

Glycerin-Based Extraction of *Vanilla planifolia*: Characteristics of Extracts under Different Bean Preparation Treatments and Their Application in Pastry Products

ABSTRACT

Natural vanilla extract remains important in pastry production, yet limited attention has been paid to glycerin-based extraction of locally sourced *Vanilla planifolia* under different bean-preparation treatments and to how the resulting extracts perform in pastry products. This study examined the characteristics of three glycerin-based vanilla extracts and evaluated the application of Extracts 1 and 2 in vanilla pudding and pastry cream. A descriptive experimental design was used to prepare extracts under different bean-preparation treatments and to assess their sensory characteristics through product application and interview-based sensory appraisal. Extract 1 developed the darkest color, and Extracts 1 and 2 were associated with more pronounced aromatic profiles than Extract 3. Extract 2 was associated with the richest aroma, characterized by fruity, smoky, and woody notes, whereas Extract 1 showed woody, smoky, and tobacco-like notes. Extract 3 developed more weakly and remained less pronounced in both color and aroma. In the pastry applications, Extract 2 was more consistently associated with a clearer and stronger vanilla character than Extract 1. These findings suggest that glycerin-based extraction shows potential for developing natural vanilla preparations for pastry use, with outcomes shaped by bean-preparation treatment.

Keywords; *bean preparation treatment; glycerin-based extraction; vanilla planifolia*

Andi Gery Anwar Mappatoba
Culinary Art Program
Politeknik Pariwisata Makassar

Intan Fauzia Amalia
Culinary Art Program
Politeknik Pariwisata Makassar

Email: andigery@poltekparmakassar.ac.id



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INTRODUCTION

Vanilla has long held an important place in pastry production because it contributes not only a sweet associated aroma but also depth, warmth, and overall flavor character to products such as creams, custards, puddings, fillings, and baked goods (Alcaire et al., 2017). Yet, despite its sensory value, the use of natural vanilla extract in routine pastry practice is often constrained by cost, limited accessibility, and variability in raw material

quality—conditions that encourage continued reliance on synthetic vanilla flavorings in many production settings (Hofmann et al., 2023; Jiménez-Carvelo et al., 2021; Khoyratty et al., 2018). These practical tensions make natural vanilla extract an important subject of study,

particularly when the concern is not vanilla as a commodity per se, but rather the quality of the extract produced and its relevance to finished pastry applications (Amr et al., 2025; Khoyratty et al., 2018).

Within natural vanilla products, extract is a particularly practical form for pastry use because it can be incorporated directly into a wide range of preparations without further (Amr et al., 2025; Khoyratty et al., 2018). In this study, *Vanilla planifolia* was selected because it is widely recognized as a highly valued vanilla species for extract production and is associated with a rich, well-balanced aromatic profile that aligns with pastry expectations (Pardío et al., 2018). Glycerin (glycerol) was used as the extraction medium because it provides an alcohol-free, food-compatible solvent option consistent with green extraction approaches and can be applied under mild maceration conditions when ethanol is undesirable (Chemat et al., 2019; Fu et al., 2022; Kowalska et al., 2021). At the same time, vanilla extract quality is shaped not only by the solvent itself but also by how the beans are prepared before maceration, since pretreatment and processing conditions influence how aroma precursors and volatile compounds are released and become extractable (Pardío et al., 2018; Perez-Viveros et al., 2025; Yeh et al., 2021).

Previous studies have examined vanilla extraction in relation to processing methods, solvent choice, and the development of aroma-related compounds (Amr et al., 2025; Delgado et al., 2021; Khoyratty et al., 2018; Oliveira et al., 2023; Pardío et al., 2018; Yeh et al., 2021). This body of work has been useful for explaining how extraction conditions may influence vanilla quality, but it has paid less attention to extract formulations that are directly relevant to pastry applications. More specifically, it remains unclear how locally sourced *Vanilla planifolia* performs when extracted in glycerin under different bean-preparation treatments and whether those treatments produce meaningful differences both in the extracts themselves and in finished pastry products. This gap matters because, in culinary use, extract quality is judged not only by how it is produced but also by how convincingly it carries aroma, color, and overall sensory character into preparations such as vanilla pudding and pastry cream.

To address this gap, the present study examined how bean-preparation treatment shaped the sensory character of glycerin-based extracts prepared from locally sourced *Vanilla planifolia* and how those differences carried into finished pastry systems. In doing so, the study extends prior work by linking bean-preparation treatments to both extract-level sensory character and product-level sensory performance. This study aimed to compare the sensory characteristics of glycerin-based vanilla extracts prepared under different bean-preparation treatments and to examine how those differences carried into vanilla pudding and pastry cream. For pastry production, this matters because bean preparation before maceration may influence how clearly vanilla remains recognizable in creams, fillings, and chilled dessert systems.

METHOD

A descriptive experimental design with interview-based sensory appraisal was used to examine treatment-related differences among three glycerin-based vanilla extracts and their subsequent use in two pastry products. The methodological work was organized around the preparation of three glycerin-based extracts from locally sourced *Vanilla planifolia*, with each extract representing a different bean-preparation treatment. This design made it possible to follow treatment-related variation from the extract stage into product application. Accordingly, the comparison focused not only on the extracts themselves but also on how their sensory characteristics were expressed in vanilla pudding and pastry cream.

Vanilla planifolia used in this study was harvested directly from a vanilla plantation in Ulaweng Riaja Village, Amali Subdistrict, Bone Regency, South Sulawesi, Indonesia. The material selected for extraction consisted of Grade B vanilla pods measuring approximately 12–13 cm in length and weighing approximately 2 g each. The pods had undergone curing and drying before being stored in airtight containers until use. The extraction medium consisted of food-grade vegetable glycerin and distilled water; the water was warmed to approximately 40–50 °C to facilitate blending of the solvent mixture. For Extracts 1 and 2, pod selection was matched as closely as practical in terms of grade, approximate size, and cured condition; however, exact pod-to-pod equivalence could not be guaranteed.

Three extracts were prepared using the same glycerin-based maceration system, with bean preparation varied across treatments while the solvent medium remained constant. Each preparation used a solvent mixture of 240 ml vegetable glycerin and 50 ml warm distilled water in a glass container. Extract 1 was prepared from five Grade B vanilla pods split lengthwise before immersion in the solvent. Extract 2 used the same number and grade of pods and the same solvent formulation, but the pods were split, the seeds were scraped out, and the remaining pod material was cut into smaller pieces before immersion. Extract 3 was prepared by reusing the pod material from Extract 1 in a fresh solvent mixture placed in a new glass bottle, thereby functioning as a second-cycle extraction condition based on previously macerated pods.

The extraction work was conducted in stages rather than being initiated simultaneously across all three treatments. Extract 1 was prepared first, and Extract 2 was prepared three weeks later under the same solvent formulation but with a different bean-preparation treatment. Extract 3 was prepared later by reusing the pod material from Extract 1 in a fresh solvent mixture, thereby functioning as a second-cycle extraction condition. After the vanilla material was combined with the solvent, each preparation was kept in a sealed glass bottle, protected from direct light, and stored at room temperature during closed-bottle maceration. During maceration, the bottles were checked and shaken once daily, typically in the morning. The maceration period extended over several weeks, with extract development in this study falling within a range of about 1–2 months before the extracts were used for sensory observation and subsequent product application.

Product application trials were conducted using Extracts 1 and 2 in two pastry preparations: vanilla pudding and pastry cream. These products were selected because they represent common vanilla-flavored dessert systems in which vanilla aroma remains pronounced after cooking and chilling, allowing visual appearance and overall sensory carryover to be assessed clearly in the finished products (Amr et al., 2025; Russo Spena et al., 2025; Velázquez et al., 2020). In both applications, ingredients were weighed before preparation, and the products were made in separate batches for each extract. For vanilla pudding, the extract was added after the cooked base was removed from the heat, and the product was then covered and chilled. For pastry cream, each extract was incorporated into the egg-based mixture before tempering and reheating; the finished cream was then cooled and held under refrigeration before evaluation.

Sensory appraisal in this study involved 13 informants. The appraisal was initially planned for 14 participants, evenly divided between two informant groups; however, one informant from the pastry-experienced group was unavailable during data collection. The final group therefore consisted of 6 informants with greater expertise in pastry work and 7 informants with more general familiarity with pastry products, including participants with a clear interest in pastry and others familiar with pastry products primarily as consumers (see Table 1). The appraisal was conducted in non-blind, separate sessions for the two informant groups. In these sessions, the informants were asked to observe the extracts and to evaluate the finished pastry products through tasting. The appraisal focused on sensory attributes commonly used in food evaluation, with emphasis on aroma for the extracts and on aroma, color, taste, and texture for vanilla pudding and pastry cream (Andersen et al., 2019; Drake et al., 2023; Ruiz-Capillas & Herrero, 2021).

Table 1
Informant Groups Involved in Sensory Appraisal

Category	n	Basis of familiarity
Pastry experienced	6	Participants with greater experience in pastry preparation, handling, and sensory observation
General familiarity	7	Participants familiar with pastry products through personal interest and/or consumer experience

Note. The appraisal was initially planned for 14 participants, evenly divided between the two informant groups. One participant from the pastry-experienced group was unavailable during data collection, resulting in a final total of 13 informants.

Responses were recorded in a group-response format during each appraisal session and then treated as descriptive qualitative data for comparative analysis. Repeated sensory descriptors were grouped to identify recurring contrast patterns within and across the two informant groups, particularly with respect to aroma intensity, perceived sweetness, color, aftertaste, and overall sensory carryover. These recurring contrasts were then synthesized into the reporting categories used in the Results tables and narrative, allowing the analysis to capture not only individual responses but also dominant patterns that recurred across the appraisal material (Assarroudi et al., 2018; Duerlund et al., 2019; Nowell et al., 2017).

RESULTS

Characteristics of Vanilla Extracts 1, 2, and 3

The three glycerin-based vanilla extracts showed clear differences in visual appearance and aroma during the observation period. Across responses from both informant groups, Extract 1 was associated with a darker color and with woody, smoky, and tobacco-like notes, with tobacco emerging as the dominant sensory impression. By contrast, Extract 2 was more consistently described as sharper and richer in aroma, with woody, smoky, and fruity notes perceived more clearly. When Extracts 1 and 2 were compared directly, the darker appearance of Extract 1 did not correspond to stronger aroma; instead, responses across the appraisal more often linked Extract 2 to greater aromatic intensity (see Table 2).

Extract 3 showed a different pattern from the first two extracts. As a second-cycle condition prepared by reusing the pod material from Extract 1 in a fresh solvent system, it developed more slowly and remained less pronounced in both color and aroma. After one month of maceration, informants described its appearance and aromatic development as broadly comparable to Extract 1 at an earlier stage, with woody and smoky notes still present but expressed less sharply overall. The contrast among the three extracts therefore involved not only differences in sensory intensity but also differences in the dominant profile associated with each treatment condition, particularly between the two first-cycle extracts and the reused-material condition represented by Extract 3 (see Figure 1).

Table 2
Sensory Characteristics of Vanilla Extracts 1, 2, and 3

Extract	Visual appearance	Dominant aroma profile	Relative aroma intensity	Brief descriptive note
Extract 1	Darker brown	Tobacco, woody, smoky	Moderate	Tobacco note emerged as the most prominent impression in the appraisal
Extract 2	Lighter than Extract 1	Woody, smoky, fruity	More pronounced than Extract 1	Aroma was described as richer and sharper than that of Extract 1
Extract 3	Less visually developed	Woody, smoky	Less pronounced than Extracts 1 and 2	Showed slower color and aroma development as a second-cycle extract

Overall, the three extracts differed not only in rate of development but also in sensory character. Extract 1 was associated with a darker appearance and a more tobacco-forward profile, whereas Extract 2 was linked to a stronger and more vivid woody-smoky-fruity aroma. Extract 3, by contrast, showed slower development and a less pronounced overall expression. Because the later product application trials involved only Extracts 1 and 2, the role of Extract 3 is best understood at the level of extract characteristics rather than in terms of performance in finished pastry products.

Figure 1
Visual Comparison of Vanilla Extracts 1, 2, and 3



Note. The photographs show the comparative appearance of three glycerin-based vanilla extracts prepared using different bean preparation treatments. To support visual comparison, the images were taken under consistent lighting, background, and framing conditions.

Sensory Evaluation of Extract Application in Vanilla Pudding

In vanilla pudding, the interview-based sensory responses showed a consistent contrast between the two extract conditions. Across both informant groups, pudding prepared with Extract 2 was more often associated with a sharper vanilla aroma and a more noticeable aftertaste, whereas pudding prepared with Extract 1 was described as sweeter, paler in color, and less pronounced in overall vanilla aroma. Vanilla notes remained evident in both preparations after cooking and chilling, but the appraisal more consistently linked Extract 2 to stronger sensory carryover in the finished product (see Table 3).

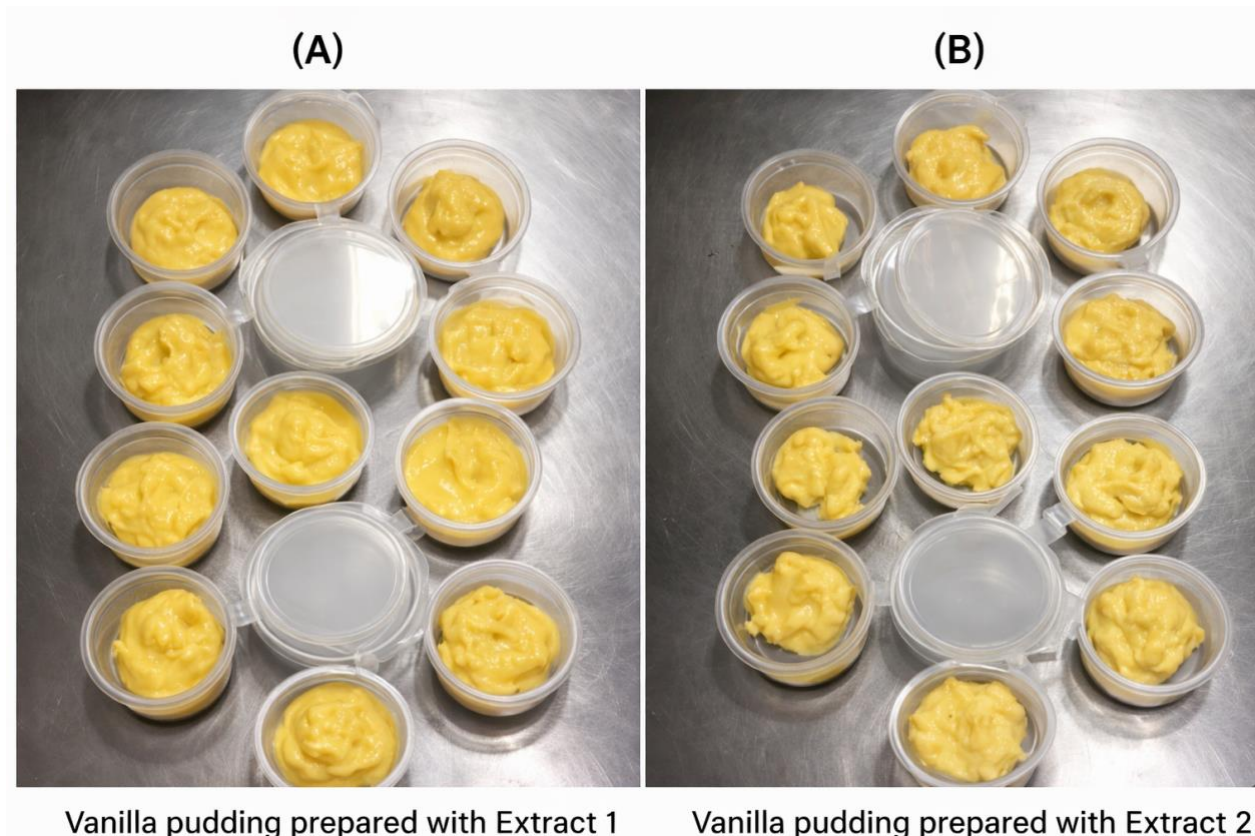
Table 3
Sensory Comparison of Vanilla Pudding Prepared with Extract 1 and Extract 2

Attribute	Vanilla pudding with Extract 1	Vanilla pudding with Extract 2
Aroma	Less pronounced vanilla aroma	More pronounced and sharper vanilla aroma
Taste	Perceived as sweeter	Less sweet in comparison
Color	Paler	Slightly darker
Aftertaste	Less noticeable	More noticeable
Texture	Generally acceptable, with little interference reported	Generally acceptable, with fine seed particles mostly not perceived as disruptive

Differences in visual appearance were also noted during product application. In the earlier trial, pudding prepared with Extract 2 appeared slightly darker, which coincided with the visible presence of vanilla seeds in the extract. In a later trial, after the seeds had been removed, the color difference between puddings prepared with Extracts 1 and 2 was reported as less marked (see Figure 2). Texture responses were generally consistent across the two preparations. Although one pastry-experienced informant noted that the visible seeds created a slightly irregular impression, most informants indicated that the fine seed particles did not materially interfere with perceived texture.

Figure 2

Visual Comparison of Vanilla Pudding Prepared with Extract 1 and Extract 2



Vanilla pudding prepared with Extract 1

Vanilla pudding prepared with Extract 2

Note. Vanilla pudding prepared with Extract 1 is shown on the left, and vanilla pudding prepared with Extract 2 is shown on the right.

Overall, the contrast between the two puddings was described less in terms of texture than in terms of aroma intensity, aftertaste, and perceived color, with pudding prepared with Extract 2 producing the more pronounced vanilla impression.

Sensory Evaluation of Extract Application in Pastry Cream

In pastry cream, the sensory responses showed the same overall contrast between the two extract conditions, but with particular emphasis on the persistence of vanilla character in the finished cream. Across both informant groups, pastry cream prepared with Extract 2 was more often associated with a sharper vanilla aroma and a more memorable aftertaste, whereas cream prepared with Extract 1 was described as sweeter and less pronounced in overall vanilla aroma. Vanilla character remained evident in both preparations, but the appraisal more consistently linked Extract 2 to stronger sensory carryover in the finished product (see Table 4).

Differences in visual appearance were also observed at the product level. In the earlier application stage, pastry cream prepared with Extract 2 was reported as slightly darker, particularly when visible vanilla seed material remained in the mixture. In the later application stage, after the seed material had been removed from Extract 2, the color difference between the two pastry cream preparations was described as less marked (see Figure 3). As in the pudding application, the contrast between the two pastry cream preparations was described less in terms of texture than in terms of aroma intensity,

aftertaste, and perceived color, with Extract 2 producing the more pronounced vanilla impression.

Table 4

Sensory Comparison of Pastry Cream Prepared with Extract 1 and Extract 2

Attribute	Pastry cream with Extract 1	Pastry cream with Extract 2
Aroma	Less pronounced vanilla aroma	More pronounced and sharper vanilla aroma
Taste	Perceived as sweeter	Less sweet in comparison
Color	Paler	Slightly darker in the earlier application
Aftertaste	Less noticeable	More noticeable and longer-lasting
Texture	Generally acceptable, with little interference reported	Generally acceptable, with visible seed material mostly not perceived as disruptive

Figure 3

Pastry Cream Prepared with Extract 1 and Extract 2



Note. Pastry cream prepared with Extract 1 is shown on the left, and pastry cream prepared with Extract 2 is shown on the right.

DISCUSSION

Taken together, the results suggest that differences in bean preparation shaped the sensory development of the glycerin-based extracts in ways that were not reducible to maceration time alone. Extracts 1 and 2 diverged not only in relative intensity but also in sensory profile: Extract 1 was associated with a darker appearance and a tobacco-woody-smoky profile, whereas Extract 2 was more often perceived as sharper and richer, with woody, smoky, and fruity notes that carried more clearly into the finished pastry products. Extract 3, produced by reextracting previously used pod material, showed weaker development and remained less expressive in both color and aroma. Read together, these findings point to bean preparation as an important factor in shaping extract character before the extracts were carried into pastry application.

What appears to distinguish Extract 2 from Extract 1, then, is not simply a more intensive treatment in general but a different way of exposing the vanilla material to the glycerin-based solvent system. In Extract 2, the pods were split, the seeds were scraped out, and the remaining pod tissue was cut into smaller pieces, resulting in a preparation in which more of the vanilla material was opened and brought into direct contact with the solvent (Antonio-Gutiérrez et al., 2023; Fu et al., 2022; Vargas-García et al., 2025). Viewed in light of the results, this treatment pattern offers a plausible explanation for why Extract 2 was more

often perceived as sharper and richer, with sensory attributes that carried over more clearly into vanilla pudding and pastry cream. Extract 1, although darker in appearance, remained associated with a more tobacco-woody-smoky profile and with less pronounced sensory carryover. In this respect, the findings suggest that darker visual development did not, by itself, correspond to stronger aromatic delivery; instead, how the vanilla material was prepared before maceration appears to have mattered more to the extract's character and clarity (Pardío et al., 2018; Vargas-García et al., 2025; Yeh et al., 2021).

Extract 3 pointed to a different limit within the same extraction system. Unlike Extracts 1 and 2, it was prepared from pod material that had already undergone an earlier maceration cycle, and its slower color development, together with weaker aromatic expression, suggests that the reused material no longer yielded the same sensory strength as the first-cycle preparations (Baqueiro-Peña & Guerrero-Beltrán, 2017; Hadj Saadoun et al., 2022; Oliveira et al., 2023). The second extraction, as observed in this study, did not produce an extract comparable to Extracts 1 and 2 in sensory clarity or intensity. Rather, Extract 3 suggests a reduced sensory return when previously used vanilla material is carried into a fresh glycerin-based solvent system.

The contrast observed at the extract level did not remain confined to the extracts themselves but extended into the finished pastry applications. Across both vanilla pudding and pastry cream, Extract 2 was more often associated with a clearer vanilla impression, a stronger aromatic presence, and a more noticeable aftertaste, whereas Extract 1 tended to produce a milder profile that was sometimes perceived as sweeter. This pattern is consistent with work showing that sensory distinctions established at the extract stage can remain perceptible after processing and cooling in finished food systems (Alcaire et al., 2017; Bertelsen et al., 2021; Velázquez et al., 2020). In the present study, those distinctions remained evident across two different pastry systems rather than being flattened by product preparation, suggesting that treatment-related differences in extract character continued to shape how vanilla was perceived in use (Spence, 2022).

Taken together, the findings position glycerin-based extraction as a workable route for developing natural vanilla preparations for pastry use, but not as a neutral or uniform process. In this study, glycerin-based extracts remained sensorially legible after cooking and chilling, which matters in pastry systems where vanilla is expected to remain recognizable in the finished product (Alcaire et al., 2017; Bertelsen et al., 2021). At the same time, the results make clear that the solvent alone does not determine extract quality. How the vanilla material is opened and exposed before maceration also shaped the strength, clarity, and sensory profile of the resulting extract. From a practical standpoint, glycerin-based vanilla extraction is therefore better understood as a preparation-sensitive process than as a single method that yields the same outcome regardless of bean treatment.

Because the study relied on interview-based sensory appraisal rather than instrumental analysis, its contribution is strongest as an applied sensory and product-use investigation showing how treatment-related differences were perceived in the extracts and in the two pastry applications, rather than as an account of the chemical basis of those

differences. The application scope was also limited to vanilla pudding and pastry cream, both selected as pastry systems in which vanilla remained sensorially evident after preparation. Future work could extend the analysis to a wider range of pastry products and combine sensory appraisal with compositional or instrumental methods to examine more closely how differences in bean preparation are carried through extraction and into finished products.

CONCLUSION

Across the bean-preparation treatments, glycerin-based extraction of locally sourced *Vanilla planifolia* did not converge on a single sensory outcome. Instead, Extracts 1 and 2 separated in both intensity and profile: Extract 2 was more consistently described as clearer and stronger in vanilla character and carried that character more distinctly into vanilla pudding and pastry cream, whereas Extract 1 produced a darker extract that was perceived as milder and was, at times, described as sweeter. Extract 3, produced by re-extracting previously used pod material, developed more weakly and did not reach the clarity or intensity of the first-cycle extracts. In this respect, the results suggest that bean preparation functioned as an important driver of extract character and of how clearly vanilla remained recognizable in finished pastry products.

From a practical standpoint, glycerin-based extraction can be used to develop natural vanilla preparations for pastry use, but the outcome depends strongly on how the beans are treated before maceration. Rather than functioning as a standardized method that yields a uniform result, glycerin-based vanilla extraction operates as a preparation-sensitive process: differences in how the pods are opened and handled shape the sensory quality that carries into the finished product. In pastry production, this makes bean preparation a key part of extract design—not a minor preparatory step.

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