against conventional coffee products or clinical assessment of antihypertensive effects. Therefore, further studies involving bioactivity testing, comparative nutritional analysis, and clinical validation are recommended to strengthen the functional claims of G-Valley Fusion Coffee as a health-supporting beverage alternative.

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