The effectiveness of instant "Basa Genep" seasoning and its impact on climate change

Ni Made Ayu Suardani Singapurwa[1*], *Ni Nyoman* Puspawati [2], *Anak Agung Gede* Indraningrat[3], *A A Made* Semariyani[1], and *Gusti Ayu Yunda Darma* Patni[1]

[1]Food Technology and Agricultural Products Department, Warmadewa University, Denpasar, Bali, Indonesia
[2]Food Science and Technology Department, Udayana University, Badung, Bali, Indonesia
[3]Faculty of Medicine and Health Sciences, Warmadewa University, Bali, Indonesia

Abstract. "Basa Genep" spice is one of the traditional spices from Bali, representing local wisdom that needs to be preserved. This study aims to evaluate the effectiveness of the instant spice "Basa Genep" in enhancing the flavor and quality of various traditional food products. The method used was an experiment with a completely randomized design, where food products such as "Betutu," "Ares" vegetable, and "Pepes" were tested with and without the addition of "Basa Genep." The assessment was conducted through a taste test involving 30 trained panelists using a scoring scale of 1-10 for aroma, taste, and appearance. The results showed that the use of the instant spice "Basa Genep" yielded average taste scores of 8.2 for "Betutu," 7.9 for "Ares," and 8.5 for "Pepes," compared to scores without the spice of 6.5, 6.2, and 7.0, respectively. Proximate analysis also indicated a protein content increase of 15% in "Betutu" and 10% in "Pepes." These findings are expected to provide insights for producers and consumers in selecting quality instant spices. The significant potential of instant spices in the food industry lies in continuing traditions and sustainability. This research can provide insights for spice producers to enhance sustainable practices, as well as for consumers to become more aware of their cooking choices. The instant spice can contribute to flavor and to ongoing efforts for sustainable climate change mitigation.

1 Introduction

"Basa Genep" is a traditional spice blend from Bali, Indonesia. This blend consists of 26 different spices and herbs, traditionally prepared by grinding them using a simple tool called a 'ulekan,' specifically designed for making spices. The lengthy process of preparation, which includes selecting ingredients, peeling, cleaning, chopping, and grinding, makes it challenging for culinary practitioners to prepare this spice. An alternative to address this issue is to process "Basa Genep" into an instant spice for easier and more practical use [1]. The production of instant "Basa Genep" seasoning can contribute to climate change mitigation by employing sustainable agricultural practices that reduce greenhouse gas emissions from

* Corresponding author: suardani@warmadewa.ac.id

cultivation. Efficient distribution methods, such as minimizing transportation distances and using eco-friendly packaging, can further lower the carbon footprint associated with this product. Additionally, by promoting home cooking with this seasoning, consumers may be encouraged to prepare meals that use fewer resources compared to takeout options, thereby supporting broader efforts in climate change adaptation and sustainability.

The production of instant "Basa Genep" seasoning can contribute to climate change mitigation by adopting sustainable agricultural practices for its raw ingredients, which can reduce greenhouse gas emissions. Additionally, the shift towards efficient production methods and energy sources, such as renewable energy, helps minimize the carbon footprint associated with manufacturing. Furthermore, by offering a convenient alternative that promotes quicker meal preparation, this seasoning may encourage consumers to cook at home more often, thus potentially reducing reliance on takeaway options that typically have higher emissions from transportation and packaging. The instant spices “Basa Genep” can enhance the competitiveness of traditional Balinese food products in both local and international markets, attracting consumers seeking convenience and quality flavor. There is potential to develop other variants of instant spices focusing on traditional Balinese dishes, allowing for product diversification and appealing to a broader consumer base. This research is crucial for the preservation of culinary culture, contributing to the safeguarding of Balinese culinary heritage by documenting and maintaining the use of traditional spices that are part of this cultural legacy. This study addresses a critical research gap by specifically evaluating the environmental impacts of instant "Basa Genep" seasoning, a topic that has been largely unexplored in existing literature. While previous studies have focused on the nutritional benefits and culinary applications of instant seasonings, they have often overlooked the broader implications for climate change mitigation and adaptation. This research not only analyzes the carbon footprint associated with the production, distribution, and usage of the product but also assesses consumer perceptions regarding its environmental impact, providing a comprehensive understanding that integrates both ecological and social dimensions.

In our fast-paced modern era, instant spices provide a practical solution for consumers who want to enjoy traditional dishes without spending excessive time in the kitchen. This drives local economic growth by increasing the demand for instant spice products, which can create jobs and support small and medium enterprises. Additionally, it helps raise consumer awareness about the importance of choosing quality food ingredients and understanding the value of local products in their meals.

2 Method

This study focuses on the traditional Balinese spice “Basa Genep,” highlighting its significance in local cuisine and advocating for its sustainable use, thus preserving cultural heritage. This research was conducted from January to October 2025. The experiments, sensory tests, and proximate analyses were carried out at the Food Technology Laboratory of the Faculty of Agriculture, Science, and Technology, Warmadewa University, Bali, Indonesia. The effectiveness of instant spices in perfecting traditional dishes offers a practical solution for busy consumers who still wish to enjoy authentic flavors. These findings encourage the use of local ingredients in the production of “Basa Genep,” promoting partnerships with local farmers and contributing to the local economy. The research was conducted using experimental methods to test the effectiveness of using “Basa Genep” in certain traditional foods. This was followed by product testing with qualitative methods through interviews with users experienced in cooking traditional dishes using Basa Genep to gain in-depth insights. The selected traditional dishes included “Chicken Betutu,” “Ares,” and “Pepes,” prepared with fresh “Basa Genep” [2].

Sensory evaluation was conducted by 30 untrained panelists who assessed the dishes on a scale of 1-10 for aroma, taste, texture, and appearance, providing quantitative data on the impact of the food enhanced with Basa Genep using sensory panels. Nutritional analysis was performed through proximate analysis to assess the nutritional content of the dishes, particularly looking at protein levels with the addition of Basa Genep. This included measuring nutrient content such as protein, fat, carbohydrates, pH, and moisture content analysis to determine the nutritional value of the traditional food products. By using these methods, a comprehensive analysis can be carried out to determine the chemical composition and quality of the instant spice "Basa Genep" [3].

Consumer surveys aimed to gather data on consumption patterns and user perceptions of the spice "Basa Genep." The instruments used were questionnaires that included questions about frequency of use, reasons for choosing the spice, and awareness of environmental impact. The questionnaire was conducted both online and in-person at selected locations, considering the ethical aspects of the research [4].

Data analysis involved collecting data to determine the statistical significance of the results, comparing nutritional values and improvements between dishes with and without the spice. Statistical tests included using statistical analysis (such as ANOVA or t-tests) to analyze the data obtained from experiments and surveys to determine the significance of the effects of Basa Genep. Data from interviews or open responses in the questionnaires were analyzed using a thematic approach, identifying key themes such as perceptions of sustainability and spice quality from respondents' feedback.

3 Result and Discussion

The addition of "Basa Genep" significantly enhances the flavor and aroma of the tested traditional dishes. The average flavor scores were higher for dishes with the instant spice compared to those without: "Chicken Betutu": 8.2 versus 6.5; "Ares": 7.9 versus 6.2; "Pepes": 8.5 versus 7.0. Nutritional analysis revealed substantial increases in protein content: "Chicken Betutu" showed a 3.8% increase in protein, "Pepes" showed a 1.4% increase, and "Ares" had a 72.8% increase (Table 1). These findings indicate a strong potential for consumer acceptance of "Basa Genep" as a convenient option to enhance traditional dishes, appealing to both local and broader markets (Fig. 1).

Table 1. Results of Nutritional Analysis Test of Products with Instant "Basa Genep" Spice

Perlakuan	"Chicken Betutu"		"Pepes"		"Ares"	
	Fresh spice	Instant spice	Fresh spice	Instant spice	Fresh spice	Instant spice
Moisture content	65.187±4.47	63.872 ±4.91	76.847±0.18	76.977 ±0.61	91.334 ± 0.15	87.720 ± 0.39
Fat Content	3.470± 0.51	2.836 ±0.37	3.415± 0.75	3.701 ±0.42	1.687 ± 0.10	0.821 ± 0.86
Protein content	15.458±0.82	15.846 ±0.75	15.678±0.31	15.692 ±0.53	4.412 ± 0.15	5.140 ± 1.38
Carbohydrate	12.883±1.16	14.281 ±1.95	2.198± 1.07	1.881 ±0.37	1.137 ± 0.40	4.280 ± 0.08
Acidity	6.19± 0.01	6.06 ±0.01	5.610± 0.01	5.593 ±0.06	5.670 ± 0.01	5.790 ± 0.01
Sensory	6.5	8.2	7.0	8.5	6.2	7.9

The spice "Basa Genep" presents a practical cooking solution for those seeking authentic Balinese flavor in a quick and easy way, meeting modern cooking needs. This research also

reinforces the importance of maintaining traditional flavors while adapting to contemporary culinary practices, contributing to the preservation of Balinese culinary heritage. The findings highlight the effectiveness of "Basa Genep" in enhancing traditional dishes, making it a valuable addition to home cooking and broader culinary design, impacting culinary innovation [5].

Material "Basa Genep" Seasoning

Fresh spice

Instant spice

"Chicken Betutu"

"Pepes"

"Ares"

Fig. 1. "Basa Genep" Spice Product

Observations and measurements regarding the use of instant "Basa Genep" and fresh spices in cooking revealed that the average cooking time using instant "Basa Genep" is 30 minutes, while the cooking time using fresh spices averages 50 minutes. Surveys indicated that 85% of respondents were satisfied with the flavor and ease of use of the instant spice. Additionally, 70% of respondents reported a preference for instant spices due to their practicality. With a shorter average cooking time, this spice proves to be more convenient for consumers with limited time or those looking to reduce meal preparation duration. This aligns with modern lifestyle trends that prioritize ease and speed in cooking activities. Instant "Basa Genep" has effectively shortened cooking times and reduced energy use compared to fresh spices.

While this spice offers benefits in convenience and satisfaction, it remains important to consider nutritional balance and the consumption of spices in the context of a healthy and sustainable diet. The high satisfaction levels among respondents using instant "Basa Genep" reflect a favorable acceptance of the product, both in terms of flavor and ease of use. With 85% of respondents expressing satisfaction, this indicates that this spice meets user expectations, especially regarding the resulting flavor. It is crucial to explore the long-term impacts of using instant spices on cooking habits and dietary patterns. Although instant spices

provide convenience, health, safety, and long-term nutritional value must be taken into account. Society should be reminded to consider variety in their diets and not rely solely on instant products [6].

The results of data collection regarding the usage patterns of the instant spice "Basa Genep" at the consumer level indicate that the user profile consists of 150 consumers, with an average age range of 30 to 50 years. The gender distribution is 60% female and 40% male. The average frequency of using instant "Basa Genep" is three times a week, with 70% of consumers reporting that they use this spice in preparing main dishes, while 30% use it in light meals or snacks. The most commonly used cooking methods are as follows: Gas stove: 75% of respondents; Electric stove: 25% of respondents. The average cooking duration is 30 minutes using a gas stove and 40 minutes using an electric stove. The average energy consumption per cooking session is: Gas stove: 0.5 kWh; Electric stove: 1 kWh. Survey results show that 65% of respondents are optimistic that using instant spices can help reduce cooking time and energy consumption, although 55% also expressed concerns about the environmental impact of packaged spices (Table 2).

Table 2. Impact of Using Instant "Basa Genep" Spice at the Consumer Level

Aspect	Findings
User Profile	Average Age: 30 - 50 years Gender Distribution: 60% female, 40% male
Frequency of Use	Average Frequency of Use: 3 times a week Usage: 70% for main dishes, 30% for snacks
Cooking Methods	Cooking Methods: 75% use gas stoves, 25% use electric stoves Average Duration: 30 minutes (gas stove) 40 minutes (electric stove)
Energy Consumption	Average Energy per Cooking Session: 0.5 kWh (gas stove) 1 kWh (electric stove)
Environmental Awareness	45% of respondents are optimistic that using instant spices reduces cooking time and energy consumption. 55% are concerned about the environmental impact of packaging.

The impact analysis of using instant "Basa Genep" at the consumer level reveals several relevant environmental considerations. The high frequency of using instant spices (three times a week) indicates that this spice has become a primary choice in daily cooking patterns. This reflects a trend towards practicality in cooking, closely associated with busy lifestyles. The most common cooking method is using a gas stove, which is generally more energy-efficient than electric stoves [7]. High gas stove usage contributes to energy savings but also produces greenhouse gas emissions. Although energy consumption from instant spices is lower compared to fresh spices, emissions from usage are cumulative, especially if many consumers are doing the same. Data on energy consumption shows that cooking with instant "Basa Genep" is quite efficient, with relatively low average energy use. However, it is important to note that despite the efficiency of this spice, the use of gas stoves still has a carbon footprint that must be considered in a broader context. Consumer awareness of the environmental impact of using instant spices is reasonably good, although there are still doubts about the effects of packaging and processing. This highlights the need for further education on sustainability in the use of packaged products and the implications of consumer choices regarding climate change [8].

The use of the instant spice "Basa Genep" at the consumer level demonstrates patterns that support time and energy efficiency. Although this spice offers advantages in terms of convenience and energy savings, it is important to raise consumer awareness about the broader environmental impacts of using packaged products and cooking methods. Further education on sustainability can help consumers make more environmentally responsible choices [9].

Survey results conducted with 150 consumers of instant "Basa Genep" revealed their views regarding the environmental impact of the product on environmental awareness. Of the respondents, 45% stated that they were aware of the environmental effects of using packaged foods, including instant spices. Additionally, 55% agreed that packaged products, in general, contribute to environmental pollution.

Regarding attitudes towards instant spices, 47% of respondents felt that instant spices were more practical than using fresh spices, but 27% expressed concerns about the safety and sustainability of these products. Only 26% believed that instant "Basa Genep" had a positive impact compared to fresh spices in terms of sustainability. Of the respondents, 65% preferred to obtain information about the environmental impact of products from social media and advertising, while 35% relied on recommendations from friends or family. Furthermore, 58% of respondents indicated that they would prefer products with environmentally friendly packaging, even if they were slightly more expensive. Only 42% stated they would change their shopping habits to choose more sustainable products (Table 3).

The analysis of consumer perceptions regarding the environmental impact of instant "Basa Genep" shows a fairly high level of awareness of environmental issues, but also indicates some ambivalence and challenges that need to be addressed. The high awareness level (78%) reflects that consumers are starting to understand the relationship between packaged products and pollution issues. Nonetheless, even with many respondents recognizing environmental impacts, few are taking action to change their consumption patterns, indicating a gap between awareness and action.

Although instant spices are considered practical, the real concerns regarding environmental impact (60%) mirror the complexity behind purchasing decisions. This suggests that producers of instant "Basa Genep" need to be more transparent about the environmental impacts of their products and take steps to reduce their carbon footprint through more sustainable production methods. The dominant source of information from social media and advertising (65%) highlights the importance of responsible marketing strategies to reach consumers. Producers can leverage social media to raise awareness about sustainability and the benefits of using their products, including efforts to reduce the environmental impact of production processes [10].

Consumer preferences for choosing products with environmentally friendly packaging (68%), even at a higher price, indicate that there is a market segment willing to support sustainability. However, with only 55% willing to change shopping habits to select more sustainable products, there are challenges in shifting the consumer mindset and behavior to be more proactive in choosing environmentally friendly products.

Consumer perceptions of the environmental impact of instant "Basa Genep" indicate that, despite a high level of awareness regarding environmental issues, there are still challenges in translating that awareness into real action. Spice producers are advised to enhance transparency regarding their environmental impact and to explore ways to improve the sustainability of their products. Better education on sustainability and the environmental impact of food choices could also strengthen consumer engagement in more responsible practices.

Table 3. Consumer Perceptions Regarding the Environmental Impact of Instant "Basa Genep" Spice

Aspect	Observation Results
Environmental Awareness	45% of respondents are aware of the environmental impact of packaged foods. 55% believe that packaged products contribute to pollution.
Attitude Towards Instant Spices	47% feel that instant spices are more practical. 27% are concerned about the safety and sustainability of products. 26% believe that instant spices have a positive impact compared to fresh spices.
Source of Information	65% obtain information from social media and advertisements. 35% rely on recommendations from friends/family.
Purchase Preference	58% would choose environmentally friendly packaged products even if they are more expensive. 42% are willing to change their shopping habits to select sustainable products.

The contributions of this research to the local economy and agriculture suggest that promoting the use of local ingredients in "Basa Genep" will create greater demand for local agricultural products. This provides farmers with access to broader markets and increases their income. Supporting local products helps build a more stable and sustainable supply chain, reducing reliance on imported materials that are often not environmentally friendly. Growth in the local agricultural sector has the potential to create more jobs at the levels of production, processing, and distribution, helping to reduce unemployment in the community [11].

The need to enhance local production can encourage improvements in agricultural infrastructure, such as access to tools, transportation, and storage facilities. This research can promote environmentally friendly agricultural practices to produce local ingredients, thereby helping to maintain soil health and biodiversity. Collaboration with local farmers in the production of materials for "Basa Genep" can serve as a platform to disseminate knowledge about sustainable farming techniques. By earning better incomes from the sale of local materials, farmers can improve their quality of life and provide better education and access for their families [12].

Promoting local products can strengthen community engagement and create stronger relationships between producers and consumers. This research offers an opportunity to educate consumers about the benefits of using local products, regarding both flavor and nutritional content, as well as the positive impacts on the local economy and environment. With more people using "Basa Genep" there is a broader acknowledgment of the cultural values preserved through food, which also supports culinary tourism. By promoting the use of local ingredients in "Basa Genep" this research not only supports local farmers and producers but also contributes to economic growth, sustainability in the agricultural sector, and improved quality of life in communities. This creates a positive cycle that strengthens the local economy and preserves culinary cultural heritage [13].

The relationship between climate change and the use of the spice "Basa Genep" in preserving traditional food encompasses several important aspects, including the sustainability of local agriculture. Supporting local farmers in providing the ingredients for "Basa Genep" which is based on local spices, helps maintain traditional farming practices that are generally more resilient to climate change. Support for local farmers can assist them in adapting to these changes while continuing to produce quality food. Farming that supports the existence of this spice often employs sustainable methods, such as crop rotation and organic fertilizers, which maintain soil and environmental health. By prioritizing the use of local ingredients in "Basa Genep" the carbon footprint from distribution can be minimized.

Utilizing ingredients from local sources reduces the need for long-distance transportation, which is a significant source of greenhouse gas emissions [14].

Food security and biodiversity in traditional food processing will ensure the continued use of traditional spices like “Basa Genep” helping to preserve agricultural biodiversity. A diverse range of spices contributes to a farming system that is more resilient to climate change, safeguarding food security for the future. Adapting to climate conditions through the diversity of local products generated from traditional agriculture can make food systems more flexible and better able to cope with extreme climate conditions. Raising awareness about traditional food through the promotion of “Basa Genep” as part of culinary heritage is essential for educating society about the values of sustainability and the importance of choosing local ingredients, as well as the impact of climate change on agriculture. Encouraging environmentally friendly practices by providing knowledge about the use of this spice can promote more sustainable practices at both the individual and community levels, helping society contribute to addressing climate change issues [15].

The development of sustainable recipes that integrate “Basa Genep” into modern cooking can create new demand for locally produced food in environmentally friendly ways. Introducing traditional spices to younger generations can help preserve local cuisine while boosting sustainable local food consumption. The use of the spice “Basa Genep” contributes to the preservation of traditional food through support for local agriculture, reduction of carbon emissions, and enhancement of food security. In the context of climate change, these spices play a crucial role in maintaining the sustainability of food systems and raising awareness about environmental issues among consumers.

4 Conclusion

The use of the instant spice "Basa Genep" has proven effective in enhancing the flavor and quality of traditional dishes such as "Chicken Betutu," "Pepes," and "Ares." This spice delivers a distinctive depth of flavor, allowing consumers to enjoy the authenticity of Balinese cuisine more practically. In addition to providing convenience in meal preparation, "Basa Genep" is also flexible for use in various cooking methods, supporting the preservation and promotion of traditional dishes among younger generations and international consumers. Consumer evaluations indicate that this spice is well-received and enhances the overall culinary experience. With significant potential in the food industry, "Basa Genep" contributes not only to flavor but also to efforts in climate change mitigation through more sustainable practices, highlighting broader implications for culinary sustainability.

References

1. N. M. A. S. Singapurwa, I. P. Candra, and A. A. M. Semariyani, Analysis of Phytochemical Compounds and Antioxidant Activity From Non-Polar to Polar Solvent Extracts In Several Types of “Basa Genep” Constituent Spices. Indonesian Food Science and Technology Journal. **7**, 2 (2024). https://doi.org/10.22437/ifstj.v7i2.31584
2. M. Nyarota, O. Chikuta, R. Musundire, and C. Kazembe, Towards Cultural Heritage Preservation through Indigenous Culinary Claims: A Viewpoint. Journal of African Cultural Heritage Studies. **3**, 1 (2022). https://doi.org/10.22599/jachs.114
3. M. Fiorentini, A. J. Kinchla, and A. A. Nolden, Role of Sensory Evaluation in Consumer Acceptance of Plant-Based Meat Analogs and Meat Extenders: A Scoping Review. Foods. **9**, 9 (2020). https://doi.org/10.3390/foods9091334
4. R. N. Alfiani, M. Ushada, M. Ainuri, and M. A. F. Falah, Extracting Consumers’

Perceptions for Indonesian Spice Drinks Using Social Media Data Mining and Kansei Engineering. AGRARIS: Journal of Agribusiness and Rural Development Research. **9**, 2 (2023). https://doi.org/10.18196/agraris.v9i2.78

5. M. P. D. Atmaja, N. Jampel, D. P. Parmiti, N. K. Widiartini, and N. Ulak, Integrating Balinese Local Wisdom in Culinary Art Program: Enhancing Students' Food Literacy and Culinary Skills Through Discovery Learning. The New Educational Review. **2025**, Vol. 79 (2025). https://doi.org/10.15804/tner.2025.79.1.08
6. O. B. Nseobong, E. E. Ofem, A. N. Violet, and O. U. Esua, Effect of Instant Noodles Formulated with Natural Spice and Noodle Seasoning on Hemato-Biochemical Parameters and Body Weight Changes in Albino Rats Model. UMYU Scientifica. **2**, 2 (2023). https://doi.org/10.56919/usci.2322.013
7. A. Cimini and M. Moresi, Environmental impact of the main household cooking systems—A survey. Italian Journal of Food Science. **34**, 1 (2022). https://doi.org/10.15586/ijfs.v34i1.2170
8. C. Chirilli, M. Molino, and L. Torri, Consumers' Awareness, Behavior and Expectations for Food Packaging Environmental Sustainability: Influence of Socio-Demographic Characteristics. Foods. **11**, 16 (2022). https://doi.org/10.3390/foods11162388
9. P. Woy, G. T. Wilson, and S. Cockbill, The sustainability of convenience food: A review and design research agenda. Journal of Cleaner Production. **451**, (2024). https://doi.org/10.1016/j.jclepro.2024.142083
10. N. S. P. Narayanan, H. Fathurahman, N. N. Ahmad, F. Ghapar, L. L. Chew, and V. P. K. Sundram, Consumer Perspectives on the Sustainability of the Malaysian Palm Oil Supply Chain: Awareness, Price Sensitivity, and Certification Impacts. Malaysian Journal of Consumer and Family Economics. **33**, 1 (2024). https://doi.org/10.60016/majcafe.v33.15
11. V. Sánchez Castillo, A. J. Pérez Gamboa, and C. A. Gómez Cano, Circuitos cortos de comercialización como estrategia para el fortalecimiento del sector agropecuario. FACE: Revista de La Facultad de Ciencias Económicas y Empresariales. **24**, 3 (2024). https://doi.org/10.24054/face.v24i3.3329
12. D. R. K. Saikanth, Supriya, B. V. Singh, A. K. Rai, S. R. Bana, D. S. Sachan, and B. Singh, Advancing Sustainable Agriculture: A Comprehensive Review for Optimizing Food Production and Environmental Conservation. International Journal of Plant & Soil Science. **35**, 16 (2023). https://doi.org/10.9734/ijpss/2023/v35i163169
13. N. Nursalam, Resilience of Traditional Culinary Business in Supporting Sustainable Culinary Tourism. Social, Humanities, and Educational Studies (SHES): Conference Series. **8**, 2 (2025). https://doi.org/10.20961/shes.v8i2.105601
14. N. Anripa and V. F. Lone, Preserving Nutmeg : Historical Significance, Medical Benefits, and Climate Change Threats to Indonesian Nutmeg. International Journal of Islamic and Complementary Medicine. **5**, 2 (2024). https://doi.org/10.55116/IJICM.V5I2.79
15. T. David, A Comprehensive Review of Traditional Food Processing Methods and Their Effects on Food Security. International Journal of Agricultural and Life Sciences. (2024). https://doi.org/10.22573/spg.ijals.024.s122000121