

Acceptability of Mulberry (*Morus Spp.*) - Infused Balsamic Reduction as A Functional Condiment: A Basis for Standardized Recipe Formulation

THESIS

Jodi Michelle K. Jacinto

School of Hospitality Management
Philippine Women's University
Manila, Philippines

In Partial Fulfillment
of the Requirements for the Degree of
Master of Science in Culinary Arts

Title	:	Acceptability Of Mulberry (<i>Morus Spp.</i>) - Infused Balsamic Reduction as A Functional Condiment: A Basis for Standardized Recipe Formulation
Author:	:	Jodi Michelle K. Jacinto
Degree	:	Master of Science in Culinary Arts
University	:	Philippine Women's University
School	:	School of Hospitality Management
Completion Year	:	2026
Adviser	:	Ephraimuel Jose L. Abellana, PhD

ABSTRACT

This study examined the acceptability of mulberry (*Morus spp.*)-infused balsamic reduction as a functional condiment and established a basis for standardized recipe formulation in Laguna. Despite the growing interest in functional foods and fruit-based condiments, limited studies have explored the utilization of mulberry in savory culinary applications, particularly in balsamic reductions. This study sought to formulate three variations of mulberry-infused balsamic reduction and determine their level of acceptability in terms of appearance, aroma, taste, texture, and overall acceptability. An experimental research design was employed. Three formulations were developed using varying proportions of mulberry, balsamic vinegar, and sugar. A total of 100 qualified respondents with familiarity and experience in food-related products participated in the sensory evaluation using a 9-point hedonic scale. Data were analyzed using weighted mean and Analysis of Variance (ANOVA) to determine significant differences among formulations. Findings revealed that all formulations were generally acceptable; however, Formulation 3 obtained the highest ratings across most sensory attributes and emerged as the most preferred formulation. Statistical analysis indicated significant differences in aroma, taste, texture, and overall acceptability, while appearance ratings remained comparable across formulations. The results suggest that ingredient proportion significantly influences consumer preference and sensory perception. The study concludes that mulberry can be successfully incorporated into balsamic reduction as a functional condiment, providing both culinary and nutritional value. The standardized formulation developed in this study may contribute to food innovation, value-added product development, and the sustainable utilization of mulberry resources in Laguna and similar agricultural communities.

Keywords: *balsamic reduction; food acceptability; functional condiment; mulberry (Morus spp.); standardized recipe formulation.*

CHAPTER 1

BACKGROUND AND LITERATURE REVIEW

Introduction

The increasing global demand for healthier and more functional food products has significantly influenced food innovation and product development. Functional foods are defined as foods that provide health benefits beyond basic nutrition due to the presence of bioactive compounds (Granato et al., 2020).

The growing consumer interest in health-conscious food choices has increased the demand for functional foods that provide benefits beyond basic nutrition. As consumers become more aware of the relationship between diet and overall well-being, the food industry continues to explore innovative products that combine nutritional value, sensory appeal, and culinary versatility. Functional condiments have emerged as a promising category of food products because they allow consumers to incorporate health-promoting ingredients into their daily meals without significantly altering eating habits.

Among the various functional ingredients available, mulberry (*Morus spp.*) has gained attention due to its rich content of anthocyanins, flavonoids, phenolic compounds, vitamins, and antioxidants. These bioactive compounds have been associated with antioxidant, anti-inflammatory, and disease-preventive properties. Despite its nutritional potential, mulberry remains underutilized in culinary applications and is commonly processed into beverages, jams, teas, and other sweet-based products. Its use in savory food preparations, particularly

condiments, remains relatively unexplored.

Fruits are widely recognized as important sources of functional compounds such as phenolics, flavonoids, vitamins, and antioxidants. Among these, mulberry (*Morus spp.*) has gained attention due to its high nutritional value and therapeutic potential. Recent studies have shown that mulberries contain significant levels of anthocyanins, which exhibit strong antioxidant and anti-inflammatory properties (Zhang et al., 2022).

Balsamic reduction is a popular culinary condiment known for its sweet-acidic flavor profile and versatility in enhancing the taste, aroma, and presentation of various dishes. The incorporation of mulberry into balsamic reduction presents an opportunity to create a value-added functional condiment that combines nutritional benefits with gastronomic appeal. Such innovation may contribute to the diversification of mulberry-based products while promoting healthier food choices among consumers.

The researcher chose this topic for several reasons. First, Laguna is home to mulberry-growing communities and farms, particularly in areas where mulberry cultivation supports local agricultural activities. Despite the availability of this fruit, its utilization remains limited, resulting in untapped opportunities for product development. Second, there is a growing need to create innovative food products that can add value to local agricultural resources while supporting community-based enterprises. Third, the researcher recognizes the potential of mulberry as a functional ingredient that can be transformed into a marketable condiment suitable for both household and commercial use.

Furthermore, there is limited research on the development and acceptability of mulberry-infused balsamic reduction as a functional condiment. This gap in the literature highlights the need for empirical investigation. By evaluating consumer acceptability and identifying the most preferred formulation, the study seeks to establish a basis for a standardized recipe formulation that may be adopted by local producers, entrepreneurs, and stakeholders in Laguna. Ultimately, the study contributes to food innovation, functional gastronomy, and the sustainable utilization of locally available agricultural resources.

Review of Related Literature and Studies

This section presents a critical review of literature and studies relevant to the acceptability of mulberry (*Morus spp.*)-infused balsamic reduction as a functional condiment and its potential as a basis for standardized recipe formulation in Laguna. The discussion is organized thematically to examine the functional properties of mulberry, its application in food product development, the role of condiments in culinary innovation, sensory evaluation and acceptability studies, and the importance of recipe standardization. Through the synthesis of related literature and studies, this chapter establishes the theoretical and empirical foundations of the present study.

Mulberry as a functional food ingredient.

Mulberry (*Morus spp.*) has been recognized as a nutrient-dense fruit containing high concentrations of anthocyanins, flavonoids, phenolic acids, vitamins, and minerals. Zhang et al. (2022) reported that mulberries exhibit strong antioxidant properties that help reduce oxidative stress and contribute to disease prevention. Likewise, Wang et al. (2021) found that mulberry extracts possess anti-inflammatory and anti-diabetic properties,

making them suitable ingredients for functional food development.

Studies conducted in Asia and Europe consistently demonstrated that mulberry retains significant amounts of bioactive compounds even after processing. Li et al. (2020) emphasized that the fruit's phenolic composition contributes to its health-promoting properties and consumer appeal. Furthermore, researchers have identified mulberry as a promising ingredient for value-added products due to its natural color, flavor, and nutritional profile.

Despite these advantages, the application of mulberry remains largely confined to beverages, jams, juices, teas, and confectionery products. Few studies have explored its use in savory food systems and culinary condiments, indicating an underutilized area of food innovation.

Synthesis

The reviewed literature establishes mulberry as a highly functional ingredient with significant nutritional and health benefits. While extensive research supports its use in beverages and sweet products, limited studies have investigated its application in savory condiments. This gap supports the need to explore mulberry-infused balsamic reduction as a novel functional food product.

Bioactive Compounds of Mulberry

The health-promoting effects of mulberry are largely attributed to its bioactive compounds. Li et al. (2020) found that anthocyanins and polyphenols are responsible for the fruit's antioxidant activity. These compounds have been associated with reduced inflammation, improved cardiovascular health, and enhanced immune response.

Research has also shown that mulberry retains a significant portion of its bioactive compounds after processing. This characteristic makes it suitable for incorporation into processed food products without substantial loss of nutritional quality.

Synthesis

The presence of stable bioactive compounds strengthens the potential of mulberry as a functional ingredient in processed foods. This characteristic supports its inclusion in balsamic reduction formulations intended to deliver both sensory and nutritional benefits.

Nutritional Benefits of Mulberry (*Morus spp.*)

Mulberry (*Morus spp.*) has gained increasing attention in food science and nutrition due to its rich nutritional composition and abundance of bioactive compounds. The fruit is recognized as a valuable source of vitamins, minerals, dietary fiber, anthocyanins, flavonoids, and phenolic compounds that contribute to its functional and health-promoting properties. According to Zhang et al. (2022), mulberries contain significant levels of antioxidants that help neutralize free radicals and reduce oxidative stress, thereby lowering the risk of chronic diseases such as cardiovascular disorders, diabetes, and certain forms of cancer. The presence of anthocyanins, which are responsible for the fruit's deep purple-red coloration, further enhances its antioxidant capacity and contributes to its nutritional value.

In addition to antioxidants, mulberries are rich in essential vitamins and minerals that support overall health and well-being. Wang et al. (2021) reported that mulberries contain vitamin C, vitamin E, iron, potassium, calcium, and magnesium, all of which play important roles in immune function, bone health, blood circulation, and cellular metabolism. Vitamin C contributes to collagen synthesis and immune defense, while iron supports the production of red blood cells and the prevention of iron-deficiency anemia. Potassium, on the other hand,

helps regulate blood pressure and maintain cardiovascular health.

Mulberries are also considered a good source of dietary fiber, which contributes to digestive health and supports proper gastrointestinal function. Dietary fiber promotes satiety, improves bowel regularity, and assists in maintaining healthy blood glucose levels. Li et al. (2020) emphasized that the fiber content of mulberries may contribute to better glycemic control and support weight management when incorporated into a balanced diet. These nutritional characteristics make mulberry a suitable ingredient for the development of functional food products that address both nutritional and consumer needs.

Research has further demonstrated that mulberry contains several bioactive phytochemicals with potential therapeutic benefits. Anthocyanins, flavonoids, and phenolic acids found in mulberry have been associated with anti-inflammatory, anti-diabetic, antimicrobial, and cardioprotective effects (Wang et al., 2021). These compounds may help reduce inflammation, improve insulin sensitivity, and protect cells from oxidative damage. Such properties have positioned mulberry as a promising ingredient in the formulation of functional foods aimed at promoting health and preventing disease.

Moreover, studies have shown that many of the beneficial compounds found in mulberry remain stable during food processing. Zhang et al. (2022) noted that mulberry retains a substantial proportion of its antioxidant activity even after undergoing drying, fermentation, concentration, and extraction processes. This characteristic supports its application in value-added food products, including sauces, beverages, condiments, and other processed foods, without significant loss of nutritional quality.

The nutritional composition and health-promoting properties of mulberry support its classification as a functional food ingredient. As consumers increasingly seek foods that provide both nutritional and physiological benefits, mulberry presents a valuable opportunity for food innovation and product development. Its combination of antioxidant compounds, essential nutrients, dietary fiber, and bioactive phytochemicals makes it an attractive ingredient for the creation of functional products that align with current trends in health-conscious consumption.

Synthesis

The reviewed literature establishes mulberry (*Morus* spp.) as a nutrient-dense fruit with significant nutritional and functional benefits. Its rich content of antioxidants, anthocyanins, vitamins, minerals, dietary fiber, and bioactive compounds contributes to its potential role in disease prevention and health promotion. Furthermore, the stability of these compounds during processing supports the use of mulberry in value-added food products. These findings provide a strong foundation for the present study, which explores the incorporation of mulberry into a balsamic reduction as a functional condiment that combines nutritional value, sensory appeal, and culinary innovation.

Mulberry in food product development and processing.

Food product development studies have increasingly focused on transforming perishable fruits into value-added products. Boasiako et al. (2024) noted that processing methods such as drying, extraction, fermentation, and concentration extend shelf life while maintaining nutritional quality. Mulberry has been successfully incorporated into juices, syrups, fermented beverages, and nutraceutical products.

Chen et al. (2020) reported that fermented mulberry products exhibited enhanced antioxidant activity and improved flavor characteristics. Similarly, Memon et al. (2021) found that processing techniques preserved substantial amounts of anthocyanins and phenolic compounds, supporting the feasibility of mulberry-based food innovations.

However, existing studies predominantly focus on sweet applications. Researchers have rarely investigated mulberry's compatibility with acidic and savory food systems. This represents a missed opportunity considering the fruit's complex flavor profile and potential contribution to culinary products.

Synthesis

The literature demonstrates that mulberry can be effectively processed into value-added products while retaining its functional properties. Nevertheless, research remains concentrated on sweet and beverage-based applications, highlighting the need for studies that explore mulberry's potential in savory condiments and culinary innovations.

Mulberry in food product development and processing applications.

The utilization of mulberry (*Morus* spp.) in food product development has been widely explored as a response to its high perishability and rich bioactive composition. Due to its delicate structure and high moisture content, mulberry is prone to rapid spoilage, necessitating processing techniques that extend shelf life while preserving its functional properties. Recent studies emphasize that processing methods such as drying, fermentation, and extraction are essential in transforming mulberry into stable and marketable products (Zhang et al., 2022).

Across different geographical contexts, mulberry has been incorporated into a variety of food products, particularly beverages, teas, powders, and fermented items. In Asian countries where mulberry cultivation is extensive, research has focused on developing mulberry-based drinks and functional beverages that retain high levels of anthocyanins and phenolic compounds (Wang et al., 2021). Similarly, European studies highlight the use of mulberry extracts in nutraceutical products, reinforcing its value as a health-promoting ingredient (Li et al., 2020). These findings collectively demonstrate the adaptability of mulberry in food processing systems under varying environmental and technological conditions.

However, a closer examination of these studies reveals a strong tendency to position mulberry within sweet or beverage-based applications. While such products effectively showcase its nutritional benefits, they limit the exploration of mulberry's potential in broader culinary contexts. Boasiako et al. (2024) noted that although mulberry retains its antioxidant properties after processing, its application in complex food systems, such as sauces or condiments, remains insufficiently studied. This indicates a gap not in the feasibility of processing mulberry, but in the scope of its culinary utilization.

Fermentation studies further support the versatility of mulberry in food development. Research on mulberry vinegar demonstrates that fermentation enhances both its nutritional profile and flavor complexity by increasing organic acids and phenolic content (Food Bioscience, 2025). These findings suggest that mulberry is compatible with acidic food systems, which is particularly relevant in the formulation of vinegar-based condiments such as balsamic reduction. Despite this compatibility, existing studies rarely extend their investigation into culinary applications, focusing instead on nutritional or biochemical outcomes.

Moreover, current literature tends to emphasize the retention of bioactive compounds during processing, often overlooking sensory integration within food systems. While maintaining antioxidant activity is important, consumer acceptability ultimately determines product success. This disconnect between functional properties and sensory application highlights the need for studies that bridge food science and culinary practice.

In relation to the present study, the existing body of literature supports the feasibility of incorporating

mulberry into processed food products and confirms its stability under various processing conditions. However, it also reveals a significant gap in its application within savory or condiment-based formulations. By developing a mulberry-infused balsamic reduction, the present study extends current knowledge by exploring a new product category that integrates both functional and sensory dimensions.

Thus, while previous research establishes mulberry as a viable ingredient in food processing, the present study advances this understanding by repositioning mulberry within a culinary framework, specifically as a functional condiment. This shift not only addresses the identified gap but also contributes to the diversification of mulberry-based products in the food industry.

Synthesis

The reviewed literature demonstrates that mulberry (*Morus spp.*) possesses significant potential as a functional food ingredient due to its rich bioactive composition and adaptability to various processing techniques. Existing studies consistently support its successful incorporation into beverages, fermented products, nutraceuticals, and other value-added food products while maintaining its antioxidant and nutritional properties. However, a critical examination of the literature reveals that research has largely focused on sweet and beverage-based applications, with limited attention given to savory culinary products and condiment development.

Furthermore, while previous studies have extensively investigated the biochemical and nutritional benefits of mulberry, relatively few have examined its integration into food systems where sensory attributes and consumer acceptability are equally important. The literature also suggests that mulberry is compatible with acidic and fermented food matrices, indicating its potential suitability for vinegar-based products such as balsamic reduction. Despite these findings, empirical evidence regarding mulberry-infused condiments remains scarce.

Collectively, the reviewed studies establish the feasibility of utilizing mulberry in food product development while highlighting a significant gap in its application as a functional condiment. This gap provides a strong rationale for the present study, which seeks to evaluate the acceptability of mulberry-infused balsamic reduction and develop a standardized recipe formulation that may contribute to culinary innovation and value-added product development in Laguna.

Fruit-based condiments and culinary innovation.

The growing demand for healthier and more innovative food products has stimulated interest in fruit-based condiments. According to Granato et al. (2020), consumers increasingly prefer products that combine flavor enhancement with nutritional benefits. Fruit-based condiments provide a means of incorporating bioactive compounds into everyday diets.

Balsamic reduction is a widely used condiment in modern gastronomy due to its concentrated flavor and versatility. It is commonly used as a glaze, dressing, or finishing sauce for various dishes. Ubeda et al. (2020) reported that fruit-infused vinegars and reductions can improve sensory appeal while increasing antioxidant content.

Although fruits such as berries, apples, and citrus fruits have been extensively used in condiment development, mulberry remains largely absent from this category. Existing research has not sufficiently examined the sensory and functional potential of mulberry-based balsamic reductions.

Synthesis

Fruit-based condiments represent a growing area of culinary innovation, offering opportunities to

combine functionality and sensory appeal. However, the absence of mulberry in this category reveals a research gap that the present study seeks to address through the development of a mulberry-infused balsamic reduction.

Balsamic Vinegar as a Culinary Ingredient

Balsamic vinegar is widely recognized for its distinctive sweet-acidic flavor and culinary versatility. Traditionally produced through the fermentation and aging of grape must, balsamic vinegar is commonly used in dressings, marinades, sauces, and reductions (Giudici et al., 2021).

Its complex flavor profile enhances both sweet and savory dishes, making it a staple ingredient in modern gastronomy. Additionally, balsamic vinegar contains organic acids and antioxidant compounds that contribute to its nutritional value.

Synthesis

The literature confirms that balsamic vinegar possesses desirable sensory and functional properties. These characteristics make it a suitable base ingredient for the development of innovative fruit-infused condiments.

Nutritional and Functional Properties of Balsamic Vinegar

Studies have shown that balsamic vinegar contains polyphenols and organic acids that contribute to antioxidant activity and digestive health. According to Giudici et al. (2021), vinegar-based products may support glycemic control and improve food preservation.

Consumers increasingly perceive vinegar-based products as healthier alternatives to highly processed condiments, contributing to their popularity in functional food markets.

Synthesis

The nutritional attributes of balsamic vinegar complement the health-promoting properties of mulberry, supporting their combined use in the development of a functional condiment.

Sensory evaluation and food acceptability.

Sensory evaluation is a critical component of food product development because it determines consumer acceptance and market potential. Stone and Sidel (2020) defined sensory evaluation as the scientific discipline used to measure, analyze, and interpret responses to food characteristics perceived through the senses.

The 9-point hedonic scale remains one of the most widely used instruments in food acceptability studies. According to Granato et al. (2020), this scale effectively captures consumer preferences regarding appearance, aroma, taste, texture, and overall acceptability. Sensory evaluation provides valuable information that guides formulation improvements and product optimization.

Researchers have emphasized that acceptability studies should be complemented by statistical analysis to ensure validity and reliability. Methods such as weighted mean and Analysis of Variance (ANOVA) enable researchers to identify significant differences among formulations and determine the most preferred product.

Synthesis

The literature confirms that sensory evaluation is an essential tool in food product development. The integration of hedonic testing and statistical analysis provides a reliable framework for assessing product acceptability, supporting the methodology adopted in the present study.

Sensory evaluation and statistical validation in food product acceptability.

Sensory evaluation has been widely utilized as a primary methodological approach in food product development, particularly in determining consumer acceptability. It is grounded in the epistemological assumption

that knowledge about food quality is constructed through human sensory perception, rather than solely through instrumental or chemical analysis. Hart (1998) argued that knowledge in applied disciplines such as food science is often derived from both objective measurement and subjective human experience. In this context, sensory evaluation reflects an interpretive epistemology, where meaning is generated through consumer interaction with the product. However, this reliance on subjective perception has raised concerns regarding reliability and validity, prompting researchers to integrate statistical methods to strengthen analytical rigor.

Recent studies have consistently utilized the 9-point hedonic scale as a standard tool for measuring consumer preference due to its simplicity and adaptability across different cultural contexts. Stone and Sidel (2020) asserted that hedonic testing allowed researchers to quantify subjective responses in a structured manner. Likewise, Granato et al. (2020) reported that sensory evaluation, when combined with statistical analysis, provided a robust framework for product optimization. However, some studies relied heavily on descriptive statistics alone, which limited the depth of interpretation and raised questions about the scientific rigor of their conclusions. On the one hand, descriptive approaches captured immediate consumer perceptions; on the other hand, they failed to determine whether observed differences among formulations were statistically significant.

This methodological tension has led to increased use of inferential statistical tools such as Analysis of Variance (ANOVA). Granato et al. (2020) argued that ANOVA enabled researchers to compare multiple treatments and determine whether differences in acceptability were significant rather than incidental. In contrast, studies that relied solely on mean comparisons risked overstating product differences without sufficient statistical evidence. Thus, the integration of ANOVA represents a shift toward a more positivist orientation within sensory research, where empirical validation is emphasized alongside subjective evaluation.

Another critical issue in sensory evaluation is the selection of panelists. Stone and Sidel (2020) reported that trained panelists provided more consistent and precise evaluations, particularly for descriptive analysis. However, consumer-based panelists were considered more appropriate for acceptability testing, as they reflected real-world preferences. This distinction highlights an ontological consideration in food research: whether food quality is viewed as an objective property measurable by experts or as a subjective experience shaped by consumers. Wang et al. (2021) emphasized that consumer perception plays a crucial role in determining the success of functional food products, reinforcing the need to prioritize acceptability over technical precision in product development studies.

Furthermore, issues of bias and variability in sensory testing have been widely discussed in recent literature. Factors such as sample presentation, environmental conditions, and panelist expectations can influence responses, potentially compromising data reliability. Stone and Sidel (2020) asserted that randomization and controlled testing conditions were necessary to minimize bias. However, not all studies implemented these controls rigorously, leading to inconsistencies in findings. This suggests that methodological design, rather than the sensory tool itself, often determines the validity of results.

In relation to the present study, the adoption of a 9-point hedonic scale combined with weighted mean and ANOVA addresses the limitations identified in previous research. The use of consumer-based panelists aligns with the study's objective of measuring acceptability rather than technical quality. At the same time, the incorporation of statistical analysis ensures that differences among mulberry-infused balsamic reduction formulations are supported by empirical evidence. This dual approach reflects a pragmatic research stance that integrates both interpretive and positivist elements.

Overall, the literature demonstrated that sensory evaluation remains a valuable tool in food product development, but its effectiveness depends on how it is implemented and analyzed. While subjective perception is central to understanding consumer preference, it must be complemented by statistical validation to ensure credibility. By combining sensory evaluation with inferential statistics, the present study strengthens its methodological foundation and contributes to ongoing discussions on balancing subjectivity and objectivity in food research.

Research Gap

Recent literature has consistently established mulberry (*Morus* spp.) as a nutritionally rich and functionally significant fruit due to its high content of anthocyanins, flavonoids, and phenolic compounds. Studies conducted across various geographical contexts have emphasized its antioxidant, anti-inflammatory, and anti-diabetic properties, positioning mulberry as a promising ingredient in functional food development (Zhang et al., 2022; Wang et al., 2021). Furthermore, research on food processing techniques has demonstrated that mulberry can be effectively transformed into value-added products such as beverages, powders, and fermented items while retaining its bioactive properties (Chen et al., 2020; Memon et al., 2021).

In parallel, the field of culinary innovation has seen a growing interest in functional condiments, particularly fruit-based reductions and vinegar-based products, which combine sensory appeal with health benefits (Granato et al., 2020). Studies on fruit vinegars and reductions have reported enhanced flavor complexity and consumer acceptability due to the balance of sweetness and acidity (Ubeda et al., 2020). These developments indicate a convergence between functional food science and gastronomy, where ingredients are evaluated not only for their nutritional value but also for their sensory contribution to food products.

However, despite the growing body of research on mulberry and its functional properties, existing studies have largely confined its application to beverages, desserts, and nutraceutical products, with limited exploration in savory or culinary condiment systems. Boasiako et al. (2024) observed that mulberry remains underutilized in complex food applications, particularly in sauces and reductions that require both functional stability and sensory integration. This suggests that current research has not fully explored the potential of mulberry beyond conventional product categories.

Moreover, while studies on fruit-based condiments have demonstrated their potential in enhancing flavor and nutritional value, these investigations have predominantly focused on commonly used fruits such as berries and citrus. To the knowledge of the researcher, there is a scarcity of empirical studies that specifically examine mulberry as a primary component in balsamic reduction or similar condiment systems. This indicates a clear gap in the literature regarding the diversification of fruit-based condiments using underutilized functional ingredients.

Furthermore, many existing studies emphasize the biochemical and nutritional aspects of mulberry while giving limited attention to consumer acceptability and sensory evaluation in culinary contexts. Despite the recognized importance of sensory evaluation in product development, there remains a lack of studies that integrate both functional properties and sensory validation within a single experimental framework. As Granato et al. (2020) argued, functional food development should not only focus on health benefits but also consider consumer perception to ensure product success.

Additionally, methodological limitations have been observed in previous studies, particularly in the reliance on descriptive analysis without sufficient statistical validation. While some studies reported mean acceptability scores, they did not employ inferential statistical tools such as ANOVA to determine significant

differences among formulations. This raises questions regarding the robustness and generalizability of their findings.

In this regard, the present study addresses the identified gaps by:

- (a) developing a mulberry-infused balsamic reduction, thereby extending mulberry application into a novel culinary domain;
- (b) integrating sensory evaluation with statistical analysis, ensuring both subjective and objective assessment; and
- (c) examining consumer acceptability within a controlled experimental framework, contributing new empirical evidence to the field.

Following Phillips' (1992) framework on originality, this study demonstrates originality by applying an existing ingredient (mulberry) to a new product category (balsamic reduction) and by testing consumer acceptability using a statistically supported methodology. In doing so, it contributes to the expansion of knowledge in functional food development and culinary innovation.

Thus, amid the growing literature on functional foods and fruit-based condiments, it is evident that mulberry's potential as a functional condiment ingredient remains underexplored, thereby establishing the need for the present study. This gap leads directly to the formulation of the research questions and the Statement of the Problem.

Statement of the Problem

This study aimed to formulate and evaluate the acceptability of mulberry-infused balsamic reduction as a functional condiment.

Specifically, it sought to answer the following questions:

1. What is the demographic profile of respondents in terms of:
 - 1.1 Age
 - 1.2 Gender
2. What is the level of acceptability of the Mulberry-Infused Balsamic reduction in terms of:
 - 2.1 appearance
 - 2.2 aroma
 - 2.3 taste
 - 2.4 texture
 - 2.5 overall acceptability?
3. Is there a significant difference in the acceptability of the different formulations of mulberry-infused balsamic reduction?
4. Which formulation of mulberry-infused balsamic reduction is most preferred by the participants?

Null Hypothesis (H₀):

There is no significant difference in the acceptability of the different formulations.

This study tested the hypothesis that there is no significant difference in the level of acceptability among the different formulations of mulberry-infused balsamic reduction. This assumption was based on the premise that variations in ingredient proportions may influence sensory attributes; however, such differences may not

necessarily result in statistically significant variations in overall consumer preference. Previous studies in food product development have shown that while formulation changes can affect sensory characteristics, consumer acceptability often remains within a comparable range when products are developed using similar base ingredients (Granato et al., 2020). Thus, the hypothesis was formulated to determine whether the observed differences among treatments are statistically significant.

This study contributes to the growing body of knowledge on functional food development by exploring the application of mulberry as an ingredient in a novel culinary product. By integrating mulberry into balsamic reduction, the study expands the potential use of underutilized fruits in condiment formulation, thereby addressing existing gaps in both food science and culinary innovation. The findings provide empirical evidence on the acceptability of mulberry-based condiments, which may serve as a basis for future product development and research.

Furthermore, the study offers practical implications for the food and hospitality industry by introducing a product that combines nutritional value with sensory appeal. As consumers increasingly seek healthier and more innovative food options, the development of functional condiments presents an opportunity for culinary professionals and food entrepreneurs to diversify their offerings. Ultimately, this research supports the advancement of functional gastronomy by bridging the gap between scientific knowledge and practical application.

Conceptual Framework

The present study adopted the Input–Process–Output (IPO) Model as its research paradigm. The model illustrates the systematic flow of the study from the selection of ingredients and formulation variables to product development, sensory evaluation, statistical analysis, and the generation of a standardized recipe formulation.

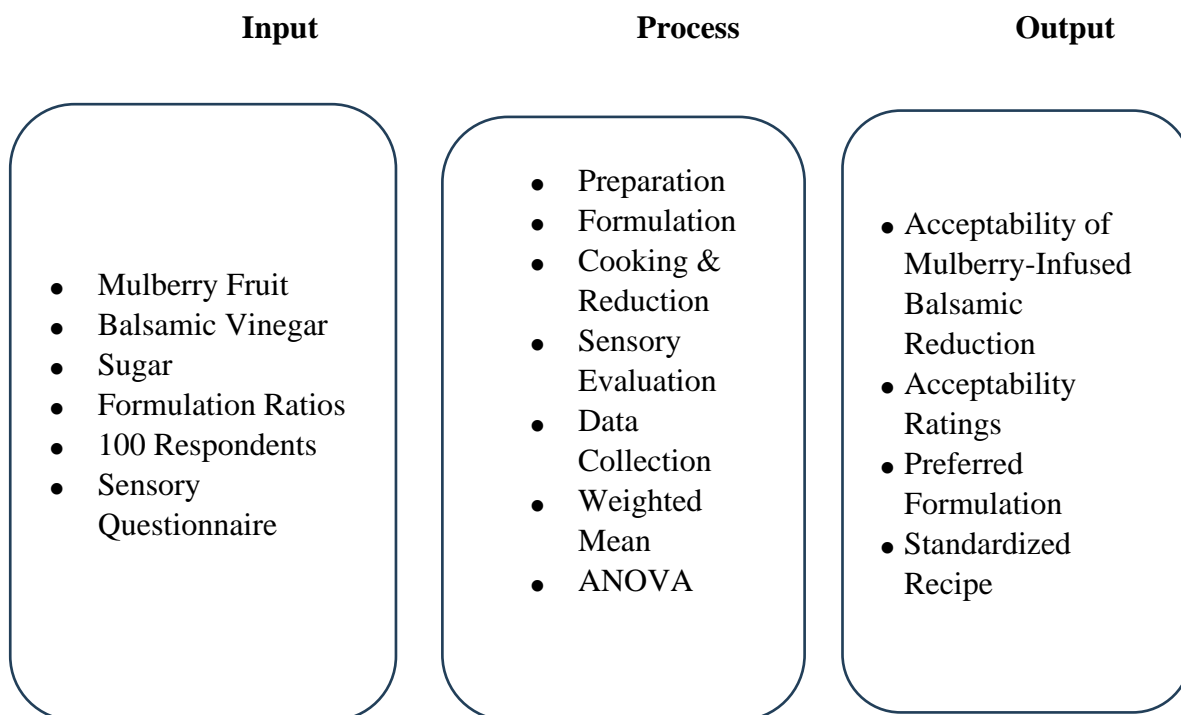


Figure 1. Conceptual Framework

Figure 1 presents the Input–Process–Output (IPO) model that guided the conduct of the study. The input phase consisted of the raw materials, formulation variables, sensory evaluation instrument, and respondents necessary for developing and assessing the mulberry-infused balsamic reduction. The process phase involved the preparation of ingredients, formulation and cooking procedures, sensory evaluation, and statistical treatment of data through weighted mean and Analysis of Variance (ANOVA). These procedures ensured the systematic evaluation of the product's acceptability.

The output phase focused on the development of an acceptable mulberry-infused balsamic reduction, the identification of the most preferred formulation, and the establishment of a standardized recipe formulation for potential utilization in Laguna. The paradigm reflects the study's integration of functional food development, sensory evaluation, and product standardization, ultimately providing a foundation for culinary innovation and value-added utilization of locally available mulberry resources.

CHAPTER 2 METHODOLOGY

Research Design

This study utilizes an experimental research design to develop and evaluate the acceptability of mulberry-infused balsamic reduction as a functional condiment. Experimental research is appropriate for this study because it allows the manipulation of the independent variable, which is the formulation of mulberry-infused balsamic reduction, and the observation of its effect on the dependent variables, specifically the sensory attributes of the product.

Three different formulations were prepared by varying the proportion of mulberry extract while keeping other ingredients constant. Each formulation was subjected to sensory evaluation to determine its level of acceptability in terms of appearance, aroma, taste, texture, and overall acceptability.

The design that the researcher compares the results across treatments and determine which formulation yielded the highest level of acceptability among respondents.

Participants

The participants of the study consist of one hundred (100) individuals selected through purposive sampling, a non-probability sampling technique appropriate for experimental food product studies where participants must possess specific characteristics relevant to sensory evaluation. Purposive sampling allows the researcher to select individuals who are capable of providing informed and reliable evaluations of the developed product, rather than relying on random selection which may include participants lacking familiarity with food assessment.

The participants compose of chef, cooks, culinary and hospitality instructors, BSHM 4th year students, restaurant owners in the 4th District of Laguna. The locale was selected due to its accessibility, availability of individuals with foundational knowledge in food preparation and evaluation, and its relevance to the hospitality and culinary field. This setting provided a suitable environment for sensory testing, as participants are exposed

to diverse food products and are capable of making informed judgments regarding flavor, texture, and overall acceptability. Embedding the study within this locale ensured that the results reflect realistic consumer perceptions within an academic and semi-professional culinary context.

The selection of participants was guided by specific inclusion parameters to ensure the validity and reliability of the data collected. Participants were required to be at least 18 years of age, possess no known allergies to mulberry or vinegar-based products, and demonstrate basic familiarity with food sensory attributes such as taste, aroma, and texture. These criteria ensured that participants could safely and effectively evaluate the samples without compromising the integrity of the results.

On the other hand, individuals with known food allergies, impaired taste or olfactory function, or lack of willingness to participate were excluded from the study. These exclusion criteria were necessary to minimize potential bias and ensure that all evaluations were based on normal sensory perception.

The choice of one hundred participants aligns with established practices in sensory evaluation research, where a sample size of 30 to 50 is considered sufficient to generate reliable and generalizable data while maintaining feasibility (Stone & Sidel, 2020). Unlike large-scale consumer surveys, experimental sensory studies prioritize controlled evaluation conditions over sample size, emphasizing the quality of responses rather than quantity.

Overall, the selected participants are considered appropriate representatives for the study as they possess the necessary sensory awareness and contextual familiarity with food products. Their background in culinary and food-related fields enhances the credibility of their evaluations, thereby strengthening the validity of the findings.

Instrument

The primary instrument used in this study was a structured sensory evaluation questionnaire designed to measure the acceptability of mulberry-infused balsamic reduction as a functional condiment. The instrument consisted of two major sections: (1) participant profile and (2) sensory evaluation of the product. The questionnaire was developed based on established sensory evaluation frameworks commonly used in food product development studies (Stone & Sidel, 2020).

The first section is the criteria or qualification of respondents. The qualification questions were administered to ensure that the selected respondents possessed the necessary background and experience to provide meaningful and reliable evaluations of the mulberry-infused balsamic reduction. The criteria focused on respondents' familiarity with food-related products, culinary practices, and their willingness to participate in sensory evaluation activities. Then gathered relevant demographic information of the participants, specifically age and gender, which are considered essential variables that may influence sensory perception and food preference. The second section comprised five (5) evaluative items corresponding to the key sensory attributes of the product, namely: appearance, aroma, taste, texture, and overall acceptability. Each attribute represented a core construct in sensory analysis, collectively capturing both visual and organoleptic qualities of the product.

The instrument utilized a 9-point hedonic scale, where participants rated each attribute from 1 (Dislike Extremely) to 9 (Like Extremely). The statements were structured in a straightforward and response-oriented format to facilitate ease of understanding and consistency in evaluation. This type of scale is widely recognized for its reliability and sensitivity in detecting differences in consumer preference, particularly in experimental food studies (Granato et al., 2020).

The selection of a hedonic sensory evaluation questionnaire was deemed most appropriate for this study because the primary objective is to determine consumer acceptability, rather than technical or descriptive profiling of the product. While alternative instruments such as descriptive analysis or ranking tests are available, these methods are more suitable for trained panelists and do not directly reflect consumer preference. In contrast, the hedonic scale allows for direct measurement of liking, making it highly relevant for product development research.

The questionnaire is adapted from standard sensory evaluation instruments widely used in food science literature. The structure and scale were based on established methodologies described by Stone and Sidel (2020), which are considered authoritative in the field of sensory evaluation. Since the instrument is grounded on standardized and publicly documented frameworks, formal permission was not required for its use. However, proper acknowledgment of the source framework was ensured through appropriate citation.

Overall, the instrument is considered appropriate for the study as it directly measures the key variables of interest, aligns with established sensory evaluation practices, and provides reliable data for statistical analysis. Its structured yet simple format ensures that participants can effectively evaluate the product, thereby enhancing the accuracy and credibility of the findings.

Validity and Reliability

In this study, the concepts of validity and reliability are carefully considered to ensure that the research instrument accurately measured the intended variables and produced consistent results.

To establish content validity, the sensory evaluation questionnaire is validated by the expert. The instrument is reviewed by professionals in the fields of food science and culinary arts, who evaluated the relevance, clarity, and appropriateness of each item in relation to the objectives of the study. Specifically, the experts assessed whether the selected sensory attributes appearance, aroma, taste, texture, and overall acceptability adequately represented the construct of product acceptability. Based on their recommendations, minor revisions are made to improve the wording and structure of the questionnaire. This process ensured that the instrument comprehensively captured the essential dimensions of sensory evaluation.

In terms of construct validity, the instrument was grounded on established sensory evaluation principles, particularly the use of the 9-point hedonic scale, which is widely recognized in food research for measuring consumer preference. Granato et al. (2020) reported that hedonic scales are effective in capturing subjective responses and are suitable for evaluating product acceptability in experimental food studies. The alignment of the instrument with established theoretical frameworks supports its validity in measuring the intended constructs.

To ensure reliability, the instrument was designed to maintain consistency in data collection procedures. Standardized instructions are provided to all participants, and the evaluation are conducted under controlled conditions to minimize variability in responses. The use of a structured questionnaire with clearly defined rating scales further enhanced the consistency of the measurement.

Although sensory evaluation inherently involves subjective perception, reliability was strengthened by ensuring that all participants evaluated the same set of samples under similar conditions. According to Stone and Sidel (2020), consistency in testing environment and procedure contributes significantly to the reliability of sensory data.

For further reliability assessment, the study may employ internal consistency analysis, such as Cronbach's alpha, to determine the degree of consistency among the sensory attributes. A Cronbach's alpha value of 0.70 or higher is generally considered acceptable for research purposes, indicating that the items in the instrument reliably measure the same construct.

Overall, the procedures that are implemented in this study was ensured that the instrument is both valid and reliable. The combination of expert validation, adherence to established sensory evaluation frameworks, and standardized data collection procedures strengthens the credibility and accuracy of the research findings.

Data Gathering Procedure

The researcher prepared all necessary materials, including fresh mulberries and other ingredients required for the formulation of the mulberry-infused balsamic reduction. Three (3) formulations were developed based on varying proportions of mulberry extract. Each formulation was prepared under controlled conditions to ensure consistency in cooking time, temperature, and ingredient measurement.

After preparation, the samples were cooled and placed in identical containers. Each sample was assigned a random code to prevent bias during evaluation. The coded samples were then arranged and presented to the participants in a randomized order.

Prior to the sensory evaluation, the participants were oriented regarding the purpose of the study and the procedure for evaluation. Informed consent was obtained from all participants, ensuring that their participation was voluntary. They are also informed of their right to withdraw from the study at any time without any consequences. To ensure safety, participants were screened for any food allergies related to the ingredients used in the study.

During the evaluation, each participant is provided with the sensory evaluation questionnaire and instructed to assess the samples based on appearance, aroma, taste, texture, and overall acceptability using the 9-point hedonic scale. Drinking water was provided to cleanse the palate between samples to minimize carry-over effects.

The evaluation was conducted in a controlled environment to minimize external factors that could influence sensory perception. Participants completed the questionnaire independently to avoid peer influence.

After the evaluation, all completed questionnaires were collected immediately to ensure completeness and accuracy of responses. The gathered data were then organized, tabulated, and prepared for statistical analysis.

Throughout the data gathering process, confidentiality and anonymity of the participants were strictly maintained. All data collected were used solely for academic purposes and were handled in accordance with ethical research standards.

Analysis and Interpretation

The data that are gathered from the sensory evaluation were tabulated and analyzed using appropriate statistical tools. The results are presented in tables showing the mean scores of each sensory attribute per treatment.

Table 1 - Nine-Point Hedonic Rating Test Scale

Scale	The Range for Interpretations Weighted	Verbal Interpretation
9	8.12 – 9.00	Like Extremely
8	7.23 – 8.11	Like Very Much
7	6.34 – 7.22	Like Moderately
6	5.45 – 6.33	Like Slightly
5	4.56 – 5.44	Neither Like nor Dislike
4	3.67 – 4.55	Dislike Slightly
3	2.78 – 3.66	Dislike Moderately
2	1.89 – 2.77	Dislike Very Much
1	1.00 – 1.88	Dislike Extremely

The data gathering was conducted using a scale ranging from 1 to 9, with each number representing a specific level of preference: 9 for "Like extremely," 8 for "Like very much," 7 for "Like much," 6 for "Like moderately," 5 for "Neither like nor dislike," 4 for "Dislike slightly," 3 for "Dislike moderately," 2 for "Dislike very much," and 1 for "Dislike extremely." This scale helped the researchers in analyzing the data effectively and accurately interpreting respondents' preferences.

The formulation with the highest mean score is considered the most acceptable.

Statistical Treatment

To determine the level of acceptability of the mulberry-infused balsamic reduction in terms of appearance, aroma, taste, texture, and overall acceptability, the weighted mean of Likert scale data from standardized test hedonic test was utilized. To test the difference and determine which among three formulations is most preferred by the participants, ANOVA was used in this research.

Ethical Considerations

After conducting this research and the approval of the research proposal and the validation of the survey instrument, data are collected from human participation. In compliance with the Data Privacy Act of 2012 (Republic Act No. 10173), all personal information was treated with strict confidentiality and will be used solely for academic purposes. Informed consent was ensured that participants clearly understood the purpose of the study in which their data would be collected, stored, and protected. The research observed the principle of data minimization, collecting only information essential to its objectives. All identifying details were anonymized, and data were securely stored, encrypted, password protection, and restricted access to authorized researchers.

Participants were also informed of their rights to access, correct, or withdraw their data in accordance with ethical and legal standards.

CHAPTER 3 ANALYSIS AND DISCUSSION

The formulations of mulberry-infused balsamic reduction can be developed using varying proportions of mulberry extract

The table presents the three formulations of mulberry-infused balsamic reduction developed for the study. The formulations varied in the proportions of balsamic vinegar, fresh mulberry, and sugar to determine the most acceptable combination of ingredients. Formulation 1 consisted of ½ cup balsamic vinegar, 500 grams fresh mulberry, and 1 tablespoon sugar. Formulation 2 contained 1 cup balsamic vinegar, 2 cups fresh mulberry, and 1 teaspoon sugar. Formulation 3 consisted of 1 cup balsamic vinegar, 1 cup fresh mulberry, and 1 teaspoon sugar.

Formulation 1 Recipe	Formulation 2 Recipe	Formulation 3 Recipe
½ C Balsamic Vinegar	1 C Balsamic Vinegar	1 C Balsamic Vinegar
500 g Fresh Mulberry	2 C Fresh Mulberry	1 C Fresh Mulberry
1 Tbsp Sugar	1 Tsp Sugar	1 Tsp Sugar

Table 2. Recipe Formulation

Table 2 presents the three formulations of mulberry (*Morus spp.*)-infused balsamic reduction developed for sensory evaluation. The formulations differed primarily in the proportions of balsamic vinegar, fresh mulberry, and sugar, allowing the study to examine how variations in ingredient composition influence product acceptability. Formulation 1 contained a higher proportion of mulberry relative to balsamic vinegar, whereas Formulation 2 increased both the balsamic vinegar and mulberry content while reducing the sugar level. Formulation 3 maintained the higher balsamic vinegar content but reduced the mulberry quantity, creating a different balance between sweetness, acidity, fruit flavor, and texture.

The development of multiple formulations reflects a fundamental principle in food product innovation, wherein ingredient ratios are systematically modified to achieve an optimal balance of sensory and functional attributes. According to Granato et al. (2020), the success of functional food products depends not only on their nutritional properties but also on their ability to satisfy consumer sensory expectations. In the context of the present study, varying the concentrations of mulberry and balsamic vinegar enabled the researcher to identify the formulation that best integrated the functional benefits of mulberry with the characteristic flavor profile of balsamic reduction.

From the perspective of Functional Food Theory, the inclusion of mulberry across all formulations ensured the presence of bioactive compounds associated with antioxidant activity and health promotion (Zhang et al., 2022). However, the theory also suggests that the effectiveness of a functional food product extends beyond nutritional composition and depends on consumer willingness to incorporate the product into regular dietary practices. Consequently, the formulation process must address both functionality and palatability. This consideration is particularly relevant in condiment development, where flavor balance is a key determinant of consumer acceptance.

The formulation strategy adopted in this study also addresses a gap identified in the literature. Existing research has predominantly explored mulberry in sweet products, beverages, and nutraceutical applications, with limited attention given to savory culinary preparations (Boasiako et al., 2024). By combining mulberry with balsamic vinegar, the study expands the application of mulberry into a condiment category that remains relatively underexplored. The varying formulations further allow an examination of how ingredient interactions influence sensory outcomes, thereby generating insights that extend beyond the nutritional properties of mulberry alone.

Viewed through the conceptual framework of the study, the formulation ratios served as the primary input variables that influenced sensory attributes such as appearance, aroma, taste, and texture. These sensory responses ultimately determined overall acceptability and guided the identification of the most suitable formulation for standardization. Thus, the three formulations were not merely recipe variations but experimental treatments designed to investigate the relationship between ingredient composition and consumer perception. This approach contributes to the growing discourse on functional gastronomy by demonstrating how local agricultural resources may be transformed into value-added culinary products that satisfy both health and sensory expectations.

The level of acceptability of the mulberry-infused balsamic reduction in terms of appearance, aroma, taste, texture, and overall acceptability of the three formulations.

Table 3 - Level of acceptability of the mulberry-infused balsamic reduction in terms of appearance

Appearance	Formulation 1	Formulation 2	Formulation 3
n = sample	100	100	100
Top 2 box	77	77	83
Like Extremely	45	45	50
Like Very Much	32	32	33
Like Moderately	14	17	13
Like Slightly	8	3	3
Neither Like nor Dislike		1	
Dislike Slightly	1	2	1

Table 3. Level of Acceptability in Terms of Appearance

Table 3 results show that all three formulations performed well, with very positive feedback from respondents. However, Formulation 3 achieved the strongest overall liking score compared to Formulations 1 and 2. Formulation 3 obtained the highest Top 2 Box score at 83%, indicating stronger overall appeal in appearance. It also received the highest “Like Extremely” rating at 50%, compared to 45% for both Formulation 1 and Formulation 2.

These findings suggest that the visual characteristics of Formulation 3 were more effective in attracting consumer preference. According to Stone and Sidel (2020), appearance is often the first sensory attribute evaluated by consumers and serves as a critical determinant of initial product acceptance. Visual cues such as color, glossiness, consistency, and overall presentation significantly influence expectations regarding taste and quality before actual consumption. In the context of fruit-based products, color intensity and visual attractiveness are particularly important because consumers often associate vibrant natural colors with freshness, nutritional value, and product quality (Li et al., 2020).

The favorable appearance ratings for Formulation 3 may also be attributed to the anthocyanin-rich pigments naturally present in mulberry. Research by Zhang et al. (2022) demonstrated that anthocyanins contribute not only to the antioxidant properties of mulberry but also to its attractive deep purple-red coloration, which enhances consumer appeal. This observation aligns with Sensory Evaluation Theory, which posits that positive visual perception can create favorable expectations that influence overall product acceptability (Stone & Sidel, 2020).

Overall, Formulation 3 stands out as the best-performing formulation in terms of appearance, driven by its stronger extreme liking scores and highest Top 2 Box result. The findings indicate that achieving an appealing visual presentation is essential in the development of functional condiments, as appearance serves as an important gateway to consumer acceptance and may enhance the perceived value of innovative food products (Granato et al., 2020).

Table 4 - Level of acceptability of the mulberry-infused balsamic reduction in terms of Aroma

Aroma	Formulation 1	Formulation 2	Formulation 3
Top 2 box	69	53	68
Like Extremely	37	14	32
Like Very Much	32	39	36
Like Moderately	18	29	22
Like Slightly	9	13	9
Neither Like nor Dislike	2	3	1
Dislike Slightly	1	2	
Dislike Moderately	1		

Table 4. Level of Acceptability in Terms of Aroma

Table 4 results indicate that Formulation 1 and Formulation 3 performed better overall compared to Formulation 2. Among the three, Formulation 1 achieved the strongest aroma appeal. Formulation 1 recorded the highest Top 2 Box score at 69%, closely followed by Formulation 3 at 68%, while Formulation 2 lagged behind at 53%. In terms of “Like Extremely,” Formulation 1 led with 37%, followed by Formulation 3 at 32%. Formulation 2 received the lowest strong liking score at only 14%.

Overall, Formulation 1 stands out as the best-performing formulation for aroma due to its highest strong liking and Top 2 Box scores. Formulation 3 also performed competitively, while Formulation 2 generated weaker emotional appeal despite being generally acceptable to respondents.

Table 5 - Level of acceptability of the mulberry-infused balsamic reduction in terms of Taste

Taste	Formulation 1	Formulation 2	Formulation 3
Top 2 box	71	42	72
Like Extremely	35	20	35
Like Very Much	36	22	37
Like Moderately	17	38	18
Like Slightly	11	16	10
Neither Like nor Dislike	1	2	
Dislike Slightly		2	

Table 5. Level of Acceptability in Terms of Taste

Table 5 shows that Formulation 1 and Formulation 3 performed strongly and were highly preferred by respondents, while Formulation 2 showed noticeably weaker performance. Formulation 3 achieved the highest Top 2 Box score at 72%, closely followed by Formulation 1 at 71%. In contrast, Formulation 2 recorded a significantly lower score at 42%. Both Formulation 1 and Formulation 3 received the highest “Like Extremely” score at 35%, indicating stronger consumer preference for taste.

Overall, Formulation 3 emerged as the strongest performer for taste, with slightly better overall liking compared to Formulation 1. Meanwhile, Formulation 2 showed weaker taste appeal and lower strong liking scores among respondents.

Table 6 - Level of acceptability of the mulberry-infused balsamic reduction in terms of Texture

Texture	Formulation 1	Formulation 2	Formulation 3
Top 2 box	77	64	78
Like Extremely	44	26	48
Like Very Much	33	38	30
Like Moderately	17	27	19
Like Slightly	5	7	3
Neither Like nor Dislike	1		
Dislike Slightly		2	

Table 6. Level of Acceptability in Terms of Texture

Table 6 indicates that Formulation 1 and Formulation 3 performed better overall compared to Formulation 2. Among the three, Formulation 1 achieved the best texture with 78% top 2 box. Formulation 3 consistent in terms of taste since it also gathered 48% of the respondents who “Like Extremely” with only 4% difference of Formulation 1 in “Like Extremely” from Formulation 1.

Overall, all three formulations gained almost all like with minimal “Dislike Slightly” in terms of Taste.

Table 7 - Level of acceptability of the mulberry-infused balsamic reduction in terms of Overall Acceptability

Overall Acceptability	Formulatio n 1	Formulatio n 2	Formulatio n 3
Top 2 box	70	53	75
Like Extremely	40	20	38
Like Very Much	30	33	37
Like Moderately	27	36	21
Like Slightly	2	10	4
Neither Like nor Dislike	1		
Dislike Slightly		1	

Table 7. Level of Acceptability in Terms of Overall Acceptability

Table 7 presents that Formulation 3 has the strongest overall consumer acceptance with score 75% on top 2 box, while Formulation 1 also performing well with 70%. Formulation 2 is notably weaker with 53%. "Formulation 3 is the strongest overall candidate based on broad consumer acceptability.

Formulation 1 is competitive, especially for generating intense consumer liking.

Formulation 2 may require improvement to increase stronger positive reactions and reduce lukewarm perceptions."

Test of difference in the acceptability of the different formulations of mulberry-infused balsamic reduction

Table 8 – Difference of acceptability of the different formulations of mulberry-infused balsamic reduction

ANOVA				
<i>Variables</i>	<i>F-value</i>	<i>df</i>	<i>P-Value</i>	<i>Difference</i>
Appearance	0.836	2	0.435	Not Significant
Aroma	5.615	2	0.004	Significant
Taste	10.528	2	<0.001	Significant
Texture	6.551	2	0.002	Significant
Overall Acceptability	8.826	2	<0.001	Significant

<i>Variables</i>	<i>Formulation</i>	<i>Formulation</i>	<i>Formulation 3</i>
	<i>1</i>	<i>2</i>	
Appearance	8.11	8.11	8.27
Aroma	7.86	7.42	7.89
Taste	7.93	7.36	7.97
Texture	8.14	7.77	8.23
Overall Acceptability	8.06	7.60	8.09

Table 8. Analysis of Variance

Table 8 presents the analysis of variance (ANOVA) on the acceptability of the different formulations of mulberry-infused balsamic reduction in terms of appearance, aroma, taste, texture, and overall acceptability. The findings revealed that appearance obtained an F-value of 0.836 with a p-value of 0.435, which is greater than the 0.05 level of significance. This indicates that there is no significant difference in the respondents' evaluation of the appearance among the three formulations. The mean scores further support this result, showing that all formulations were similarly rated in appearance, with Formulation 3 having the highest mean score of 8.27, while Formulations 1 and 2 both obtained a mean of 8.11. This implies that the visual quality of the product remained acceptable regardless of formulation variations.

On the other hand, aroma showed a significant difference among the formulations, as indicated by an F-value of 5.615 and a p-value of 0.004, which is lower than 0.05. Among the three formulations, Formulation 3 received the highest mean score of 7.89, followed closely by Formulation 1 with 7.86, while Formulation 2 obtained the lowest mean score of 7.42. This result suggests that the formulation significantly influenced the aroma of the mulberry-infused balsamic reduction, with Formulation 3 being the most preferred by the respondents in terms of smell.

Similarly, taste yielded an F-value of 10.528 and a p-value of less than 0.001, indicating a highly significant difference among the formulations. The mean scores revealed that Formulation 3 achieved the highest rating of 7.97, followed by Formulation 1 with 7.93, while Formulation 2 obtained the lowest mean of 7.36. This

finding implies that the respondents perceived noticeable differences in flavor among the formulations, and Formulation 3 was considered the most palatable and acceptable in terms of taste.

In terms of texture, the ANOVA result also revealed a significant difference, with an F-value of 6.551 and a p-value of 0.002. Formulation 3 again obtained the highest mean score of 8.23, followed by Formulation 1 with 8.14, while Formulation 2 had the lowest mean score of 7.77. This indicates that the variations in formulation significantly affected the texture of the product, and the respondents favored the texture of Formulation 3.

Lastly, the overall acceptability of the mulberry-infused balsamic reduction showed a significant difference among the formulations, as evidenced by an F-value of 8.826 and a p-value of less than 0.001. Formulation 3 recorded the highest overall mean score of 8.09, followed by Formulation 1 with 8.06, while Formulation 2 obtained the lowest mean score of 7.60.

Most preferred formulation of mulberry-infused balsamic reduction by the participants

The results indicate that Formulation 3 obtained the highest acceptability ratings across most sensory attributes and emerged as the most preferred formulation among the respondents. This finding suggests that the specific proportion of mulberry and balsamic vinegar used in Formulation 3 achieved a more desirable balance of flavor, aroma, texture, and overall sensory quality compared to the other formulations. While all formulations incorporated the same functional ingredient, the variation in ingredient ratios appeared to influence how respondents perceived the product, particularly in attributes directly associated with eating satisfaction.

Viewed through the lens of Sensory Evaluation Theory, the findings reinforce the proposition that consumer acceptance is largely determined by sensory perception rather than nutritional value alone (Stone & Sidel, 2020). Although mulberry is recognized for its antioxidant and health-promoting properties, respondents ultimately evaluated the product based on sensory experiences such as taste, aroma, and texture. The superior performance of Formulation 3 suggests that successful functional food development requires an effective integration of health benefits and sensory appeal. This observation supports the argument that consumers are more likely to accept functional foods when desirable sensory characteristics are maintained alongside nutritional advantages (Granato et al., 2020).

The findings also contribute to ongoing discussions in functional food research regarding the balance between functionality and palatability. Previous studies have emphasized that the incorporation of bioactive ingredients may sometimes alter product flavor and texture, potentially reducing consumer acceptance (Zhang et al., 2022). However, the favorable evaluation of Formulation 3 demonstrates that mulberry can be incorporated into a vinegar-based condiment without compromising sensory quality. This extends existing literature by illustrating that mulberry is not limited to sweet products and beverages but may also be successfully integrated into savory culinary applications.

Moreover, the results address an important gap identified in the review of literature. Existing studies have largely focused on mulberry's nutritional composition, antioxidant capacity, and application in juices, teas, and fermented beverages (Wang et al., 2021; Boasiako et al., 2024). Comparatively little attention has been given to its use in condiment development. The present findings therefore provide empirical evidence that mulberry possesses not only functional value but also culinary versatility. This expands the discourse on mulberry utilization and supports the emerging trend toward functional condiments as vehicles for delivering health-promoting compounds in everyday diets.

From the perspective of the study's conceptual framework, the findings demonstrate how formulation variables influence sensory attributes, which subsequently determine overall acceptability. The results validate the framework's assumption that changes in ingredient composition affect consumer perception and product preference. More importantly, the emergence of Formulation 3 as the most preferred treatment suggests that the relationship between functionality and acceptability is not inherently conflicting; rather, appropriate formulation strategies can successfully integrate both dimensions.

Ultimately, the findings highlight a broader implication for food innovation and product development. Rather than viewing local agricultural resources solely as raw materials, the study demonstrates how they may be transformed into value-added products that meet contemporary consumer expectations for both health and sensory satisfaction. In this regard, Formulation 3 represents more than a preferred recipe; it exemplifies how functional gastronomy can bridge scientific knowledge, culinary creativity, and local agricultural development within the context of Laguna.

CHAPTER 4

CONCLUSION, IMPLICATIONS, AND RECOMMENDATIONS

This study aimed to determine the acceptability of mulberry (*Morus spp.*)-infused balsamic reduction as a functional condiment and establish a basis for standardized recipe formulation in Laguna. The study was anchored on the growing demand for functional foods and the need to diversify the utilization of locally available agricultural resources through culinary innovation.

The findings suggest that mulberry possesses considerable potential beyond its traditional applications in beverages and sweet products. By integrating mulberry into a balsamic reduction, the study demonstrated that functional ingredients can be successfully incorporated into savory culinary preparations without compromising consumer acceptability. More importantly, the study highlights that the development of functional food products should not be limited to nutritional enhancement alone but should also consider sensory quality, consumer preference, and culinary applicability.

At a broader level, the study reinforces the view that food innovation can serve as a bridge between agriculture, nutrition, and gastronomy. The acceptability of the developed product indicates that local agricultural commodities such as mulberry can be transformed into value-added products that respond to contemporary consumer preferences for healthier and more innovative food choices. Consequently, the study contributes to the advancement of functional gastronomy by demonstrating how scientific knowledge and culinary creativity may be integrated into a single product development framework.

Furthermore, the study supports the importance of recipe standardization as a foundation for product consistency, quality assurance, and potential commercialization. The resulting formulation provides a practical model that may be adopted by food entrepreneurs, hospitality practitioners, and local producers seeking to develop innovative mulberry-based products within Laguna and similar agricultural communities.

The findings further demonstrate that the successful development and acceptability of mulberry-infused balsamic reduction can create new opportunities for value-added agricultural production. The product has the potential to increase the utilization and marketability of locally grown mulberry, thereby recognizing and supporting the efforts of mulberry farmers whose livelihood depends on agricultural production. Through the

development of innovative food products, mulberry may become a more economically valuable crop, encourage greater cultivation and provide additional income-generating opportunities for farming communities.

The study also highlights the potential of mulberry as a catalyst for agritourism development. Beyond its use as a functional ingredient, mulberry farms may serve as tourism destinations offering farm visits, mulberry-picking activities, culinary demonstrations, product tasting experiences, and farm-to-table programs. Such initiatives can strengthen the connection between agriculture and tourism while promoting the unique agricultural identity of Laguna.

The findings of the study have implications for food product development, culinary education, agribusiness, tourism development, and community extension initiatives. The successful development of a mulberry-infused balsamic reduction demonstrates that underutilized agricultural commodities can be transformed into innovative functional food products with potential consumer acceptance. This may encourage food developers and culinary professionals to explore alternative uses of locally available resources and create products that promote both nutrition and sustainability.

From an agricultural perspective, the study highlights opportunities for increasing the value of mulberry production in Laguna. The development of standardized mulberry-based products may provide additional income-generating opportunities for local farmers, processors, and entrepreneurs while supporting the diversification of agricultural outputs. The commercialization of mulberry-based products may contribute to rural economic development and strengthen local agricultural value chains.

Likewise, local government units may benefit from the findings by using the study as a basis for agricultural development programs, food innovation initiatives, livelihood projects, and agritourism promotion. The study supports the potential integration of mulberry farming into local tourism programs through farm tourism activities that showcase mulberry cultivation, harvesting, processing, and culinary applications.

The hospitality and restaurant industry may also benefit from the findings. Restaurant owners and food entrepreneurs may utilize the standardized mulberry-infused balsamic reduction as a unique locally sourced condiment that supports farm-to-table dining concepts. The incorporation of mulberry-based products into restaurant menus may strengthen local sourcing practices while providing consumers with healthier and innovative culinary options.

Educational institutions may utilize the study as a reference for research and extension programs focused on functional food development, culinary innovation, food entrepreneurship, sustainable agriculture, and agritourism development.

The study also contributes to the growing body of literature on functional condiments and sensory evaluation. By combining product formulation, consumer acceptability testing, and recipe standardization, the research provides a framework that may guide future investigations involving other indigenous fruits and locally sourced ingredients.

Based on the findings and conclusions of the study, it is recommended that Local Government Units (LGUs) develop programs and initiatives that support mulberry farmers through training, product development assistance, entrepreneurship programs, and market linkage opportunities. Such efforts may encourage the production of value-added mulberry products and enhance the economic potential of mulberry cultivation within

Laguna. LGUs may also collaborate with academic institutions, tourism offices, and agricultural stakeholders to promote the sustainable utilization of mulberry as both an agricultural resource and a functional food ingredient.

Furthermore, local government agencies and tourism stakeholders are encouraged to explore the development of mulberry farm tourism activities, such as mulberry-picking experiences, farm tours, product tasting sessions, culinary demonstrations, and farm-to-table programs. These initiatives may increase public awareness of the nutritional and culinary value of mulberry while generating additional sources of income for farmers and local communities. Integrating mulberry farms into existing tourism circuits may also strengthen Laguna's agritourism offerings and promote rural development.

Mulberry farmers are likewise encouraged to explore value-added processing opportunities and establish partnerships with food processors, restaurants, hospitality establishments, and entrepreneurs. By diversifying their products beyond fresh fruit production, farmers may increase the market value of their harvests and create more sustainable livelihood opportunities. The formation of cooperatives or farmer associations may also strengthen production capacity and improve access to wider markets.

Restaurant owners, culinary professionals, and hospitality establishments may consider incorporating mulberry-infused balsamic reduction and other mulberry-based products into their menus as part of farm-to-table and locally sourced dining initiatives. Such practices not only support local agriculture but also provide consumers with innovative functional food products that combine nutritional benefits with unique culinary experiences. Collaboration between restaurants and local mulberry growers may further strengthen community-based food systems and encourage sustainable sourcing practices.

Academic institutions are encouraged to utilize the findings of this study as a basis for future research, extension programs, and instructional activities related to functional food development, culinary innovation, food entrepreneurship, sustainable agriculture, and agritourism. Collaborative projects involving students, researchers, farmers, and local communities may further contribute to the development and promotion of mulberry-based products.

Future researchers are encouraged to conduct laboratory analyses focusing on the antioxidant activity, nutritional composition, phytochemical content, and microbiological quality of mulberry-infused balsamic reduction to further validate its functional properties. Additional studies may also investigate shelf life, storage stability, packaging requirements, consumer purchasing behavior, and market feasibility to determine the product's commercial potential. Moreover, future research may explore the development of other mulberry-based products, including dressings, marinades, sauces, glazes, gourmet condiments, and other culinary applications.

Finally, stronger collaboration among Local Government Units, academic institutions, mulberry farmers, restaurant owners, tourism stakeholders, and entrepreneurs is highly recommended to maximize the agricultural, economic, culinary, and tourism potential of mulberry in Laguna. Through coordinated efforts and sustained innovation, mulberry may emerge as both a valuable functional food ingredient and an agritourism attraction that contributes to local economic growth, agricultural sustainability, and community development.

From an international perspective, future research may compare consumer perceptions of mulberry-infused balsamic reduction across different countries and cultural contexts. Comparative studies may provide valuable insights into the global market potential of mulberry-based functional condiments and contribute to the international discourse on functional gastronomy. Researchers may also explore the application of advanced food technologies, including encapsulation techniques, preservation methods, and innovative packaging systems, to

enhance product quality and extend shelf life. Such investigations would align with the growing global emphasis on sustainable food innovation and value-added agricultural products (Granato et al., 2020).

Moreover, future studies should examine the broader culinary applications of mulberry beyond balsamic reduction. The development of mulberry-based dressings, marinades, glazes, sauces, and gourmet condiments may provide additional opportunities for product diversification and commercialization. Given the increasing consumer demand for functional foods and plant-based ingredients, expanding the utilization of mulberry within contemporary culinary systems represents a promising direction for future research and industry development.

Ultimately, the present study serves as an initial step toward integrating mulberry into functional condiment development. While the findings provide a foundation for standardized recipe formulation in Laguna, continued research is necessary to validate the product's nutritional value, commercial feasibility, and broader consumer acceptance. Through sustained scholarly inquiry and industry collaboration, mulberry may emerge as a valuable ingredient in both local and international functional food markets, thereby contributing to food innovation, agricultural sustainability, and culinary advancement.

. ABOUT THE AUTHOR

Jodi Michelle K. Jacinto is a College Instructor at Laguna State Polytechnic University (LSPU)–Siniloan Campus, Laguna, Philippines, where she has been serving since 2019. In this role, she delivers lectures, facilitates discussions, and conducts demonstrations in hospitality management courses, fostering interactive and experiential learning among students.

Her professional background includes industry experience as a Cook at New World Manila Bay Hotel in Manila, where she developed practical competencies in culinary operations, food preparation, and hospitality service. This combination of academic and industry experience enables her to integrate real-world applications into hospitality education. Ms. Jacinto has actively participated in various professional development programs and trainings, including Culinary Bootcamp: Mastering Catering Operations, Survival Swimming and Fire Fighting Course, Risk Management Applied for Safety and Sanitation, Personality Development, Macro Perspective of Tourism and Hospitality, and Introductory Assistant Language Teacher Training. She also holds several professional credentials, including the Teaching English as a Foreign Language (TEFL) Certification, Certified Hospitality Management Professional (CHMP) designation, and the TESDA Bread and Pastry Production National Certificate II (NC II). Her academic and professional interests include hospitality management, culinary arts, food service operations, tourism education, hospitality training, customer service excellence, and food safety and sanitation. She is committed to advancing hospitality education through instruction, research, and community engagement. Her continuing professional development reflects her dedication to academic excellence, industry relevance, and the preparation of future hospitality professionals.

REFERENCES

- [1]. Boasiako, P., et al. (2024). Processing and utilization of mulberry (*Morus* spp.) in value-added food products. *Journal of Food Processing and Preservation*, 48(2), e17890.
- [2]. Chen, X., et al. (2020). Fermentation effects on antioxidant activity and quality characteristics of mulberry-based products. *Food Chemistry*, 315, 126283.
- [3]. Food Bioscience. (2025). Nutritional and functional characteristics of fermented mulberry vinegar. *Food Bioscience*, 63, 105432.

- [4]. Giudici, P., Gullo, M., Solieri, L., & Falcone, P. M. (2021). Balsamic vinegar: Production, composition, and health-promoting properties. *Foods*, 10(5), 1128.
- [5]. Granato, D., et al. (2020). Functional foods: Product development and trends. *Comprehensive Reviews in Food Science and Food Safety*, 19(5), 2343–2367.
- [6]. Hart, C. (1998). *Doing a literature review: Releasing the social science research imagination*. Sage.
- [7]. Li, Y., et al. (2020). Polyphenolic composition and antioxidant activity of mulberry (*Morus* spp.) fruits. *Food Research International*, 137, 109698.
- [8]. Memon, A. A., et al. (2021). Effect of processing on anthocyanins and phenolic compounds in mulberry products. *Journal of Food Science and Technology*, 58(9), 3421–3430.
- [9]. Phillips, E. M. (1992). *The handbook of originality in research*. Open University Press.
- [10]. Stone, H., & Sidel, J. L. (2020). *Sensory evaluation practices* (5th ed.). Academic Press.
- [11]. Ubeda, C., Hidalgo, C., Torija, M. J., Mas, A., & Troncoso, A. M. (2020). Fruit vinegars and reductions: Sensory properties, antioxidant activity, and consumer acceptance. *Foods*, 9(11), 1610.
- [12]. Wang, Y., et al. (2021). Health benefits of mulberry bioactive compounds. *Nutrients*, 13(5), 1452.
- [13]. Zhang, H., et al. (2022). Bioactive compounds and antioxidant properties of mulberry (*Morus* spp.): A review. *Antioxidants*, 11(4), 732.

LIST OF APPENDICES

Appendix A

Certificate of Language Editing

CERTIFICATION

To Whom It May Concern:

This is to certify that the undersigned edited the thesis of JODI MICHELLE K. JACINTO titled, **“ACCEPTABILITY OF MULBERRY (*MORUS SPP.*) - INFUSED BALSAMIC REDUCTION AS A FUNCTIONAL CONDIMENT: A BASIS FOR STANDARDIZED RECIPE FORMULATION**

Neither was the intention of the researcher nor the formatting was modified during the editing process. Corrections in terms of lexical choices, subject-verb agreement, and limited sentential-level errors were made.

Whatever conceptual and technical flaws, shortcomings, and errors that the paper may contain are all of the responsibilities of said Author.

This Certification is issued upon the request of the writer for whatever purpose it may serve her best in the completion of her degree of MASTER OF SCIENCE IN CULINARY ARTS at The Philippine Women’s University, School of Hospitality Management Department.


MIZPAFAITH G. AUSTRIA, LPT, MAEd
Teacher I

Mizpafaith.garcia@deped.gov.ph
Date: 6-10-2026

Appendix A
Certificate of Language Editing

CERTIFICATION

To Whom It May Concern:

This is to certify that the undersigned edited the thesis of JODI MICHELLE K. JACINTO titled, **“ACCEPTABILITY OF MULBERRY (*MORUS SPP.*) - INFUSED BALSAMIC REDUCTION AS A FUNCTIONAL CONDIMENT: A BASIS FOR STANDARDIZED RECIPE FORMULATION**

Neither was the intention of the researcher nor the formatting was modified during the editing process. Corrections in terms of lexical choices, subject-verb agreement, and limited sentential-level errors were made.

Whatever conceptual and technical flaws, shortcomings, and errors that the paper may contain are all of the responsibilities of said Author.

This Certification is issued upon the request of the writer for whatever purpose it may serve her best in the completion of her degree of MASTER OF SCIENCE IN CULINARY ARTS at The Philippine Women’s University, School of Hospitality Management Department.

MIZPA FAITH G. AUSTRIA, LPT, MAEd
Teacher I

Mizpafaith.garcia@deped.gov.ph

Date: _____

Appendix B
Certificate of Statistical Treatment

CERTIFICATION

To Whom It May Concern:

This is to certify that the undersigned carried out required statistical treatment based on the identified research problem of the thesis of JODI MICHELLE K. JACINTO titled, "ACCEPTABILITY OF MULBERRY (*MORUS SPP.*) - INFUSED BALSAMIC REDUCTION AS A FUNCTIONAL CONDIMENT: A BASIS FOR STANDARDIZED RECIPE FORMULATION".

I understand that I should remain the Author's statistician until the paper has been approved by the Panel Members. I am responsible for whatever conceptual and technical flaws, shortcomings, and errors that the paper may contain in terms of the statistical treatment.

This Certification is issued upon the request of the writer for whatever purpose it may serve her best in the completion of her degree of MASTER OF SCIENCE IN CULINARY ARTS at The Philippine Women's University, School of Hospitality Management Department.


JIMBOY D. GASCO
Master in Applied Statistics (CAR)
Mathematics and Statistics Instructor

Email address: jimboy.gasco@lspu.edu.ph
Date: 6-4-2026

the
led,
IIC
ED

l by
ws,

rve
S at

Research Instrument

QUALIFICATION QUESTIONS

Direction: Please answer the following questions honestly by checking the appropriate answer.

Are you currently studying or working in a food-related field?

Yes

No

Are you familiar with condiments, sauces, or balsamic reduction products?

Yes

No

Have you previously tasted or used balsamic reduction products?

Yes

No

Do you have experience in food preparation, culinary arts, or food service?

Yes

No

Are you willing to evaluate the appearance, aroma, taste, texture, and overall acceptability of the product samples?

Yes

No

SENSORY EVALUATION QUESTIONNAIRE

Title of the Study:

ACCEPTABILITY OF MULBERRY (*MORUS SPP.*) - INFUSED BALSAMIC REDUCTION AS A FUNCTIONAL CONDIMENT: A BASIS FOR STANDARDIZED RECIPE FORMULATION IN LAGUNA

PART I. PARTICIPANT PROFILE

Direction: Kindly provide the following information. Your responses will be kept confidential.

Name (Optional): _____

Age: _____

Gender: Male Female Prefer not to say

PART II. SENSORY EVALUATION

Direction: You are requested to evaluate the given samples of mulberry-infused balsamic reduction.

Please rate each sample based on the following sensory attributes using the scale provided.

9-POINT HEDONIC SCALE

Scale Description

- | | |
|---|--------------------------|
| 9 | Like Extremely |
| 8 | Like Very Much |
| 7 | Like Moderately |
| 6 | Like Slightly |
| 5 | Neither Like nor Dislike |
| 4 | Dislike Slightly |
| 3 | Dislike Moderately |
| 2 | Dislike Very Much |
| 1 | Dislike Extremely |

EVALUATION FORM

Sample A: FORMULATION 1

Sensory Attribute	9 – Like Extremely	8 – Like Very Much	7 – Like Moderately	6 – Like Slightly	5 - Neither Like nor Dislike	4 - Dislike Slightly	3 - Dislike Moderately	2 - Dislike Very Much	1 - Dislike Extremely
Appearance									
Aroma									
Taste									
Texture									
Overall Acceptability									

COMMENTS (Optional)

Sample B: FORMULATION 2

Sensory Attribute	9 – Like Extremely	8 – Like Very Much	7 – Like Moderately	6 – Like Slightly	5 - Neither Like nor Dislike	4 - Dislike Slightly	3 - Dislike Moderately	2 - Dislike Very Much	1 - Dislike Extremely
Appearance									
Aroma									
Taste									
Texture									
Overall Acceptability									

COMMENTS (Optional)

Sample C: FORMULATION 3

Sensory Attribute	9 – Like Extremely	8 – Like Very Much	7 – Like Moderately	6 – Like Slightly	5 - Neither Like nor Dislike	4 - Dislike Slightly	3 - Dislike Moderately	2 - Dislike Very Much	1 - Dislike Extremely
Appearance									
Aroma									
Taste									
Texture									
Overall Acceptability									

COMMENTS (Optional)

ETHICAL STATEMENT

Your participation in this study is voluntary. All information will be treated with strict confidentiality and will be used solely for academic purposes. Thank you so much.

This instrument was adapted from standard sensory evaluation practices (Stone & Sidel, 2020)

Appendix D Raw Data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	F
1	Name	Ag	Sex	Consu	F1 -Appearan	F1 -Aron	F1 -	F1 -Textu	F1 -Overa	Comments	F2 -Appearan	F2 -Aroi	F2 -	F2 -	F2 -Overall	Comment	F3 -Appearan	F3 -Aroi	F3 -Text	F3 -	F
2		35	M	Consume	8	8	9	8	9		8	7	7	8	8		9	6	8	8	8
3	Jean Ramos	38	F	Not Cons	7	9	9	8	8		4	4	4	4	4		9	9	9	9	9
4	Claire	28	F	Consume	7	8	8	8	8		7	7	7	7	7		8	9	9	9	9
5		29	PNTS	Consume	9	8	8	9	9		7	8	8	7	7		8	8	8	8	9
6		35	PNTS	Not Cons	8	7	6	7	7		8	7	7	8	7		8	8	8	8	8
7		33	M	Not Cons	8	9	9	7	8		9	9	9	8	9		9	8	9	9	9
8	John De Leon	33	M	Consume	8	9	8	8	8		8	8	7	8	8		9	8	9	8	8
9		30	F	Consume	8	8	9	8	9		8	9	8	8	9		7	8	8	7	7
10		32	F	Not Cons	9	8	8	8	8		9	8	8	9	8		9	8	9	9	9
11	German E. Alvarez Jr.	49	M	Not Cons	8	3	6	7	7	masam	8	7	7	7	8		8	8	8	8	8
12	Hosa	49	F	Not Cons	8	9	9	9	9		8	8	7	9	7		8	7	7	7	9
13		34	F	Consume	8	8	8	8	8		8	8	9	7	8		9	9	9	9	9
14	Toto	41	M	Consume	9	9	9	9	9		7	8	7	8	8		8	8	7	8	9
15	Jorge	47	M	Consume	9	7	9	9	9		9	6	8	9	8		9	7	9	9	9
16	Vida	59	F	Consume	9	9	9	9	9		9	8	8	7	8		7	9	8	8	8
17	Flores Chester John	22	M	Consume	4	4	6	7	7		4	5	6	7	7		4	5	6	7	7
18	Renz	29	m	Consume	8	8	9	8	9		8	8	8	8	8		8	8	9	9	9
19		32	m	Not Cons	9	8	8	9	9		9	8	9	9	9		9	8	9	9	9
20	Prix Dylan Salamatn	21	M	Not Cons	7	9	8	9	7		7	6	4	8	6		7	9	9	9	9
21		18	m	Consume	7	8	8	8	8		6	6	6	6	6		7	7	7	7	7
22	Pao	n/a	M	Consume	6	6	6	7	7		7	6	7	7	7		7	7	7	7	7
23	Diana Rose Geronimo	22	F	Not Cons	8	7	8	8	8		9	8	9	9	9		9	9	9	9	9
24	Gelaica Calleja	23	F	Consume	9	9	8	9	8		9	9	9	9	8		7	7	8	7	7
25	Jennylyn	22	F	Not Cons	9	9	9	9	9		9	7	8	9	9		9	9	9	9	9
26	Jenastia C. Tria	21	F	Not Cons	9	6	6	7	7		9	8	7	7	7		9	9	8	8	8
27	Kyla	22	F	Not Cons	8	8	8	8	9		8	9	9	8	9		8	8	8	8	8
28	John Rhyamar V. Pasco	21	M	Consume	9	8	7	8	8		9	8	9	9	9		9	8	8	8	8
29	Princess	22	PNTS	Not Cons	8	7	7	8	7		8	7	7	8	7		8	7	6	8	8
30	Kyle Yvan Ray Metrallo	23	m	Consume	9	9	9	9	9		9	8	9	9	8		9	9	7	7	9
31		18	F	Not Cons	8	6	9	9	7		8	4	7	4	6		9	7	9	9	9
32	Kali	38	F	Consume	6	7	8	7	7		9	7	7	8	7		9	6	6	8	8
33		26	M	Consume	9	8	8	9	9		9	8	9	9	9		9	9	8	8	9
34	Falson De Ramos	44	M	Not Cons	8	7	7	7	7		9	9	9	9	8		8	8	8	7	7
35	Sancon	36	M	Not Cons	8	7	9	8	8		8	6	9	8	9		8	7	8	9	8
36	Jamie Lee Aseoche	37	F	Not Cons	7	7	6	6	7		9	8	8	8	8		7	6	6	7	7
37	Abigail Montalfo	22	F	Consume	9	9	9	9	9		9	8	9	9	9		9	9	8	8	9
38	Zyra Mamagat	35	F	Consume	9	9	9	8	9		7	7	6	7	7		9	9	8	8	9
39	John Cris Encila	22	M	Consume	9	7	8	9	9		9	8	9	9	9		9	9	9	9	9
40	Gio	22	M	Consume	9	9	9	9	9		9	7	6	7	8		9	8	8	8	8
41	Lloyd	23	M	Consume	8	9	9	9	9		8	8	9	9	9		9	9	8	8	9
42		24	F	Consume	8	8	8	8	8		8	7	7	8	7		8	7	7	8	8

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	F
47		21	M	Not Cons	6	7	8	7	7		7	6	8	8	7		6	7	8	7	7
48	Jennie Ampongian	21	F	Consume	9	5	8	9	8		9	8	9	9	9		8	9	9	9	9
49	Jedalen Calipay	22	F	Not Cons	9	8	9	9	8		9	8	9	9	8		9	6	9	9	9
50		23	M	Not Cons	9	9	9	8	9		8	8	9	9	9		9	8	9	9	9
51		22	M	Consume	8	9	7	8	8		8	7	8	8	8		8	8	9	8	8
52	Melissa	55	F	Consume	9	9	8	8	9		5	6	6	6	6		8	8	8	8	9
53	May	36	F	Consume	7	8	7	7	7		9	8	8	9	8		7	7	8	9	9
54	Axa	22	F	Not Cons	8	9	9	9	9		8	8	8	9	7		8	9	9	9	9
55	Mizfah	27	F	Consume	9	9	8	9	9		7	7	6	6	6		8	8	7	7	7
56		22	F	Not Cons	8	9	8	8	8		9	9	8	8	8		9	8	9	9	9
57	Maria	36	F	Consume	6	7	6	6	6		7	7	7	7	7		8	8	8	8	8
58	Brandon Wesley Q. Var	26	M	Consume	9	9	9	9	9		9	9	9	9	9		9	9	9	9	9
59	Jan Michael Aseoche	34	M	Not Cons	8	9	7	7	7		8	8	8	8	8		9	8	9	9	9
60	Johara Jean Marin	28	F	Not Cons	9	9	6	9	9		9	9	7	9	9		9	8	9	9	8
61	Jefferson	26	Male	Consume	9	8	8	8	8		9	9	7	8	8		9	8	8	8	9
62	N/A	40	F	Consume	6	8	7	6	7		8	7	6	7	7		9	8	7	8	8
63	N/A	29	F	Not Cons	7	7	7	7	7		8	6	7	8	8		8	9	8	8	8
64	N/A	39	M	Consume	9	8	8	9	8		9	8	8	8	8		9	7	6	8	8
65	Roselle	47	F	Consume	7	6	9	8	7		9	8	7	7	7		7	8	8	9	9
66	Neal Valeria	38	M	Consume	9	9	9	9	8		9	8	8	8	8		9	9	8	8	8
67	Keng Cortez	29	F	Consume	9	8	8	9	9		9	8	7	8	7		9	6	6	8	8
68	Lilaarlyn K.	44	F	Consume	9	9	9	9	9		8	6	8	8	8		8	8	9	9	9
69	Romer	48	M	Consume	8	8	8	9	8		9	5	6	9	6		8	9	8	9	9
70	Ziggy	43	PNTS	Consume	9	9	9	9	9		9	8	7	8	8		9	7	7	8	8
71	EI	44	M	Consume	9	8	7	9	9		9	8	9	9	9		9	9	8	9	9
72	N/A	55	F	Consume	9	9	9	9	9		8	7	7	8	8		8	8	7	7	9
73	Jenimicah	37	F	Consume	9	9	8	9	9		6	8	5	6	6		9	8	9	9	9
74	N/A	40	F	Consume	9	9	8	8	8		9	9	9	8	8		8	7	8	8	8
75	Jordan Bellido	50	M	Not Cons	8	8	8	8	7		7	7	7	8	8		9	9	8	8	8
76	Kevin	42	M	Consume	6	7	7	8	7		8	7	7	7	7		8	8	8	8	8
77	David	56	M	Consume	9	8	9	9	9		9	8	7	7	7		8	8	6	7	7
78	N/A	37	M	Consume	9	9	9	9	9		9	8	7	8	7		7	6	6	7	7
79	Michello	39	F	Consume	6	7	7	6	7		8	7	6	7	7		8	9	8	8	8
80	Daman	41	M	Consume	8	8	8	8	8		7	7	7	7	7		9	9	9	9	9
81	Jade	48	F	Consume	9	6	8	9	9		9	5	7	9	7		9	7	6	6	6
82	N/A	25	F	Consume	9	9	9	9	9		8	8	8	8	8		7	7	7	7	7
83	N/A	38	F	Not Cons	8	8	7	8	7		7	7	7	7	7		8	7	6	7	7
84	N/A	45	F	Consume	7	6	6	7	6		8	8	7	7	8		8	7	7	7	7
85	N/A	68	PNTS	Consume	9	8	8	9	9		7	8	7	8	6		9	8	8	8	8
86	Jome	45	Male	Consume	6	5	5	5	5		6	6	6	7	6		6	6	7	8	7
87	N/A	52	F	Consume	7	7	7	7	7		8	7	7	8	7		9	8	8	9	9
88	Alyssa Sanchez	27	F	Not Cons	9	9	9	9	9		9	6	7	9	7		8	6	8	7	8

Appendix E

Standardized Recipe for Mulberry-Infused Balsamic Reduction

MULBERRY-INFUSED BALSAMIC REDUCTION

Yield Approximately 1 cup (240 mL)

Ingredients

1 cup balsamic vinegar
1 cup fresh mulberries
(washed and stems removed)
1 teaspoon white sugar



Directions

STEP 1: PREPARE THE MULBERRIES

Wash the fresh mulberries thoroughly under running water. Remove any stems, damaged fruits, or debris. Drain well.

STEP 2: COMBINE THE INGREDIENTS

In a saucepan, combine the balsamic vinegar, fresh mulberries, and sugar. Stir gently to distribute the ingredients evenly.

STEP 3: SIMMER THE MIXTURE

Place the saucepan over medium heat and bring the mixture to a gentle simmer. Reduce the heat to low and allow it to cook for approximately 20–25 minutes. Stir occasionally while gently crushing the mulberries to release their juice, color, and flavor into the balsamic vinegar.

STEP 4: REDUCE THE LIQUID

Continue simmering until the mixture has reduced by approximately one-third to one-half of its original volume and develops a syrup-like consistency. Avoid boiling vigorously to prevent burning and excessive evaporation.

STEP 5: STRAIN THE MIXTURE

Remove the saucepan from the heat. Pour the mixture through a fine mesh strainer to separate the fruit solids from the liquid. Press lightly with the back of a spoon to extract as much liquid as possible.

STEP 6: FINAL REDUCTION

Return the strained liquid to the saucepan and simmer for an additional 5–10 minutes until the desired consistency is achieved. The reduction should lightly coat the back of a spoon.

STEP 7: COOL AND STORE

Allow the mulberry-infused balsamic reduction to cool completely. Transfer to a sterilized glass bottle or jar and store under refrigeration.

Appendix F

Recipes using Mulberry-Infused Balsamic Reduction



MULBERRY - INFUSED BALSAMIC REDUCTION

Curated Recipes

CHEF JODI MICHELLE JACINTO

TABLE FOR ONE, PLEASE

Mulberry-Infused Balsamic Reduction is a functional condiment that combines the sweet-tart flavor of mulberry with the rich acidity of balsamic vinegar. Beyond its nutritional benefits, it serves as a versatile ingredient that enhances both savory and sweet dishes. This recipe collection demonstrates its various culinary applications and promotes the utilization of locally grown mulberry in innovative food products.



Mulberry-Infused Balsamic Reduction is a versatile functional condiment that can be incorporated into salads, meats, seafood, desserts, beverages, and gourmet appetizers. Its unique sweet-acidic flavor profile makes it suitable for both traditional and contemporary culinary applications while promoting the utilization of locally grown mulberry as a value-added agricultural product.

MULBERRY BALSAMIC GARDEN SALAD

Yield 4 servings

Healthier than the instant stuff, but
with the same level of convenience.

Directions

Ingredients

4 cups mixed greens
1 cup cherry tomatoes, halved
½ cucumber, sliced
¼ cup feta cheese
2 tablespoons Mulberry
Balsamic Reduction

- 1 Arrange greens, tomatoes, and cucumber in a salad bowl.
- 2 Sprinkle feta cheese on top.
- 3 Serve immediately.
- 4 Drizzle with mulberry balsamic reduction.



MULBERRY BALSAMIC GRILLED CHICKEN

Yield 4 servings

Ingredients

4 chicken breast fillets
Salt and pepper to taste
2 tablespoons olive oil
¼ cup Mulberry Balsamic
Reduction

Directions

- 1 Season chicken with salt and pepper.
- 2 Grill until fully cooked.
- 3 Brush with mulberry balsamic reduction during the last few minutes of grilling.
- 4 Serve hot.



MULBERRY GLAZED PORK TENDERLOIN

Yield 6 servings

Directions

- 1 Season pork with garlic, salt, and pepper.
- 2 Roast at 180°C for 30–40 minutes.
- 3 Brush generously with mulberry balsamic reduction.
- 4 Continue roasting until glazed.

Ingredients

500 g pork tenderloin
¼ cup Mulberry Balsamic Reduction
2 cloves garlic, minced
Salt and pepper



MULBERRY BALSAMIC BURGER

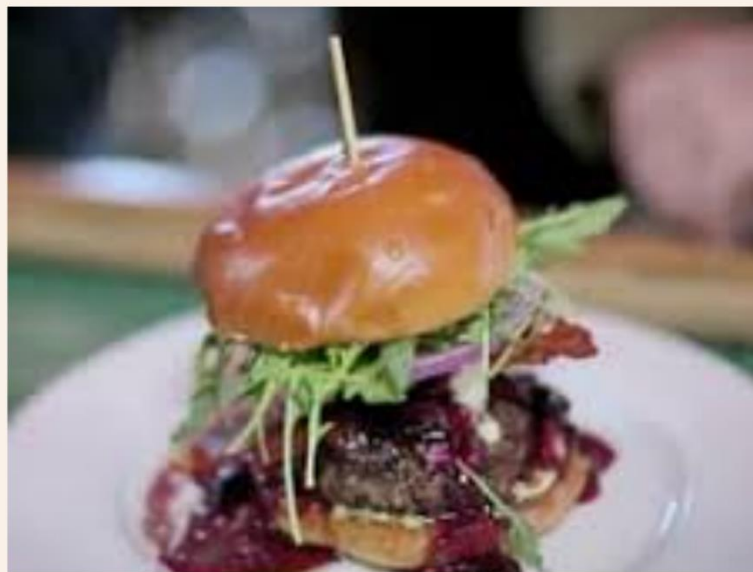
Yield 4 servings

Ingredients

4 beef burger patties
4 burger buns
Lettuce
Tomato slices
2 tablespoons Mulberry
Balsamic Reduction

Directions

- 1 Grill burger patties.
- 2 Assemble burgers with vegetables.
- 3 Add mulberry balsamic reduction as a gourmet sauce.



MULBERRY BALSAMIC PIZZA

Yield 8 Slices

Ingredients

1 prepared pizza crust
Mozzarella cheese
Prosciutto or ham
Arugula
Mulberry Balsamic
Reduction

Directions

- 1 Bake pizza with cheese and ham.
- 2 Top with fresh arugula.
- 3 Drizzle mulberry balsamic reduction before serving.



MULBERRY BALSAMIC SALMON

Yield 4 servings

Ingredients

4 salmon fillets
Salt and pepper
3 tablespoons Mulberry
Balsamic Reduction

Directions

- 1 Season salmon fillets.
- 2 Bake at 180°C for 15 minutes.
- 3 Drizzle mulberry balsamic reduction before serving.



MULBERRY BALSAMIC BRUSCHETTA

Yield 12 Pieces

Ingredients

French baguette slices
Cream cheese
Fresh strawberries
Mulberry Balsamic Reduction

Directions

- 1 Toast baguette slices.
- 2 Spread cream cheese.
- 3 Add sliced strawberries.
- 4 Finish with mulberry balsamic reduction.



MULBERRY BALSAMIC CHEESE BOARD

Yield 6 Servings

Directions

Ingredients

Assorted cheeses
Crackers
Grapes
Nuts
Mulberry Balsamic Reduction

- 1 Arrange ingredients on a serving board.
- 2 Serve mulberry balsamic reduction as a dipping sauce.



happy eating

MULBERRY-INFUSED BALSAMIC REDUCTION
Recipe Book
Culinary Applications and Serving Suggestions

Prepared by:
Jodi Michelle K. Jacinto
Master of Science in Culinary Arts
Philippine Women's University

ACKNOWLEDGMENT

The Author would like to express her deepest gratitude and appreciation to the following people who helped and supported her in the completion of this research study:

First and foremost, the Author would like to thank and acknowledge Almighty God for the graces and blessings that He gave, and also for the strength, knowledge to finish her work, and for His Unconditional love that He gave to the Author.

Ephraimuel Jose L. Abellana, PhD, Dean of the School of Hospitality Management for his guidance and support to the author throughout her study;

Angelina U. Blanco, DBA, the Thesis Chairperson, for the unceasing support and assistance and for giving the author enlightening explanation and advices every time she needed her;

Christi Blandina M. Aldave, one of the thesis panelists, for her support, knowledge, instruction and contribution to the completion and the success of this study;

Jocelyn R. Sardena, DEM, one of the thesis panelists, for her invaluable knowledge and for making the research journey enjoyable and meaningful. Her significant contributions have played a vital role in the successful completion of this study.

Jimboy D. Gasco, the Statistician, for sharing his expertise in the statistical analysis of the study.

Ephraimuel Jose L. Abellana, PhD, the Author's Adviser, for his support, knowledge, instruction and contribution to the completion and the success of their study;

JODI MICHELLE K. JACINTO

DEDICATION

The Author would like to dedicate this study to Tito Adel, Tita Itet, Mommy Miles, Jepoy, Nanay Mercy, Kali, and my partner Mikko, who have been a constant source of love, encouragement, and inspiration throughout this journey. Their unwavering support, understanding, and belief in the Author's potential provided the strength needed to overcome challenges, moments of doubt, and the many demands of graduate studies.

To Tito Adel and Tita Itet, thank you for your guidance, generosity, and for always believing that every challenge can be overcome with determination and faith. Your encouragement has motivated the Author to keep moving forward despite difficulties.

To Mako, Mikko and core friends thank you for bringing joy, motivation, and encouragement into the Author's life. Your presence served as a reminder that every hard-earned achievement becomes more meaningful when shared with the people who matter most.

The Author also dedicates this study to family, friends, professors, and mentors whose guidance, wisdom, and support have contributed greatly to the successful completion of this work.

Above all, the Author dedicates this study to God Almighty, for His endless grace, wisdom, and blessings. Through His guidance and strength, the Author was able to persevere and complete this endeavor with faith and gratitude.

This study is more than an academic achievement it is a reflection of the love, support, and encouragement received from the people who have made this journey worthwhile. Their belief in the Author has been one of the greatest motivations in turning this goal into reality.