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Food Safety and Community Behavior Toward Traditional Foods in West Sumatra Tourist Destinations: A Chemical, Biological, and Science Education Perspective

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Abstract: Traditional foods in tourist destinations have the potential to pose a threat to food safety due to biological and chemical contamination, as well as the gap between community knowledge and practices. This study aims to evaluate food quality from microbiological and chemical aspects, as well as community behavior towards food safety in tourist destinations in West Sumatra. A descriptive-quantitative approach was applied through laboratory tests (microbes and hazardous chemicals) and surveys of trade and consumer behavior. Data were analyzed statistically using descriptive statistics based on percentages. The results showed that 100% of pensi and langkitang samples were contaminated with Escherichia coli and Salmonella, and contained formaldehyde. Although the community's knowledge of food safety was relatively good (>80%), their attitudes and actual actions were still low, especially in Bukittinggi. These findings reveal the need for an interdisciplinary approach that integrates scientific evidence with contextual science education. This study concludes that local food safety issues can be used as a basis for social-scientific issue (SSI)-based science learning and ethnoscience to improve science literacy, health awareness, and sustainable behavioral change. The integration of laboratory data, behavioral analysis, and science education frameworks makes these findings relevant to public policy, curriculum, and SDGs.

Keywords: Consumer behavior; Food safety; Laboratory testing; Science literacy; Traditional food

Introduction

Food safety has become a global issue that directly affects public health, quality of life, and the competitiveness of the culinary tourism sector (Organization, 2020; Lin et al., 2022). Traditional foods that are characteristic of a region, in addition to holding cultural value, are also a key factor in determining tourist satisfaction (Rahmah et al, 2022; Khoshkam et al., 2023). West Sumatra, as one of the world's best halal tourist destinations (Zulvianti et al., 2022), relies on its distinctive cuisine as its main attraction, drawing many tourists to visit (Sari et al., 2023). Ideally, traditional foods sold at tourist sites should meet hygiene and sanitation standards, be free from microbiological contamination and harmful chemical additives, and be served in a safe manner (DeWaal et al., 2022).

However, the popularity of these traditional foods is not always matched by food safety guarantees, potentially endangering consumer health and damaging the reputation of regional tourism. Various studies have revealed that food sold in traditional markets and tourist

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areas is often contaminated with pathogenic bacteria such as Escherichia coli and Salmonella (Rutaro et al., 2024) and contains illegal chemical additives such as formaldehyde, borax, and synthetic dyes (Anjani et al., 2025; Nuraini et al., 2021; Rahman et al., 2023). The consequences of this condition not only include health aspects such as food poisoning and gastrointestinal infections (De Vries, 2021), but also impact the reputation of tourist destinations, reduce public trust in local cuisine, and weaken the economic position of culinary SMEs (Latianingsih et al., 2025; Mau et al., 2024).

The main causes are poor sanitation, lack of supervision, and economic pressures that force traders to use cheap preservatives even though they are dangerous. In tourist destinations, this situation is exacerbated by high visitor mobility and minimal hygiene controls, thereby increasing the potential for the spread of gastrointestinal infections (Oladayo et al., 2022).

Although interventions have been carried out such as hygiene training for traders (Triyono et al., 2025) or the integration of food safety topics into school curricula (Nugraha et al., 2022), the results are still limited because these approaches are partial. They focus only on technical laboratory aspects, behavioral surveys, or education alone, without connecting the three holistically. As a result, even though public knowledge about the dangers of formalin is quite high, their attitudes and actual actions are often inconsistent, creating a gap between knowledge and practice (KAP gap), as seen in the preliminary findings of this study.

The uniqueness of this study lies in its interdisciplinary approach, which has never been systematically applied in the context of culinary tourism in West Sumatra. This study simultaneously integrates laboratory testing (chemical and biological), analysis of trader and consumer behavior (knowledge, attitudes, and actions), and a science education framework based on the local context. Unlike previous studies that only measured contamination or conducted surveys, this research bridged objective data with social reality and offers educational solutions based on real phenomena.

This research is important for three main reasons. First, from a reputation and economic perspective, food safety violations in tourist destinations can damage West Sumatra's image as a trusted halal destination, thereby threatening the sustainability of the culinary tourism sector, which is a pillar of the local economy. Second, from a public health perspective, high levels of contamination in wet traditional foods have the potential to cause gastrointestinal infections, especially in vulnerable groups such as children and the elderly. Third, from a science education perspective, this study shows that traditional foods can be a relevant learning context for improving students' science literacy, critical thinking, and social responsibility.

The findings of this study provide a scientific basis for developing a science learning model based on socio-scientific issues and ethnoscience, in which the concepts of chemistry (formalin detection), biology (bacterial contamination), and physics (principles of temperature and hygiene) are taught through real phenomena that are close to the lives of students. This approach not only improves understanding but also encourages sustainable behavioral change, as science is positioned not as an abstract science but as a tool for solving everyday problems.

Thus, this research not only answers scientific questions about food quality but also offers a transformational solution: turning traditional foods from objects of risk into a medium for contextual science learning. The integration of laboratory testing, behavioral analysis, and contextual education will make a significant contribution to local government policy, curriculum development, and community empowerment, while also supporting the achievement of the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health) and SDG 4 (Quality Education).

Method

Type of Research

This study uses a combination of descriptive and quantitative methods, supported by laboratory analysis (microbiological and chemical tests) and surveys of community behavior (traders and consumers) regarding food safety. This approach is used to get a thorough understanding of specialty food quality at tourist sites and the community's response to food safety issues. This study intends to provide a thorough understanding of food safety and quality as well as the attitudes of vendors and customers regarding traditional foods at tourist destinations in West Sumatra Province.

Place and Time of Research

The research location covers five tourist destinations in West Sumatra, namely Purus Padang Beach, Bukittinggi, Payakumbuh, Maninjau Lake, and Singkarak Lake. However, laboratory tests and behavioral surveys were focused on Purus Padang Beach and Bukittinggi. Sampling, laboratory testing, and questionnaire distribution were carried out from May to July 2024.

Population and Sample

The population in this study was divided into two groups (a) the population of traditional foods sold at tourist sites and (b) the population of vendors and

consumers (local tourists). Five types of traditional foods were sampled from each location, for a total of 70 samples. The sampling technique used was purposive sampling, which involved selecting the most popular and most consumed foods by tourists, such as pensi, langkitang, satay cracker, and local fish dishes.

For respondents regarding food safety behavior, two groups were used: (a) 45 respondents who were traditional food vendors and (b) 46 respondents who were consumers/local tourists. Respondents were selected using accidental sampling, i.e., respondents were encountered directly while consuming traditional food at tourist locations. Data collection was conducted over varying time periods (morning–afternoon, weekdays, and weekends) to reduce time bias and obtain more representative demographic variation.

Data Types

The data types employed in this study include primary data, which consist of an inventory of sorts of food specialties at tourist locations, laboratory test results on food (microbiology and chemistry), and behavioral survey data (knowledge, attitudes, and actions) of traders and consumers.

Data Collection Technique

Data was collected using three basic strategies, as follows: First, inventory food type is typical. A survey field was done to identify and record the types of traditional food sold by traders in the Purus Beach tourism area in Padang and Bukittinggi. Types of food chosen are popular and frequently consumed by local tourists, such as pensi, langkitang, kerupuk kuah, and other local fish dishes.

Second, laboratory tests food. Food samples are inventoried and then tested in the laboratory for known quality safety. Microbiological testing covering testing content Escherichia coli and Salmonella using the Total Plate Count (TPC) method refers to SNI 2897:2008. Chemical tests are done to detect the existence of dangerous materials such as formalin, borax, and rhodamine B using reagent chemistry fast in accordance with procedures from BPOM RI.

Third, survey the behavior of traders and consumers. The survey used a closed questionnaire with a four-point Likert scale to measure three indicators of security behavior. Food: knowledge (7 items), attitudes (10 items), and actions (3 items). Questionnaire This has been validated by two experts (fields of science and safety education food), with a results validity of 91.1% (very valid category). The reliability test instrument was done through a trial on 10 respondents early, with Cronbach's Alpha results of 0.88 (category reliable).

Data Analysis Techniques

Result data inventory types of traditional food at the tourist destinations were served in table form and analyzed in a descriptive qualitative way. Laboratory test data were analyzed in a descriptive statistic way using percentage techniques and then compared with criteria or standard quality food security from a qualitative aspect that has been set by the government.

Survey data on the behavior of traders and consumers was tabulated and analyzed in a way that used descriptive statistics, percentages, and average score values. Furthermore, the results are classified into three categories: Good: >76%, Moderate: 56–75%, Poor: <55%. This classification refers to behavioral measurement criteria in the fields of education and public health.

Result and Discussion

Results of the Inventory of Traditional Foods at tourist destinations

Data from the inventory of traditional foods at tourist destinations in West Sumatra can be seen in Table 1. This table lists 36 traditional foods from West Sumatra. Most of these foods are made from local ingredients, which shows the close relationship between cuisine and regional ecology. This diversity offers rich opportunities for contextual science learning but also increases variation in handling and the risk of contamination.

Table 1. Traditional Food at the Destination Tourism in West Sumatra

Traditional food	Typical
Purus beach:	
Langkitang	Wet food
Pensi	Wet food
Satay cracker sauce +noodle	Dry food
Salalauk	Wet food
Chicken foot soup	Wet food
Bukittinggi:	
Sanjai crackers	Dry food
Karak kaliang	Dry food
Balado chips	Dry food
Pias	Dry food
Peanut brittle	Dry food
Balam's nest	Dry food
Egg-karak kaliang	Dry food
Dakak dakak	Dry food
Kapau rice	Wet food
Satay cracker-Noodle	Dry food
Maninjau lake:	
Palai rinuak	Food wet
Salai bada	Food wet
Pensi	Food wet
Grilled fish	Food wet
Rakik rinuak	Wet food

Traditional food	Typical
Rakik ikan	Wet food
Payakumbuh:	
Kalamai	Wet food
Bareh randang	Wet food
Egg randang	Dry food
Randang rutiang	Dry food
Eel randang	Dry food
Grilled sagun	Dry food
Batiah	Dry food
Fish curry	Wet food
Singkarak lake:	
Fry the bilih fish	Dry food
Sour bilih fish	Wet food
Bilih fish with flour	Dry food
Crackers	Dry food
Fish crackers	Dry food
Lento	Dry food
Lamang tapai	Wet food

Traditional foods were cataloged from five main destinations in West Sumatra: Purus Beach Padang, Bukittinggi, Payakumbuh, Maninjau Lake, and Singkarak Lake. The dominance of freshwater fish and shellfish-based dishes such as pensi, langkitang, and rinuak indicates a strong connection between culinary culture and local resources. This phenomenon reinforces the findings of Rivza et al. (2022), who state that culinary tourism is not only a gastronomic experience but also a medium for understanding local cultural identity and the environment.

In the context of science education, this diversity can be utilized as contextual teaching materials in biology, physics, and chemistry education (Karimov et al., 2024; Adam et al., 2025). These contextual teaching materials can bridge the gap between cultural experiences and daily life related to food safety within a scientific context. However, this diversity also opens up different food safety risks depending on the type of processing and serving conditions.

Quality Test Food Safety

Microbiological testing

Microbiological tests were conducted to detect the presence of Escherichia coli and Salmonella bacteria. A total of 35 samples of traditional foods were analyzed. The samples consisted of five types of food, namely langkitang, pensi, satay cracker sauce, satay crackers, and noodles.

Table 2 shows that wet foods such as pensi and langkitang are more susceptible to biological contamination by Salmonella and Escherichia coli, while dry foods are more stable and durable. This is relevant to the findings of Alp et al. (2021), who stated that in dry foods, the water content is reduced, thereby preventing/delaying the growth of microorganisms in the food, although it cannot be considered sterile.

Table 2. Test Results Bacteria *Salmonella* and *E. coli* in Samples from Purus Beach, Padang

Traditional food	Salmonella Test	E. coli Test
Langkitang	(+)	(+)
Pensi	(+)	(+)
Kuah satay cracker	(-)	(-)
Satay cracker	(-)	(-)
Noodle	(-)	(-)
Langkitang	(+)	(+)
Pensi	(+)	(+)
Kuah satay cracker	(-)	(-)
Satay cracker	(-)	(-)
Noodle	(-)	(-)
Langkitang	(+)	(+)
Pensi	(+)	(+)
Kuah satay cracker	(-)	(-)
Satay cracker	(-)	(-)
Noodle	(-)	(-)
Langkitang	(+)	(-)
Pensi	(+)	(-)
Kuah satay cracker	(-)	(-)
Satay cracker	(-)	(-)
Noodle	(-)	(-)
Langkitang	(+)	(-)
Pensi	(+)	(-)
Kuah satay cracker	(-)	(-)
Satay cracker	(-)	(-)
Noodle	(-)	(-)
Langkitang	(+)	(+)
Pensi	(+)	(+)
Kuah satay cracker	(-)	(-)
Satay cracker	(-)	(-)
Noodle	(-)	(-)
Langkitang	(+)	(+)
Pensi	(+)	(+)
Kuah satay cracker	(-)	(-)
Satay cracker	(-)	(-)
Noodle	(-)	(-)

The percentage of samples identified as containing Salmonella and E. coli bacteria in the characteristic food samples from Purus Beach, Padang, can be seen in Table 3. Microbiological test results showed that 100% of langkitang and pensi samples from Purus Beach contained Salmonella, and 71.43% contained Escherichia coli.

Table 3. Percentage Salmonella and E. Coli Bacteria Test Results from Purus Beach, Padang

Traditional food	Salmonella (%)	E. coli (%)
Langkitang	100	71.43
Pensi	100	71.43
Satay cracker sauce	0	0
Noodle	0	0
Satay cracker	0	0

These results are consistent with research by Koumassa et al. (2025), which revealed that street food in coastal areas has a higher risk of microbiological contamination due to exposure to the open environment and poor sanitation. These findings reinforce the WHO warning that street food in developing countries has a higher risk of microbiological contamination due to exposure to open environments and poor sanitation (Organization, 2020).

The presence of Escherichia coli is an indicator of fecal contamination and indicates inadequate hygiene practices (Yohans et al., 2022). Escherichia coli is used as an indicator of food quality because it lives in the intestines of humans and animals and is excreted through feces, so its presence in water warns of the possible presence of other pathogens originating from the intestines or digestive systems of animals and humans. Additionally, Escherichia coli can ferment lactose to produce gas at room temperature, making it a reliable indicator for water bacteriological testing (Sugiah et al., 2023; Bhattacharya, 2025).

Meanwhile, the presence of Salmonella has the potential to cause acute gastroenteritis and is very dangerous for vulnerable groups such as children and the elderly. This contamination occurs due to weak oversight of the supply chain from production to serving, particularly among street vendors. Salmonella bacteria are the primary cause of foodborne diseases. Generally, Salmonella causes illness in the digestive system (Wilson & Wilson, 2021).

Chemical test

Chemical tests were conducted on 35 samples of typical foods from Purus Beach in Padang to detect the presence of formaldehyde, borax, and rhodamine B. Meanwhile, samples from Bukittinggi were only tested for formaldehyde, rhodamine B, and methyl yellow, given their drier nature and different processing patterns. The results showed that all samples from Bukittinggi were free of these three hazardous chemicals, in contrast to the high levels found in wet samples in Padang.

The percentage of samples of traditional foods from Purus Beach, Padang, identified as containing formalin, borax, and rhodamine B is shown in Table 5. The results of the analysis show that 100% of the langkitang, pensi, and satay cracker sauce samples contained formalin, while no borax or rhodamine B was found in any of the samples. 87.71% of noodle and 14.29% satay cracker samples were detected to contain formalin, indicating a pattern of hazardous substance use focused on wet foods.

Formalin should not be used in food because it is toxic and carcinogenic. A similar study by Prabowo et al. (2021) found that formalin is still being used secretly in traditional snacks to extend their shelf life, despite being banned by the Indonesian Food and Drug Administration (BPOM). This underscores the importance of food chemical literacy not only among producers but also consumers.

Table 4. Test Results for Formalin, Borax, and Rhodamine B on Samples from Purus Beach, Padang

Traditional food	Formalin	Borax	Rhodamine B
Langkitang	(+)	(-)	(-)
Pensi	(+)	(-)	(-)
Satay cracker sauce	(+)	(-)	(-)
Satay cracker	(-)	(-)	(-)
Noodle	(+)	(-)	(-)
Langkitang	(+)	(-)	(-)
Pensi	(+)	(-)	(-)
Satay cracker sauce	(+)	(-)	(-)
Satay cracker	(-)	(-)	(-)
Noodle	(+)	(-)	(-)
Langkitang	(+)	(-)	(-)
Pensi	(+)	(-)	(-)
Satay cracker sauce	(+)	(-)	(-)
Satay cracker	(-)	(-)	(-)
Noodle	(+)	(-)	(-)
Langkitang	(+)	(-)	(-)
Pensi	(+)	(-)	(-)
Satay cracker sauce	(+)	(-)	(-)
Satay cracker	(-)	(-)	(-)
Noodle	(-)	(-)	(-)
Langkitang	(+)	(-)	(-)
Pensi	(+)	(-)	(-)
Satay cracker sauce	(+)	(-)	(-)
Satay cracker	(+)	(-)	(-)
Noodle	(+)	(-)	(-)
Langkitang	(+)	(-)	(-)
Pensi	(+)	(-)	(-)
Satay cracker sauce	(+)	(-)	(-)
Satay cracker	(-)	(-)	(-)
Noodle	(+)	(-)	(-)
Langkitang	(+)	(-)	(-)
Pensi	(+)	(-)	(-)
Satay cracker sauce	(+)	(-)	(-)
Satay cracker	(-)	(-)	(-)
Noodle	(+)	(-)	(-)

Table 5. Chemical Test Results for Purus Beach, Padang

Traditional food	Formalin (%)	Borax (%)	Rhodamine B (%)
Langkitang	100	0	0
Pensi	100	0	0
Satay cracker sauce	100	0	0
Noodle	85.71	0	0
Satay cracker	14.29	0	0

The effects of formalin accumulation in the body are carcinogenic, leading to cancer and tumors in human organs over the long term. It has also been revealed that certain food side effects can affect brain function, including behavioral disorders in school-age children.

These behavioral disorders include sleep disturbances, concentration problems, emotional disturbances, hyperactivity, and exacerbation of symptoms in people with autism. The short-term effects of using food additives cause very common symptoms, such as dizziness, nausea, vomiting, diarrhea, or difficulty defecating (Subedi et al., 2025).

Samples from Bukittinggi in the form of dry samples were tested in the laboratory for formalin, Rhodamine B, and methyl yellow content. The tests were conducted on samples taken from four sampling points, namely Jam Gadang, Ngarai Sianok, Pasar Bawah, and Souvenir center. The samples collected were those most commonly consumed at the tourist destinations in question. The laboratory test results showed that all the traditional foods at the tourist destinations studied tested negative for formalin, methyl yellow, and Rhodamine B. Although deemed safe, ongoing monitoring is still necessary because the practice of using illegal food additives often fluctuates depending on supply and the knowledge of vendors.

Food Safety Behavior of Traders and Consumers: Knowledge, Attitudes, and Actions Typical Food

Based on the answers of respondents, a recapitulation can be made from the category actors (knowledge, attitudes, and actions) of traders and consumers of traditional food as in Table 6. It shows that the knowledge of traders and consumers of specialty foods regarding food safety in Pantai Purus Padang and Bukittinggi is classified as good, with a percentage reaching 80–92%. This reflects that information about biological hazards such as Salmonella and Escherichia coli, as well as hazardous chemicals such as formalin and borax, is widely known.

Table 6. Recapitulation Category Knowledge, Attitude, and Actions from Traders and Consumer

Aspect	Purus Beach:		Bukittinggi:	
	Trader (%)	Consumer (%)	Trader (%)	Consumer (%)
Knowledge:				
Good	80	86.67	92	88
Currently	15	10	8	6.25
Not enough	5	3.33	0	6.25
Attitude:				
Good	90	93.33	12	93.75
Currently	10	3.33	60	6.25
Not enough	0	3.33	28	0
Action:				
Good	90	67	100	43.75
Currently	10	33	0	18.75
Not enough	0	0	0	37.75

Referring to Agustine et al. (2023), educational level influences a person's knowledge. Although the educational backgrounds of traders vary from elementary school to high school, their food safety knowledge has been categorized as good. This is possible because a person's knowledge is not only influenced by their environment and educational level but also by information sources, experience, and educational activities. According to the research by Tuglo et al. (2021) persons who have attended food safety training courses are six times more likely to practice proper food hygiene than those who have not.

These results are similar with the findings of a study by Sheehama et al. (2025) that street vendors' knowledge can be improved through informal education, personal experience, and social influence in the workplace. High knowledge serves as a crucial foundation for safe decision-making processes in selecting and selling food. This is consistent with the results of Kuboka et al. (2024) emphasizing the importance of a behavioral change approach to enhance food safety through rigorous and regular training and supervision. However, high knowledge does not necessarily guarantee the formation of appropriate behavior, as stated in the Knowledge-Attitude-Practice (KAP) theory, that knowledge is only one determinant of attitude and action.

The majority of respondents in Pantai Purus had a positive attitude toward food safety, both traders (90%) and consumers (93.33%). However, a contrast was seen among traders in Bukittinggi, where only 12% showed a positive attitude, while the rest were in the moderate (60%) and poor (28%) categories. This gap between knowledge and attitude can be explained through the Theory of Planned Behavior (Afshar & Ghaleh, 2021), which emphasizes that intention, attitude, subjective norms, and perceived control all influence behavior, consistent with the findings of Li et al. (2023). In this context, although traders have good knowledge, economic pressures, resource constraints, and local market culture may hinder the internalization of aligned attitudes. Food safety training needs to be continued to support transforming information into acceptable attitudes and activities.

Concrete actions to maintain food safety show significant variation. Traders in Bukittinggi show a good level of action of 100%, while consumers in the same area are low (only 43.75% in the good category). On the other hand, the actions of merchants and consumers in Pantai Purus are relatively more balanced. This situation indicates that actions do not always align with attitudes and knowledge. This highlights low levels of applied science literacy (Martini, et al., 2023), where understanding fails to translate into concrete preventive actions, such as choosing safe food, reading labels, or avoiding snacks with bright colors.

The study by Barbu et al. (2022) confirms that consumer behavior is greatly influenced by external factors such as availability of choices, peer influence, parental influence, and trust in local products. Therefore, educational strategies need to focus on habit formation and social control, rather than simply transferring knowledge. This strategy works well when it starts with contextual and applied science learning activities.

Implications for Science Education

The outcomes of this study have substantial implications for improving scientific instruction in schools, especially in the local context of West Sumatra. Food safety of traditional foods is an issue that is rich in science concepts, including: Biology: bacteria and microbial contamination such as Salmonella and Escherichia coli that cause disease. Chemistry: reactions involving hazardous chemicals like formalin, boric acid, and synthetic dyes, as well as methods for detecting them using simple reagents. Physics: principles of temperature and heat in food heating, drying, and hygiene of utensils.

A science learning approach based on socio-scientific issues (SSI) and ethnoscience is highly relevant for addressing this food safety topic because it involves real-world problems and the cultural context of students. This approach has proven helpful in increasing students' scientific literacy, critical thinking skills, and cultural awareness (Tsaniyah & Fadly, 2024; Fauziah & Ihsan, 2024). Additionally, this approach also strengthens the Profile of Pancasila students, particularly in terms of critical thinking, independence, and cooperation.

As the main consumers of traditional foods, students need to be educated about the dangers of chemicals in food, simple detection methods, and the importance of sanitation practices in everyday life. This is in line with Sonawane et al. (2022), who emphasize the necessity of beginning food safety instruction in school to reduce the risk of foodborne illness.

In addition to schools, community-based education also needs to be strengthened. According to Yamin et al. (2025), community empowerment is an effective strategy in changing societal behavior, including in health and food-related aspects. Therefore, active community participation in training and education programs based on local food will strengthen community resilience and reduce the risk of unsafe food consumption. This is reinforced by Rachmawati et al. (2021), who state that community involvement in culture-based education can be the main foundation for local empowerment and behavioral transformation.

Conclusion

Based on the comprehensive findings of this study, the main conclusion confirms that the traditional culinary wealth of West Sumatra's tourist destinations is seriously threatened by systematic microbiological and chemical contamination, with 100% of langkitang and pensi samples detected containing Salmonella and formaldehyde. Although the level of public awareness about these dangers is very high (>80%), there is a sharp and worrying gap between knowledge, attitudes, and actions, especially among Bukittinggi traders, only 12% of whom have a positive attitude towards food safety, while consumer actions in the region are only 43.75% in the good category. This phenomenon shows that knowledge-based interventions alone, such as hygiene training or partial integration of food safety topics into the curriculum, are insufficient to change behavior because they do not address the root of the problem. The novelty of this research lies in its interdisciplinary approach, which simultaneously connects laboratory scientific evidence, analysis of real community behavior, and a science education framework using traditional foods as a bridge between abstract science and everyday reality. The scientific implications are far-reaching, providing empirical evidence that local cultural contexts can be a strong foundation for building impactful science literacy, thus offering a replicable learning model throughout Indonesia and developing countries with similar culinary heritages. From a practical standpoint, these findings call for a transformation of science education from theoretical learning to participatory experiences—through activities such as formalin rapid testing in the classroom, interviews with vendors, or student-led awareness campaigns—that directly connect concepts in chemistry, biology, and physics to social responsibility. The limitations of this study lie in its geographical focus on two main destinations, its cross-sectional design that cannot measure long-term behavioral change, and its use of rapid chemical detection methods that require further validation. Therefore, further research is needed to develop and test culturally adapted SSI-based learning modules, conduct longitudinal studies to track the long-term impact of educational interventions, and expand the geographical coverage to rural areas and other tourist destinations in West Sumatra. It is also necessary to collaborate with health and education authorities to integrate these findings into public policy, curriculum, and SDGs.

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Author Contributions

Conceptualization, M. R, M. S, N.; methodology, M. R, M. S, N.; validation, M. S, and A. M.; formal analysis, M. R, M. H, L.M ; investigation, A. M, and N.; resources, A. M. and M. H.; data curation, M. R.: writing—original draft preparation, M. R and N.; writing—review and editing, M. S and L. M.: visualization, N. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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