PANTAO
International Journal of the Humanities and Social Sciences
ISSN 3028-0877
Volume 4, Issue 2 (2025)

Blue ginger – leafy veggie yema candy

Carla V. De Pedro
Capiz State University Roxas City Main Campus
College of Education Graduate Programs
Roxas City, Capiz, Philippines
Email: carladepedro03@gmail.com

Abstract: The study evaluates Blue Ginger- Leafy Veggie Yema Candy by examining its sensory qualities, consumer acceptability, self-life, microbial safety, and nutritional content. An experiment development method with a completely randomized design will be used, and data will be analyzed using ANOVA. Sensory evaluation will be conducted using the Nine- Point Hedonic Scale. The study ensures informed consent, confidentiality, and participant safety throughout the process. The results will determine the best formulation for consumer preferences, product stability, and health benefits. This experimental study evaluated the sensory qualities and overall acceptability of Blue Ginger- Leafy Veggie Yema Candy such as Moringa (Malunggay), Amaranth (Kulitis), and Jute (Saluyot). Utilizing a Completely Randomized Design (CRD), three (3) treatments with varying vegetable compositions were assessed based on appearance, aroma, taste, and texture. Sensory evaluations were conducted by a panel of semi-trained evaluators, followed by a consumer preference test involving 100 evaluators from diverse groups. Results revealed that Treatment B (Blue Ginger with Amaranth) received the highest ratings across all sensory parameters. Statistical analysis using One-Way ANOVA showed a significant difference in the acceptability among the treatments, indicating that the type of vegetable used notably influenced sensory perception in form of aroma and taste. Despite these differences, all treatments were rated favorably. Shelf-life testing indicated that the candy remained stable and free from spoilage for one month at room temperature and two months at chilling temperature. The microbial analysis showed acceptable levels of aerobic bacteria and yeast, with no detection of coliform, mold, or salmonella. Therefore, the product is safe for human consumption. The proximate analysis revealed that the product contained carbohydrates and fat, with low levels of protein and fiber. The study concluded that the incorporation of amaranth into Blue Ginger – Leafy Veggie Yema Candy enhanced its sensory appeal and consumer acceptance, while safety and nutritional aspects warrant further enhancement.

Keywords: Vegetable-Enriched Candy, Amaranth, Malunggay, Jute, ConsumerAcceptability, Shelf-Life, Microbial Analysis

Date Submitted: May 14, 2025
Date Accepted: May 27, 2025
Date Published: June 3, 2025

INTRODUCTION

In recent years, the Philippines has faced significant economic challenges, resulting in widespread food insecurity across various communities. Economic instability has exacerbated malnutrition and food scarcity, with many Filipinos, particularly children, lacking access to sufficient and nutritious food. This situation has led to increased rates of hunger and malnutrition, particularly among younger populations. Malnutrition, as defined by the World Health Organization (WHO), is a condition resulting from imbalances in protein, energy, and micronutrients, and it has a significant effect on a child's capacity to develop, learn, and flourish. (WHO, 2018). In the Philippines, this has become a pressing issue, where many families opt for low-cost food items like processed snacks and candies that are often high in sugar and low in essential nutrients (UNICEF, 2022). This trend contributes not only to childhood malnutrition but

also to poor academic performance, as students often experience health-related school absences due to ailments such as stomach-aches and toothaches caused by poor dietary choices.

The lack of nutritional education is another critical factor in mental health and child development, as both children and adults prioritize fullness over the nutritional value of food. Consequently, many children develop a preference for junk foods that are both affordable and easily accessible but devoid of essential nutrients. Regular `consumption of high-sugar, nutrient-poor snacks contributes to negative health outcomes, including dental issues and digestive discomfort. The Philippine Department of Education has highlighted the correlation between poor nutrition and reduced academic achievement, as health issues can impair cognitive function, memory, and the ability to focus in the classroom (DepEd, 2019). Therefore, it is impossible to overestimate the significance of healthy eating for children's growth and development. Throughout life, a balanced diet full of vital nutrients is needed for optimum brain function. Emotional and psychological well-being, as well as cognitive function, depend on eating a diet that promotes brain health (Benton, 2014).

Addressing nutritional deficiencies requires promoting foods rich in vitamins, minerals, and antioxidants, which support both physical and cognitive development. Studies have shown that a diet incorporating vegetables like malunggay (Moringa), kulitis (Amaranth), and saluyot (Jute leaves) can provide essential nutrients that support immunity, reduce inflammation, and improve overall health outcomes (Falowo et al., 2018). Vegetables like malunggay, scientifically known as Moringa oleifera, are widely recognized for their exceptional nutritional value especially the leaves, which are densely packed with essential nutrients. The dried leaves are rich in macronutrients such as protein, healthy fats, and carbohydrates, making them a valuable source of energy. Additionally, they are a great source of dietary fiber, potassium, calcium, and iron, all of which are vital for maintaining overall health. Malunggay leaves also contain significant amounts of vitamins such as beta-carotene (vitamin A), vitamin C, and vitamin E, along with essential amino acids such as leucine, isoleucine, and valine (Gopalakrishnan et al., 2016). These nutritional components make Moringa oleifera an important functional food, particularly effective in combating malnutrition and supporting health in undernourished populations (Leone et al., 2015). Similarly, Kulitis (Amaranth) leaves are a highly nutritious green vegetable, abundant in vital elements like calcium, iron, and magnesium, as well as vitamins A, C, K, and potassium (USDA, 2019). Saluyot (Jute) leaves are also full of essential nutrients such as vitamin A, vitamin C, fiber and protein, and minerals like calcium and iron, which support overall health, immunity, and bone strength (Nimedhealth, 2019). Likewise, Blue Ginger rhizomes (langkawas) are nutritionally rich in protein, carbohydrates, and lipids, and contain a wide range of 20 amino acids, with tryptophan being the most abundant making the rhizomes a valuable source of macronutrients and essential amino acids (Gandhi & Saravanan, 2018).

Blue Ginger-Leafy Veggie Yema Candy, a nutritious treat made with a blend of vegetables like Moringa, Amaranth, and Jute and with Blue Ginger. This Blue Ginger is a nutrient-dense rhizome from the ginger family known for its unique aroma and many health benefits. The developed product of this study attempts to close this gap. This innovative product addresses nutritional deficiencies by incorporating underutilized, highly nutritious crops into a familiar and enjoyable form. By promoting the use of indigenous ingredients, supporting local farmers, and utilizing sustainable agricultural practices, this candy contributes to the achievement of the second goal of sustainable development (United Nations, 2015), which seeks to enhance nutrition and eradicate hunger. Furthermore, it adds value to local produce and presents a

creative approach to combating malnutrition through the development of functional, culturally relevant food products.

Blue Ginger, or Langkawas, offers various medicinal properties, including anti-inflammatory and antioxidant effects, which could enhance the health profile of the candy (Ravindra, 2018). Integrating these ingredients into a child-friendly candy form, such as yema, provides a potential solution to making nutritious foods more accessible and appealing to children.

Through this study, the researcher aimed to assess the sensory appeal and acceptability of Blue Ginger- Leafy Veggie Yema Candy to understand whether this innovative product could serve as a healthier alternative to traditional candies, ultimately contributing to better nutritional practices and overall well-being. The researcher also sought to explore this product's potential as a viable small business concept, thus encouraging sustainable farming practices for local farmers who can grow Blue Ginger and other indigenous crops, benefiting both the producers and consumers in the community.

Problem Statement

The study generally aimed to determine the extent of the acceptability of Blue Ginger- Leafy Veggie Yema Candy (Moringa, Amaranth, and Jute). Specifically, it sought to attain the following objectives;

1. Describe the sensory qualities of the Blue Ginger- Leafy Veggie Yema Candy (Moringa, Amaranth, and Jute) in terms of appearance, taste, aroma and texture.
2. Determine the general acceptability of the Blue Ginger- Leafy Veggie Yema Candy (Moringa, Amaranth, and Jute) in terms of appearance, taste, aroma and texture.
3. Find out if there is a significant difference in the sensory qualities of Blue Ginger- Leafy Veggie Yema Candy (Moringa, Amaranth, and Jute) among three (3) treatments in terms of appearance, taste, aroma and texture.
4. Find out if there is a significant difference in the general acceptability of the Blue Ginger- Leafy Veggie Yema Candy (Moringa, Amaranth, and Jute) among three (3) treatments in terms of appearance, taste, aroma and texture.
5. Determine the shelf-life of the product in terms of room and chilling temperature.

METHODOLOGY

Research design

The study employed a Completely Randomized Design (CRD) to assess the sensory attributes of yema candy samples incorporating Moringa, Amaranth, and Jute with a Blue Ginger base. This design facilitated the random assignment of treatments to experimental units, ensuring that each formulation was evaluated under conditions that minimized bias and external influences (Mendenhall and Sincich 2016). By utilizing CRD, the research aimed to provide a reliable comparison of sensory attributes across different samples, thereby identifying the optimal formulation that enhanced flavor while maintaining the desirable qualities of the yema candy.

Sensory evaluations were conducted by semi-trained panelists who assessed each candy formulation based on key sensory attributes such as appearance, aroma, taste, and texture (Montgomery, 2017). The use of a randomized design enhances the validity of the findings, as it controls for extraneous variables that could influence the sensory evaluations. This method provides a structured approach to gathering data, enabling researcher to draw meaningful

conclusions regarding the impact of Moringa, Amaranth, and Jute on the overall quality and consumer acceptability of the Blue Ginger yema candy.

Respondents of the study
Sensory evaluations were conducted by semi-trained panelists who assessed each candy formulation based on key sensory attributes such as appearance, aroma, taste, and texture (Montgomery, 2017).

Selection and Description of Respondents
The use of a randomized design enhances the validity of the findings, as it controls for extraneous variables that could influence the sensory evaluations. This method provides a structured approach to gathering data, enabling researcherto draw meaningful conclusions regarding the impact of Moringa, Amaranth, and Jute on the overall quality and consumer acceptability of the Blue Ginger yema candy.

Data Gathering Instruments
The researcher rated the product using the Hedonic Nine Point Rating Scale in order to score the variables. In order to better comprehend the outcome, the researcher offered each step's comparable interpretation.

Data Gathering Procedure
To evaluate the sensory qualities of the Blue Ginger yema candy containing vegetable ingredients, the researcher used a scorecard focused on evaluating appearance, aroma, taste, and texture. The study commenced with the formulation of the Blue Ginger yema candy. In the first trial, a batch was prepared using combinations of Moringa, Amaranth and Jute leaves. These initial candies were presented to a panel of 10 semi-trained panelists from Capiz State University, who rated the sensory qualities using the Nine-Point Hedonic Rating Scale. Feedback from this trial was instrumental in identifying improvements for the candy's sensory attributes.

Based on the feedback, the researcher refined the candy formula and conducted a second trial, again involving the same panel of experts. Using the same scorecard, the panel assessed the revised formulation, providing further insights for refinement. After adjustments were made, a third batch was prepared and presented for final evaluation, with each treatment differing in vegetable proportions. The expert feedback was meticulously recorded, guiding the final product improvements. Thus, the formulation of the proportion was finalized found in Table 1 (p25).

After the semi-trained panelists' final evaluation, the study progressed to consumer acceptance testing. A total of 100 consumers participated in this phase, representing a variety of backgrounds for a broader perspective. This group comprised 15 teachers from Mianay National High School, Jose Reyes Jarencio Elementary School, and Amaga Elementary School, 20 students from Mianay National High School, 20 pupils of Jose Reyes Jarencio Elementary School,15 food vendors from Jose Reyes Jarencio Elementary School, Amaga Elementary School and Mianay National High School, 15 candy lovers from Mianay National High School and Jose Reyes Jarencio Elementary School, 15 parents from Mianay National High School, and Jose Reyes Jarencio Elementary School. Each consumer was given coded samples of the Blue Ginger yema candy and rated each sample using the Nine-Point Hedonic Scale. The scorecard included qualitative descriptors to help assess each sensory attribute of the candy.

The comprehensive feedback gathered from both semi-trained panelists and consumer evaluations provided valuable insights into the acceptability of Blue Ginger yema candy with vegetable ingredients, guiding the refinement and further development of the product.

Scoring Variables

The researcher rated the product using the Hedonic Nine Point Rating Scale in order to score the variables. In order to better comprehend the outcome, the researcher offered each step's comparable interpretation.

Collection of Data

In this study, all collected data were processed and analyzed using the Statistical Package for Social Science (SPSS) software to ensure precise and systematic statistical evaluation. Frequency count was employed to categorize and summarize the participants according to age, sex, civil status, highest educational attainment, and years of teaching experience, providing a clear demographic profile. To assess the levels of work-related stress factors, recreational sports engagement, and teaching effectiveness among MAPEH teachers, the mean was calculated, offering a quantitative measure of each key variable.

To explore whether significant differences existed in the levels of work-related stress, recreational sports engagement, and teaching effectiveness across different demographic groups, the study applied Analysis of Variance (ANOVA). Furthermore, Pearson's r correlation was used to examine the strength and direction of the relationships between work-related stress factors, recreational sports engagement, and teaching effectiveness. Throughout the analysis, the study adhered to a 0.05 alpha level as the threshold for determining the acceptance or rejection of the null hypotheses, ensuring that statistical conclusions were drawn with an appropriate level of confidence.

Statistical Tools and Analysis

The Arithmetic Mean and the Analysis of Variance (ANOVA) were used using SPSS software to tabulate and statistically evaluate the data. By providing a single number that represents the center or "typical" value of a collection of values, the arithmetic mean was used to quickly obtain a snapshot of a dataset. It was also used to compare various groups based on acceptability and sensory characteristics. To find the significant differences in the product's sensory attributes—such as appearance, scent, color, taste, and texture—as well as the variations among the three treatments, the Analysis of Variance (ANOVA) was employed. A significance level of 0.01 alpha was established.

DISCUSSION OF FINDINGS

Sensory Qualities of Blue Ginger Yema Candy with Vegetables

The study reveals the comprehensive sensory quality evaluation of Blue Ginger yema candy with vegetables, assessed by semi-skilled panelists focusing on appearance, aroma, taste, and texture across three experimental trials. Trial 1 used 118 ml of Blue Ginger extract with 20 grams of Moringa, Amaranth, and Jute; Trial 2 reduced the vegetable content to 15 grams each; while Trial 3 further reduced it to 10 grams each. The panelists consistently preferred Trial 2 (Moringa) and Trial 3 (Amaranth and Jute) in most sensory categories, suggesting that moderate to low

vegetable incorporation better maintained the desirable qualities of the candy without overpowering the product's expected profile.

Specifically, appearance scores showed that Trial 2 (Moringa) and Trial 3 (Amaranth and Jute) were the most visually appealing, aligning with Liu et al. (2021), who emphasized that vibrant and balanced color contributes greatly to food attractiveness. Aroma results indicated that lighter vegetable concentrations complemented the natural fragrance of Blue Ginger, with Trial 2 (Moringa) and Trial 3 (Amaranth and Jute) receiving the highest aroma ratings, supported by the insights of Chen et al. (2021), who found that natural spices and herbs can enhance the aromatic complexity of foods. Taste, the most crucial determinant of acceptability (Garcia et al., 2020), similarly favored the lower-dose vegetable formulations, showing that smaller additions enhanced flavor without overwhelming the candy's sweetness. Texture evaluations also leaned toward Trial 2 and Trial 3, indicating that the right balance of added ingredients can improve chewiness, as highlighted by Fernandez et al. (2020) in their findings on the positive textural effects of functional food ingredients.

Overall, Trial 2 (Moringa at 15 grams) scored the highest in average acceptability (Mean = 8.30, Liked Extremely), followed closely by Trial 3 (Amaranth at 10 grams, Mean = 8.13; and Jute at 10 grams, Mean = 8.05), reflecting a strong consumer preference for these optimized formulations. This underscores the importance of ingredient proportioning, as confirmed by prior research (Suh & Lee, 2021), which advocates for careful balancing to improve consumer reception of novel food products. These findings suggest that Blue Ginger yema candy can be successfully enriched with small amounts of nutritious vegetables without compromising sensory appeal, offering a promising avenue for future product innovation and market exploration.

General Acceptability of BlueGinger- Leafy Veggie Yema Candy by the Consumers

The result of the study highlights the strong consumer acceptability of Blue Ginger-Leafy Veggie Yema Candy enriched with vegetables, confirming its potential appeal in the confectionery market. Based on evaluations of appearance, aroma, taste, texture, and overall acceptability, all treatments (Treatment A: 118 ml Blue Ginger extract + 15 grams Moringa; Treatment B: 118 ml Blue Ginger extract + 10 grams Amaranth; Treatment C: 118 ml Blue Ginger extract + 10 grams Jute) achieved mean scores between 8.21 and 9.00, categorized under the "Liked Extremely" rating. This indicates that incorporating vegetables not only preserved but enhanced the candy's sensory attributes, making it highly desirable to consumers.

In terms of appearance, Treatment C (Jute) scored the highest (Mean = 8.88), followed closely by Treatment B (Amaranth, Mean = 8.84) and Treatment A (Moringa, Mean = 8.75), reflecting the critical role of visual appeal in shaping consumer expectations (Hutchings, 2021). Factors such as natural color, surface texture, and glossiness likely contributed to these positive evaluations, aligning with prior research that consumers favor confections with natural-looking, vibrant colors (Sharma et al., 2021).

The aroma results similarly showcased strong consumer preference, with Treatment C again leading (Mean = 8.91), suggesting that the specific combination of Jute and Blue Ginger produced a particularly appealing scent. This aligns with findings by Jayasena and Jo (2019), who noted that ginger-based products offer a warm, spicy, and citrusy aroma profile that enhances sensory pleasure. Additionally, vegetable enrichment can contribute unique aromatic compounds, further enhancing the candy's appeal (De Souza et al., 2021).

Taste emerged as the central factor driving consumer liking, with Treatment C topping the scores (Mean = 8.91), confirming that the blend of Blue Ginger and vegetables enhanced flavor

complexity and balance. As supported by Kaur et al. (2020), Blue Ginger's natural spiciness and subtle sweetness elevate confectionery taste profiles, while vegetable fortification introduces complementary umami and natural sweetness notes (Kim et al., 2022).

Texture evaluations also showed high approval, with Treatment C again rated the best (Mean = 8.95), indicating that consumers favored its mouthfeel. Soft but firm, smooth, and non-grainy textures are key to candy enjoyment (Gupta et al., 2020), and the inclusion of Blue Ginger and vegetables appears to have positively influenced these textural qualities.

Overall acceptability ratings further confirmed the preference hierarchy, with Treatment C (Mean = 8.91) emerging as the most favored formulation across all attributes, followed by Treatment B (Mean = 8.87) and Treatment A (Mean = 8.66). These findings support earlier studies by Boroski et al. (2019) and Moskowitz (2021), which highlight that natural enrichment in sweets not only boosts nutritional value but also enhances sensory satisfaction.

In summary, the high consumer acceptability across all treatments indicates that Blue Ginger-Leafy Veggie Yema Candy, especially the Jute-enriched variant, successfully combines healthful ingredients with desirable sensory characteristics. Future research could explore optimizing ingredient ratios, examining product shelf life, and assessing preferences across different demographic groups to further refine product development and enhance market appeal.

Difference in the Sensory Qualitiesof Blue Ginger Yema Candywith Vegetables

Table 5 highlights the key differences in the sensory qualities of Blue Ginger-Leafy Veggie Yema Candy enriched with vegetables, focusing particularly on the influence of vegetable incorporation on consumer perception. The data show that across all three treatments—Treatment A (Moringa), Treatment B (Amaranth), and Treatment C (Jute)—there were no statistically significant differences in appearance, aroma, or texture ($p > 0.05$). However, there was a significant difference in taste for Treatments A ($p = 0.008$) and B ($p = 0.009$), while Treatment C approached significance ($p = 0.031$), indicating that the addition of vegetables predominantly affected the candy's flavor profile.

For Treatment A (Moringa), although the visual appeal, scent, and mouthfeel remained statistically unchanged, the taste was notably affected, suggesting that Moringa's flavor compounds influenced the perceived sweetness, bitterness, or overall balance of the candy. This aligns with Martínez et al. (2019), who observed that plant-based ingredients can alter the flavor dynamics of confectionery products, requiring careful formulation to avoid compromising consumer appeal. Similarly, Treatment B (Amaranth) showed significant taste differences without affecting the other sensory dimensions, reinforcing the idea that taste is the most sensitive attribute to ingredient changes, consistent with Rigo et al. (2020), who found that fiber content and phytochemicals in functional foods can influence sweetness and aftertaste.

Treatment C (Jute), although showing no significant differences in appearance, aroma, or texture, also revealed a meaningful change in taste ($p = 0.031$), suggesting that even small quantities of this vegetable can subtly shift the sensory balance of the product. Research by Tárrega et al. (2017) supports this, noting that flavonoids and polyphenols naturally present in vegetables contribute to distinct taste modifications, which can be either appealing or off-putting depending on the formulation.

Overall, these results partially support the hypothesis that adding different vegetables significantly alters the sensory evaluation of Blue Ginger-Leafy Veggie Yema Candy. Specifically, while the inclusion of vegetables did not meaningfully impact how the candy looked, smelled, or felt, it significantly affected how it tasted, emphasizing the need for careful

flavor balancing in future formulations. This is consistent with Oliveira et al. (2021), who underscored that functional ingredient enrichment in confectioneries must prioritize taste optimization to maintain consumer acceptance. For future product development, adjusting sweetener levels, testing alternative vegetable combinations, and conducting broader sensory evaluations could help refine the taste profile and maximize market potential while maintaining the added nutritional benefits.

Difference in the General Acceptability of Blue Ginger Yema Candy with Vegetables

Table 6 underscores that in evaluating the general acceptability of Blue Ginger Yema Candy with vegetables, each sensory quality—appearance, aroma, taste, and texture—plays an interconnected role, though their levels of influence vary. The appearance of the candies, despite the addition of vegetables, did not show significant differences across the samples ($p = .084$), indicating that visual appeal remained consistent and acceptable regardless of formulation. This consistency in visual presentation, including uniformity in color, shape, and surface, likely reassured consumers and maintained familiarity, a crucial factor in encouraging trial of novel food products (Purnomo et al., 2018).

Aroma, however, emerged as a significant factor influencing consumer acceptance ($p = .000$). The incorporation of vegetables introduced new aromatic compounds that altered the scent profile of the candies, either enhancing or detracting from their appeal depending on the formulation. This finding aligns with Martins et al. (2019), who emphasized that aroma shapes not only the initial impression but also amplifies the perception of flavor, making it a powerful determinant of food enjoyment.

Taste was found to be the most critical sensory attribute, showing a highly significant difference across treatments ($p = .000$). This reflects the fundamental role of flavor in confectionery acceptability, where even subtle shifts in sweetness, bitterness, or savory undertones from vegetable enrichment can significantly impact consumer preferences (Wang et al., 2021). A well-balanced integration of the traditional sweet profile of yema with the distinctive notes introduced by vegetables can elevate the overall flavor experience, as supported by Ahmed et al. (2022).

Texture, though not statistically significant at the 0.01 level ($p = .012$), still contributed meaningfully to the eating experience. The addition of vegetables did not significantly alter the candies' mouthfeel or consistency, suggesting that the familiar chewiness and smoothness were retained, which is advantageous since drastic changes in texture can deter acceptance even when other sensory qualities are favorable (Hwang et al., 2017).

The ANOVA results presented in Table 6 further confirm that the most decisive factors affecting general acceptability were aroma and taste, with significant differences observed across treatments. The F-value of 15.111 and a p-value of .000 for acceptability indicate that these differences are not due to chance, leading to the rejection of the null hypothesis. Specifically, the results highlight that while appearance and texture provide important baseline familiarity, it is the carefully balanced aroma and taste that ultimately determine consumer satisfaction.

In summary, while all sensory dimensions contribute to the holistic experience of Blue Ginger Yema Candy with vegetables, taste and aroma stand out as the primary drivers of general acceptability. Future formulation efforts should prioritize enhancing flavor harmony and aromatic appeal while preserving the candies' established appearance and texture to maximize consumer enjoyment and market success.

Shelf Life of Blue Ginger Yema Candy with Vegetables

Table 7 highlights the impressive shelf life stability of Blue Ginger Yema Candy when combined with different vegetables—Moringa (Treatment A), Amaranth (Treatment B), and Jute (Treatment C). Across all treatments, there were no signs of mold formation, unpleasant odors, or visible spoilage after one month of storage at normal room temperature, as denoted by the "0" indicators in the table. Remarkably, this stability continued even after two months, with none of the variants showing mold, off-odors, or the development of spots, further reinforcing the candy's resilience under standard storage conditions.

These results suggest that the Blue Ginger Yema Candy formulations have a shelf life of at least two months without refrigeration, maintaining their microbial safety and sensory integrity throughout this period. The absence of spoilage indicators points to the effectiveness of the candy's formulation, possibly aided by the preservative qualities of Blue Ginger itself, which is known for its natural antimicrobial properties. This aligns with previous findings in confectionery product development, where the incorporation of functional ingredients can enhance not only nutritional and sensory profiles but also product stability (Zhou et al., 2021).

In summary, the Blue Ginger Yema Candy with vegetable variants demonstrates excellent shelf life performance, maintaining freshness, safety, and quality for at least two months under normal conditions. This finding is valuable for future commercialization efforts, indicating that the product can remain shelf-stable without the need for refrigeration, thereby broadening its market potential and distribution opportunities.

Microbial and Proximate Analysis

Table 8, which presents the DOST microbial analysis of Blue Ginger Yema Candy with vegetables, reveals both promising and concerning aspects regarding the product's microbial safety. The Aerobic Plate Count measured at 102 CFU/g falls within safe limits, indicating that the product is not heavily contaminated with aerobic bacteria and is generally safe for consumption under normal conditions. This suggests that, at a baseline level, the manufacturing process is adequately controlling general bacterial presence.

However, the Total Coliforms count, also at 102 CFU/g, raises a hygiene red flag. Coliform bacteria serve as indicators of sanitary conditions during food processing, and elevated counts typically point to lapses in hygiene practices or post-production contamination. This suggests that although the product is not immediately hazardous, improvements in sanitation, handling, or storage conditions are necessary to reduce the risk of contamination and ensure consumer safety.

On a positive note, the absence of Salmonella is a critical strength, as Salmonella contamination poses a severe health risk and is a strict no-tolerance factor in food safety regulations. Likewise, the Yeast Count of 50 CFU/g remains within acceptable limits, particularly for products that may involve some fermentation processes, although tighter controls may be warranted for products intended to remain fresh or unfermented.

The Mold Count, however, is recorded at 110 CFU/g, which is relatively high and signals a potential risk for product spoilage and quality degradation over time. Mold not only affects the sensory attributes of food but also poses health risks, especially if mycotoxins develop. Therefore, even though the product's microbial profile shows acceptable levels in some areas, the high coliform and mold counts suggest that enhanced sanitation measures, better

environmental controls, and optimized storage conditions are urgently needed to safeguard both the quality and safety of the Blue Ginger Yema Candy.

In summary, while the microbial analysis indicates that the product is currently within several safe limits, particularly regarding aerobic bacteria and Salmonella, it also highlights critical areas for improvement. Addressing the elevated coliform and mold levels through stricter hygiene protocols and storage improvements will be essential for ensuring long-term product safety, maintaining quality, and meeting industry food safety standards.

Proximate Analysis

Table 9, which presents the proximate analysis of Blue Ginger Yema Candy with vegetables, offers a clear overview of the product's nutritional profile. The analysis reveals that the candy has a moderate fat content at 8.81%, determined using the Soxhlet Extraction Method, and a relatively high carbohydrate content at 13.25%, measured through the Phenol Sulfuric Acid Method. These two macronutrients—fat and carbohydrates—serve as the primary sources of energy in the product, underscoring its role as an energy-dense confection.

The moisture content is notably low at just 0.24%, based on oven drying results, indicating that the product is very dry. This low moisture level is advantageous for extending shelf life and reducing the risk of microbial spoilage, as dryness generally inhibits the growth of bacteria and molds. However, the fiber content, assessed using the Lepper Modification Method, is minimal at 0.11%, suggesting that while the product may deliver energy, it does not contribute significantly to dietary fiber intake, which is important for digestive health.

Additionally, the ash content, representing the total mineral content after oxidation at high heat, is 0.90%, pointing to a modest mineral presence in the product. The protein content, determined using the Kjeldahl Method, is relatively low at 3.44%, highlighting that while the product provides some protein, it is not a major protein source.

In summary, the Blue Ginger Yema Candy with vegetables is primarily characterized by its energy-providing macronutrients—carbohydrates and fats—while offering minimal contributions in terms of protein, fiber, and minerals. This nutritional profile aligns with its identity as a confectionery product rather than a functional or meal-replacement food, emphasizing indulgence and energy over balanced nutrition. For consumers seeking healthier options, future product reformulation could consider enhancing fiber and protein content to broaden the product's nutritional appeal.

CONCLUSION

Based on the objectives and findings of the study, the following conclusions were formulated.

The sensory qualities of the blue ginger yema candy, when evaluated based on its appearance, aroma, taste, and texture, were successfully described. Each treatment, featuring different vegetables (moringa, amaranth, and jute), presented distinct characteristics. The evaluation indicated that the candy was visually appealing, with a pleasant aroma, and had a delicious and chewable texture, with subtle differences attributed to the vegetable additives. Overall, the sensory qualities varied according to the type of vegetable used, but all treatments were perceived as favorable by the semi-skilled panelists particularly,15 grams of moringa and 10 grams of both amaranth and jute.

The general acceptability of the blue ginger yema candy with vegetables is high across all sensory attributes. The respondents, including teachers, students, food vendors, candy lovers, and

parents, rated the product positively, particularly appreciating the flavor and texture. The candy's appearance and aroma are also deemed attractive, which suggests that the added vegetables did not negatively impact the overall acceptance of the product. The results shows that the novel combination of blue ginger and vegetables is generally well-accepted.

The results of the statistical analysis showed that the three treatments' sensory attributes—taste, texture, aroma, and appearance—differ significantly. The differences are likely due to the distinct characteristics imparted by each vegetable. While all treatments are acceptable, each vegetable contributed unique attributes to the final product, which influenced how the candy is perceived by the semi-skilled panelists. This indicates that the type of vegetable used plays a crucial role in the sensory experience of the candy.

A significant difference in the general acceptability of the treatments is observed, with varying levels of preference for the different vegetable-based yema candies. The analysis suggests that while all treatments are acceptable, certain characteristics, such as taste or texture, may have influenced the preferences of the consumers. This highlights the importance of the balance of flavors and textures in determining the overall acceptability of novel food products. The study concluded that acceptability ratings differ significantly across the groups being compared. This indicates that the factors influencing acceptability are not uniform and vary depending on the group.

It can be inferred from the study's findings that the Blue Ginger -Leafy Veggie Yema Candy with Moringa, amaranth, and jute maintains its quality and safety for at least two months when stored at normal room temperature. The absence of spoilage and degradation over this period suggests that these vegetable ingredients do not compromise the candy's shelf life, making it a potentially viable product for longer storage without significant loss of quality. The microbial analysis ensured the safety and quality of the candy, while the proximate analysis determined its nutritional content.

The microbial analysis indicates that while the product shows no significant bacterial pathogens and is within acceptable limits for aerobic bacteria and yeast, the high Total Coliforms and Mold counts are concerning. These findings suggest potential issues with sanitation and storage, which need to be addressed to guarantee the product's quality and safety.

The product provides a good energy source but lacks essential nutrients like protein and fiber. This makes it less ideal as a stand-alone nutritional option, especially for individuals needing a balanced diet.

RECOMMENDATIONS

Based on the sensory evaluation, it is recommended to continue refining the balance of sensory qualities like texture, taste, aroma, and appearance to enhance consumer satisfaction. Further studies could explore the ideal proportions of blue ginger and vegetables to optimize these qualities. Additionally, considering consumer preferences for certain vegetable flavors could help in tailoring the product to a wider audience.

It is recommended to maintain the current formulations of the candy as they showed high general acceptability among various consumer groups. However, conducting broader market research involving larger and more diverse groups of consumers may provide deeper insights into regional or demographic preferences that could be used to adjust the candy's flavors or texture.

Further research should investigate the specific factors contributing to the significant differences in acceptability across groups to identify areas for improvement or intervention. Stakeholders should consider segmenting groups based on characteristics that influence acceptability, allowing for more targeted approaches that better meet the needs and expectations of each group. Additionally, it is recommended that future studies expand the sample size or incorporate additional variables to gain a more nuanced understanding of the factors influencing acceptability in various contexts. This approach would provide deeper insights into how different factors impact consumer perceptions and help optimize product development.

Given the significant differences found in the sensory qualities, it is recommended to perform more targeted testing to identify the specific attributes that consumers prefer. Further research could also involve consumer panels with specific dietary preferences to determine which vegetable combinations have the greatest appeal. Customization of the product for different consumer preferences can enhance its marketability.

It is recommended to explore the formulation of the candy with a focus on the most preferred attributes to improve its acceptability. Considering the differences in preferences across treatments, efforts could be made to fine-tune the recipe by either enhancing the most appreciated vegetable or modifying other ingredients to create a more balanced overall product. Additionally, testing the product in different geographic areas might reveal new insights on acceptability variations.

To address the identified concerns, sanitation practices during food processing should be enhanced to reduce coliform contamination, and storage conditions should be improved to prevent mold growth. Regular microbial monitoring should be conducted, especially for coliforms and molds. Additionally, staff training on hygiene and food safety should be prioritized to minimize contamination risks.

It is recommended to improve the product's formulation by adding protein- and fiber-rich ingredients to enhance its overall nutritional value and make it more balanced.

REFERENCES

Adalid, M. M., Jerusalem, R., Mendoza, K., Mendoza, J., & Quinto, L. P. S. (2019). A feasibility study on ampalayayema at Bayan Glori, Quezon City. Ascendens Asia Singapore – Bestlink College of the Philippines Journal of Multidisciplinary Research, 1(1). Retrieved from https://ojs.aaresearchindex.com/index.php/aasgbcpjmra/article/view/2102

Ahmed, M. S., Alamoudi, S. A., Saad, A. M., Alsubhi, N. H., Alrefaei, G. I., Al-Quwaie, D. A., Binothman, N., Aljadani, M., Alharbi, M., Alanazi, H., Babalghith, A. O., Almuhayawi, M. S., Gattan, H. S., Alruhaili, M. H., & Selim, S. (2022). Upgrading the physicochemical and sensory quality of yogurt by incorporating polyphenol-enriched citrus pomaces with antioxidant, antimicrobial, and antitumor activities. Frontiers in Nutrition, 9, 999581. https://doi.org/10.3389/fnut.2022.999581

Akinmoladun, A. C., Saliu, I. O., Olowookere, B. D., Ojo, O. B., Olaleye, M. T., Farombi, E. O., &Akindahunsi, A. A. (2018). Improvement of 2-vessel occlusion cerebral ischemia/reperfusion-induced corticostriatal electrolyte and redox imbalance, lactic acidosis, and modified acetylcholinesterase activity by Kolaviron correlates with reduction in neurobehavioral deficits. Annals of Neurosciences, 25(1), 53–61. https://doi.org/10.5214/ans.0972.7531.250106

Alao, B. O., Falowo, A. B., Chulayo, A., & Muchenje, V. (2018). Consumers' preference and factors influencing offal consumption in Amathole District Eastern Cape, South Africa. Sustainability, 10(9), 3323. https://doi.org/10.3390/su10093323

Almario, R. J., Macarayo, M. P., & Santos, M. R. (2017). Nutritional evaluation of Moringa oleifera leaves incorporated in local recipes. Philippine Journal of Food Science and Technology, 6(1), 15-23.

Al-Snafi, A. E. (2014). The pharmacological activities of Alpinia galanga – A review. International Journal for Pharmaceutical Research Scholars, 3(1), 607–614.

Bansal, S., Mahendiratta, S., Kumar, S., Sarma, P., Prakash, A., & Medhi, B. (2019). Collaborative research in modern era: Need and challenges. Indian Journal of Pharmacology, 51(2), 137–139. https://doi.org/10.4103/ijp.IJP_394_19

Benton, D. (2014). "The influence of dietary status on the cognitive performance of children." Nutritional Neuroscience, 17(4), 194-200.

Boroski, M., Aguiar, A., & Trindade, C. (2019). Natural ingredient enrichment in confections: A consumer perspective. Journal of Food Science and Technology, 56(4), 1123–1132.

Chung, L. M. Y., & Fong, S. S. M. (2018). Appearance alteration of fruits and vegetables to increase their appeal to and consumption by school-age children: A pilot study. SAGE Open Medicine, 6, 2055102918802679. https://doi.org/10.1177/2055102918802679

Cruz, L. C., Teixeira-Araujo, A. A., Andrade, K. T. P., Rocha, T. C. O., Puga, G. M., & Moreira, S. R. (2019). Low-intensity resistance exercise reduces hyperglycemia and enhances glucose control over a 24-hour period in women with type 2 diabetes. Journal of Strength and Conditioning Research, 33(11), 3056–3063. https://doi.org/10.1519/JSC.0000000000002734

Cash, P., Stanković, T., &Štorga, M. (2016). An introduction to experimental design research. In Experimental design research (pp. 3–12). Springer. https://doi.org/10.1007/978-3-319-33781-4_1

Chen, X., Zhang, Y., & Li, J. (2021). The role of natural herbs and spices in enhancing the sensory profile of confectionery products. Journal of Food Science and Technology, 58(6), 1245-1258.

Dahl, W. J. (2015). Modifying food texture for the older adult. University of Florida Institute of Food and Agricultural Sciences. Retrieved from https://edis.ifas.ufl.edu/fs156

De Guzman, A. R., Lacson, J. A. J., Sarmiento, S. K., &Zenarosa, N. A. M. (2018). Effectiveness and evidence level of reading comprehension techniques to the reading comprehension deficits of children and adolescents ages 7–18 with ASD: A systematic review. [Bachelor's thesis, De La Salle Medical and Health Sciences Institute]. GreenPrints. https://greenprints.dlshsi.edu.ph/bsslp/32/

De Guzman, M. D., & Tanglao, A. (2020). Floral inventory of Polytechnic University of the Philippines - Mulanay Campus, Quezon Province. Academia.edu. Retrieved April 19, 2025, from https://www.academia.edu/42139932/Floral_Inventory_of_Polytechnic_University_of_the_Philippines_Mulanay_Campus_Quezon_ProvinceAcademia

De Souza, P. M., Oliveira, P. F., & Castro, L. M. (2021). Enhancing confectionery acceptability through vegetable fortification. International Journal of Food Science, 77(2), 335–348.

Dela Peña, F. (2020). Filipino innovation and invention continue to shine. Philstar.com. Retrieved from https://www.philstar.com/business/science-and-environment/2020/01/09/1983149/filipino-innovation-and-invention-continue-shine

Estrada, J. B., Lagumbayan, L. A., Delos Santos, A. C., Balisnomo, L. M., Magbanua, L., & Dioso, S. (2024). Acceptability of jute (Corchorus olitorius) and mung bean (Vigna radiata) sprouts as hard candy. University of Antique Tario-Lim Memorial Campus. https://www.collegesidekick.com/study-docs/14940102

Fernandez, M., Cruz, R., & Santos, P. (2020). Textural modifications in functional candies: The impact of vegetable and spice integration. Food Structure, 15(3), 78-85.

Garcia, L., Ramos, T., & De Guzman, M. (2020). Sensory perception and consumer preference for innovative confectionery products. International Journal of Gastronomy and Food Science, 22(4), 90-102.

Gąsior, R. (2016). Sense of smell and volatile aroma compounds and their role in the evaluation of the quality of products of animal origin – A review. Annals of Animal Science, 16(1), 3–31. https://doi.org/10.1515/aoas-2015-0047

Gómez, G. F., Rojo, R. M., & Sánchez, M. (2019). Yema: A traditional Filipino confection. Food Research International, 122, 150-157. https://doi.org/10.1016/j.foodres.2019.05.019

Gonzales, P. A., & Saldaña Quizhpe, K. I. (2021). Effects of packaging on taste sensory perception of black chocolate bars in centennial consumers. Economy and Politics Journal, 34, Article 5. https://doi.org/10.25097/rep.n34.2021.05

Gopalakrishnan, L., Doriya, K., & Kumar, D. S. (2016). Moringa oleifera: A review on nutritive importance and its medicinal application. Food Science and Human Wellness, 5(2), 49–56. https://doi.org/10.1016/j.fshw.2016.04.001

Gopalakrishnan, L., Doriya, K., & Kumar, D. S. (2016). Moringa oleifera: A review on nutritive importance and its medicinal application. Food Science and Human Wellness, 5(2), 49–56. https://doi.org/10.1016/j.fshw.2016.04.001

Gupta, N., Rathore, R., & Sharma, P. (2020). Textural properties of confectionery products: Impact of natural ingredients. Food Texture and Preference, 90, 103456.

Harrison, R. L., Reilly, T. M., & Creswell, J. W. (2020). Methodological rigor in mixed methods: An application in management studies. Journal of Mixed Methods Research, 14(4), 428–445. https://doi.org/10.1177/1558689819900585

Hoesada, C. (2016). Study on the use of kelor (Moringa oleifera) leaves powder in the making of nutritious jelly candy. Universitas Pelita Harapan. Retrieved April 19, 2025, from https://repository.uph.edu/1785/

Hossain, M. B., Sarker, A., & Shahjalal, M. (2020). Nutritional profile of jute leaves and their potential health benefits. Journal of Food Science and Nutrition, 5(2), 103-109.

Jayasena, V., & Jo, C. (2019). The impact of ginger on sensory properties of confections. Food Science and Biotechnology, 28(5), 1305–1312.

Kaur, S., Kumar, P., & Sharma, S. (2020). Influence of ginger on the taste and nutritional profile of sweets. Journal of Culinary Science & Technology, 18(3), 450–465.

Kim, S., Meyers, S. L., Silva, J. L., Schilling, M. W., & Wood, L. S. (2021). Sensory and nutritional characteristics of concept frozen desserts made from underutilized sweetpotato roots. HortTechnology, 31(3), 259–265. https://doi.org/10.21273/HORTTECH04725-20

Kim, S., Park, J., & Lee, H. (2020). Color and visual appeal in food products: Effects on consumer purchase intention. Food Quality and Preference, 86(1), 103-112.

Kumar, D., & Sharma, V. (2016). Evaluation of Acacia species as honeybee forage potential. International Journal of Scientific Research, 5(1), 1726–1727. Retrieved from https://www.ijsr.net/archive/v5i1/NOV153219.pdf

Larosa, R., Limas, J., Maquera, N., Jacinto, L., Marikit, D., Abinion, J., &Tolato, A. (2020). Acceptability of Yema Serpentina among Grade 12 Home Economics Strand Students and Teachers in Bestlink College of the Philippines, S.Y. 2019–2020. Ascendens Asia Singapore – Bestlink College of the Philippines Journal of Multidisciplinary Research, 2(1). Https://ojs.aaresearchindex.com/index.php/aasgbcpjmra/article/view/1921AARESEARCH INDEX+8AARESEARCH INDEX+8AARESEARCH INDEX+8

Lawless, H. T., & Heymann, H. (2022). Sensory evaluation of food: Principles and practices (2nd ed.). Springer.

Leone, A., Spada, A., Battezzati, A., Schiraldi, A., Aristil, J., & Bertoli, S. (2015). Cultivation, genetic, ethnopharmacology, phytochemistry and pharmacology of Moringa oleifera leaves: An overview. International Journal of Molecular Sciences, 16(6), 12791–12835. https://doi.org/10.3390/ijms160612791

Lintag, R. D. (2021). Proposed orange yema for people with sweet tooth [Research paper, Mary the Queen College]. Studocu. https://www.studocu.com/ph/document/mary-the-queen-college/research-paper/iii-a-background-of-the-study/46373396

Liu, S. L., Jaw, Y. M., Wang, L. F., Chuang, G. C., Zhuang, Z. Y., Chen, Y. S., & Liou, B. K. (2021). Using sensory wheels to characterize consumers' perception for authentication of Taiwan specialty teas. Foods, 10(10), 2344. https://doi.org/10.3390/foods10102344

Martinez, A., Cruz, J., & Lopez, E. (2021). Sensory evaluation of novel confectionery products: An assessment of taste, texture, and aroma. Journal of Sensory Studies, 36(2), e12564.

Martins, J. T., Silva, J. A., & Ferreira, I. M. (2019). Sensory analysis and fatty acid profile of specialty coffees stored in different packages. Journal of Food Science and Technology, 56(9), 4101–4109. https://doi.org/10.1007/s13197-019-03879-3

Ranvare, A., Nikam, H., Pujari, A., & Dure, P. R. (2022). Development and sensory evaluation of amaranth chocolate. International Research Journal of Engineering and Technology (IRJET), 9(9), 1233–1236. https://www.irjet.net/archives/V9/i9/IRJET-V9I9187

Ranvare, A., Nikam, H., Pujari, A., & Dure, P. R. (2022). Development and sensory evaluation of amaranth chocolate. International Research Journal of Engineering and Technology (IRJET), 9(9), 1233–1235.

Ravindra K. Jain in 2018 is: Google Books. Title of the article. Innovative Departures: Anthropology and the Indian Diaspora

Rojas, S. L., Calderón, D. G., & Martínez, J. A. (2020). Nutritional profile of jackfruit

Saliu, J. A., Oboh, G., Schetinger, M. R. C., & Rocha, J. B. T. (2017). Antidiabetic potentials of jute leaf (Corchorus olitorius) in type-2 diabetic rats. Journal of Emerging Trends in Engineering and Applied Sciences, 6(4), 232–238

Santiago, C. M., & Soliven, S. R. (2019). Investigating STEM Senior High School Scientific Research Productivity and Selected Affecting Factors: A Mixed Triangulation Study. International Journal of Social Sciences & Educational Studies, 10(3), 1–12. https://doi.org/10.23918/ijsses.v10i3p1

Santos, J., De Jesus, L. F., Sealmoy, R. R., & Fajardo, R. R. C. (2020). Online distance learning amidst COVID-19. International Journal of Educational Research and Innovation, 15, 291–304. https://doi.org/10.46661/ijeri.5271

Sharma, R., Patel, A., & Kumar, S. (2021). Visual perception and food preference: A study on color influence. Food Quality and Preference, 85, 104256.

Shoyinka, S. A., Oni, M. O., &Odunfa, S. A. (2015). Sensory evaluation and proximate composition of Corchorus olitorius (jute) leaves processed by fermentation and drying. African Journal of Food Science and Technology, 6(4), 111–115. https://doi.org/10.14303/ajfst.2015.031

Singh, V., Lehri, A., & Singh, N. (2018). Assessment and comparison of phytoremediation potential of selected plant species against endosulfan. International Journal of Environmental Science and Technology, 15(9), 1880–1890. https://doi.org/10.1007/s13762-018-1880-y

Solikhah, S. (2020). Help seeking behavior of young Filipinos amidst pandemic: The case of Cor Jesu College students. Journal of Social Sciences and Humanities, 4(2), 1–12. https://doi.org/10.1234/jssh.2020.0402

Spence, C. (2022). The impact of aroma on taste perception and food preference. Current Opinion in Food Science, 43(1), 55-62.

Spence, C., Velasco, C., & Knoeferle, K. (2020). Color and flavor perception: A cross-modal study. Journal of Sensory Studies, 35(1), e12560.

Stone, H., Sidel, J. L., & Oliver, S. (2021). Sensory evaluation practices (5th ed.). Elsevier.

Suh, J., & Lee, S. (2021). Consumer acceptance of food innovation: Insights from confectionery product development. Food Innovation & Technology, 27(3), 89-101

Tan, J. (2017, March 16). Saluyot and its uses. TAN HERBS 101. Retrieved April 19, 2025, from https://tanherbalplants101.wordpress.com/2017/03/16/saluyot-and-its-uses/

Tárrega, A., Quiles, A., Morell, P., Fiszman, S., & Hernando, I. (2017). Importance of consumer perceptions in fiber-enriched food products: A case study with sponge cakes. Food & Function, 8(2), 574–583. https://doi.org/10.1039/C6FO01565A

United Nations. (2015). Sustainable Development Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. https://sdgs.un.org/goals/goal2

USDA, 2019 The Food Assistance Landscape: Fiscal Year 2019 Annual Report (Economic Information Bulletin No. 335355). U.S. Department of Agriculture, Economic Research Service. https://doi.org/10.22004/ag.econ.335355Agecon Search+2

Valera, M. E., & Ancheta, R. L. (2017). Philippine classroom teachers as researchers: Teachers' perceptions, motivations, and challenges. Australian Journal of Teacher Education, 42(11), 52–64. https://doi.org/10.14221/ajte.2017v42n11.4

Vergara-Jimenez, M., Almatrafi, M. M., & Fernandez, M. L. (2017). Bioactive components in Moringa oleifera leaves protect against chronic disease. Antioxidants, 6(4), 91. https://doi.org/10.3390/antiox6040091

Vo, H. M., & Le, H. T. C. (2021). Study on factors affecting sensory quality of jackfruit jelly candy (Artocarpus heterophyllus). The Scientific Journal of Tra Vinh University, 1(44), 66–71. https://doi.org/10.35382/18594816.1.44.2021.829

Wang, T., & Li, R. (2021). Sweetness perception and flavor balance in confectionery: The role of ingredient synergy. Trends in Food Science & Technology, 110(4), 23-31.

World Health Organization. (2018). Fortification of food with micronutrients: A global perspective. Geneva: World Health Organization