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RESEARCH ARTICLE
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Disparities in Sanitation and Physicochemical Quality of Peanut (*Arachis hypogaea* L.) and Ginger (*Zingiber officinale*) in Traditional Markets: A Case Study of Semarang, Central Java, Indonesia

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ABSTRACT

Peanut and ginger are among the most widely used ingredients in Indonesian cuisine, including in Semarang City. These commodities are primarily cultivated in the uphill areas of Semarang and distributed to consumers in downhill regions through three government-managed traditional market categories. Given its role in daily consumption, it is essential to ensure safe distribution. This study aimed to analyze the differences and correlations among market categories in terms of moisture content, temperature, physical quality, and sanitary hygiene, as well as the interrelationships between these parameters in peanuts and ginger sold in traditional markets in Semarang. This study uses 87 samples from 29 markets. The findings revealed significant differences ($P<0.05$) in hygiene sanitation for peanuts across market categories, whereas the other parameters showed no significant variation ($P>0.05$). In contrast, gingers exhibited significant differences ($P<0.05$) in moisture content, physical quality, and sanitary hygiene, with temperature being the only parameter with no significant variation ($P>0.05$) among the market categories. Furthermore, correlation analysis indicated significant relationships ($P<0.05$) between moisture content and temperature, physical quality, and hygiene sanitation as well as between physical quality and hygiene sanitation for both peanut and ginger commodities.

Keywords: Traders, Moisture content, Temperature, Physical quality, Sanitary hygiene.

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INTRODUCTION

Semarang City, the capital of Central Java Province, has a significant potential for continued development. The city's geographical landscape is divided into two distinct areas: uphill and downhill. These differences in topography influence the agricultural sector, particularly in the cultivation and distribution of essential commodities. Among these, peanuts (*Arachis hypogaea* L.) and ginger (*Zingiber officinale*) are predominantly cultivated in the hilly regions of Semarang, supplying downhill areas with essential agricultural products that support local food industry and community needs. Peanuts, which are members of the Leguminosae family, play a crucial role in Indonesia's agricultural sector. They are the second most widely cultivated legumes after soybeans (Karlina and Irmawijaya, 2022). Peanuts are versatile and widely utilized in various food preparations, contributing to the local economy and the food processing industry. The ability to enhance the added value of peanuts through food industry applications makes them a vital commodity in the Semarang agricultural landscape. Ginger, a medicinal plant belonging to the Zingiberaceae family, is a highly valued spice known for its distinctive pungent flavor and rich bioactive compounds. Ginger possesses significant antioxidant, anti-inflammatory, and antimicrobial

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properties (Ozkur et al., 2022), making it a staple ingredient in traditional and modern foods and health products. Ginger is a basic ingredient of traditional beverages (Al-Baarri et al., 2019). Understanding the impact of these geographical differences is essential to ensure optimal storage conditions, maintain product quality, and improve supply chain efficiency.

A market is a system of institutions, procedures, social relations, and incentives with business activities that occur in the form of selling goods, services, or labor for subjects who perform in exchange for money (Susanto, 2018). However, even though traditional markets play an important role in supporting community economic activities, the available infrastructure still lags behind modern markets. This can be seen in the fact that traditional market infrastructure in developing countries is not as good as modern markets because it does not have a good environment for maintaining food hygiene and safety (Tran, 2023). Cambodia is one of the countries in Southeast Asia with poor traditional market hygiene conditions that can lead to food contamination, such as storage conditions without temperature control and packaging (Sorm et al., 2022).

The development of markets in Semarang City can be said to be quite rapid. The pattern of marketing in Semarang City shows the number of traditional markets both from neighborhood scale to city scale as many as 54 markets spread across 16 sub-districts in Semarang City (Prasetia, 2021). Traders in traditional markets have diverse characteristics, including traders of Fresh Food of Plant Origin. Some traders in traditional markets still ignore food safety, such as the condition of traders in traditional markets who are sometimes not in good health, potentially contaminating the products sold. In addition, the provision of clean water for various hygiene and sanitation activities is important because contaminated water can cause various health problems (Sharma and Bhattacharya, 2017). The placement of products sold is sometimes not given a mat, and the condition of products that are not fresh and not in accordance with provisions, such as labels and storage, is not appropriate. Good traders should pay attention to food safety aspects such as the use of aprons, Clean and Healthy Living Behavior, places away from sources of contamination, and maintain cleanliness.

Market categorization is the process of classifying markets based on specific criteria. The purpose of market categorization is to provide a clearer understanding of different market types, which helps to analyze and make informed decisions related to consumer behavior and market dynamics. The Semarang government has adopted a market categorization based on Pereira et al. (2020), which includes city, regional, and neighborhood markets, each specifically managed by the Department of Trade, Ministry of Trade, Republic of Indonesia. City markets are located in strategic areas, with large spaces and permanent buildings. This category of markets can serve the entire city area and offer a wide range of goods. These markets serve approximately 200,000 to 220,000 residents. In contrast, regional markets are also situated in strategic locations with large spaces and permanent buildings, but they serve a smaller population, ranging from 10,000 to 15,000 residents. Finally, neighborhood markets are located in strategic areas with permanent or semi-permanent buildings. These markets primarily cater to local residential areas and offer a limited selection of goods. The service range of neighborhood markets is restricted to approximately 10,000–15,000 residents. Market categories can facilitate food safety review.

Food safety is a science that discusses the preparation, handling, and storage of food, so that it is not contaminated by physical, biological, or chemical contaminants. The main objective of food safety is to ensure that the food consumed by the public as consumers is free from physical, biological, or chemical foreign substances to minimize the potential for disease due to food hazards. Food contamination may originate from several sources. Physical contamination can occur when foreign objects, such as hair, metal, plastic, dirt, and nails, enter food (Onyeaka et al., 2023). Biological contamination is a substance produced by living organisms such as viruses and bacteria, whereas chemical contamination can occur when food is exposed to chemicals such as pesticides, herbicides and heavy metals, as well as other emerging pollutants (Sohrabi et al., 2021). Additionally, cross-contamination is possible in fresh food products. Cross-contamination can occur from the production process to distribution, owing to the transfer of bacteria from one food object or material to another (Possas and Rodriguez, 2023). The safety of foodstuffs must be ensured because they are beneficial to human health (Donowarti et al., 2021).

In addition, product storage methods can support improved food safety. Commodity storage requires proper temperature, humidity, and air circulation to suppress and prevent mold growth and aflatoxin production. The recommended storage method for peanuts by the Codex Alimentarius Commission (CAC, 2004) is water activity (aw) less than 0.7, room RH below 70%, and temperature between 0–10°C. These conditions can inhibit the growth of Aspergillus flavus and Aspergillus parasiticus molds. In addition, high moisture content in peanuts is susceptible to mold growth. Moisture content of 7.59 to 9.06% can extend the shelf life of various peanut varieties (Kaur et al., 2023). Appropriate storage conditions are essential to suppress fungal growth and preserve the freshness of ginger. Both temperature and water activity are key factors in controlling fungal proliferation and aflatoxin formation. *Aspergillus flavus* shows optimal growth on ginger at a water activity level of 0.98–0.995 and temperatures between 30–35°C (Okereke, 2020). Contaminant fungi such as *Aspergillus* spp. and *Penicillium* spp. may develop during storage, producing airborne and seed-borne mycotoxins; hence, environmental humidity and temperature significantly affect their occurrence (Putri et al., 2023). To reduce quality loss and ensure safety, Kaushal et al. (2017) recommend maintaining ginger rhizomes at a relative humidity of approximately 70–75%. Therefore, it is necessary to determine the differences in moisture content, temperature, physical quality, hygiene, and sanitation, as well as to examine the relationship between

these parameters and the market categorization of peanuts and ginger.

MATERIALS & METHODS

The study was conducted from June to October 2024 at research locations in several traditional markets in Semarang City and the Central Laboratory for Research and Services Universitas Diponegoro (CORES-DU), Semarang. Sampling was conducted in the morning between 7:00 a.m. and 9:00 a.m.

Data Collection

The samples used in the study were obtained using a purposive sampling technique, with a total sample size of 87 from 29 markets for each commodity. A total of 29 markets are divided into 4 city markets, 9 regional markets, and 16 neighborhood markets. The uneven numbers between market categories are due to the varying number of markets in the field. Traditional markets were selected using purposive sampling, chosen to represent all locations with the requirement that traditional markets have at least three vendors selling peanuts or ginger and willing to be interviewed and observed. The same applies to the selection of stalls or vendors in relation to commodity availability and willingness to be interviewed.

Purposive sampling is a sampling technique based on certain considerations, the population characteristics of which are known in advance. The study used data sourced from primary and secondary data. Primary data are obtained directly through surveys or the implementation of observations at the location concerned without prior processing or interpretation (Siregar et al., 2022). Primary data were obtained through questionnaires, interviews, observations, and test results. Secondary data were also used in this study. Secondary data are information or data that have been previously collected by other parties for certain purposes and used to complement research data needs.

Scoring Method

The assessment was conducted by researchers through observation and interviews with traders. Aspects assessed in the physical quality questionnaire included the aroma and surface cleanliness, such as freedom from foreign objects, insect contamination, and mold. Hygiene and sanitation assessments covered location, storage building facilities, hygiene facilities, machinery and support facilities, and pest control. Physical quality and hygiene sanitation were assessed using a scoring system. This method involves assigning a score or value to each parameter on a scale of 1 to 10 (Solikhan et al., 2019). The use of an even scale was intended to prevent responses from clustering in the middle, avoiding a gray area. A score of 1 indicated that the statement was unsuitable, whereas a score of 10 indicated that the statement was suitable (Pamungkas and Zuhroh, 2016).

The scoring method also known as a scale-based approach is widely applied to rank and prioritize criteria in multi-criteria analysis (Andesa et al., 2022). In this study, it was implemented through questionnaires addressing quality and sanitation hygiene. A 1–10 scale was employed with the adoption of an even-point format intended to minimize neutral or "grey area" responses. Scores of 1–2 corresponded to compliance levels of 0–20% with the questionnaire criteria, 3–4 reflected compliance of 21–40%, 5–6 represented 41–60%, 7–8 indicated 61–80%, and 9–10 denoted compliance of 81–100% (Pradana & Mawardi, 2021). The questionnaire was administered by researchers through direct observation and interviews with traders. Items assessed in the physical quality domain included aroma and bean cleanliness, specifically the absence of foreign objects, insect contamination, and mold. The hygiene and sanitation domain encompassed evaluations of location, storage infrastructure, hygiene facilities, machinery and related equipment, as well as pest management practices. The reliability of the questionnaire was assessed by calculating Cronbach's α (alpha) to determine its internal consistency (Sharma, 2016).

Parameter Testing

A grain moisture meter (AR-991, China) was used to measure moisture content. The device was inserted into the center of the commodity storage area. A digital food thermometer (TP 101, China) was used for the temperature measurements. Both the temperature and moisture content tests were conducted by inserting the probe into the center of the commodity to a depth of 5-10cm, with a sample volume of 10±0.5kg. The commodities tested were unpeeled and in the form of fresh food.

Data Analysis

Differences in market categorization of moisture content and storage temperature were analyzed using Analysis of Variance (ANOVA) at the 95% significance level and Tukey's Multiple Comparison test if there were significant differences ($P<0.05$). Physical quality and hygiene sanitation were analyzed using the Kruskal-Wallis test at a 95% significance level and continued using Dunn's Multiple Comparison test if there were significant differences ($P<0.05$). The correlation of the categorization of city, region, and neighborhood markets on the level of food safety based on moisture content, storage temperature, physical quality, and hygiene sanitation, and the correlation were further analyzed with the Spearman correlation test using GraphPad Prism 9.5.0 software. The Spearman correlation value is shown in the interval $-1 \leq rho \leq 1$. Based on the Spearman correlation significance criteria, a $P<0.05$ was interpreted as indicating a correlation between the variables.

RESULTS & DISCUSSION

Moisture Content of Peanuts and Gingers in Various Categories of Traditional Markets

Based on the results of the peanut moisture content test (Table 1), the moisture content of peanuts in the city market showed the highest average compared to the regional and neighborhood markets at 10.68±0.43. Different conditions in the regional and neighborhood

markets showed results of 10.61±0.73 and 10.51±0.52. No significant differences were observed (P>0.05). The variation in the moisture content test results in the city markets tends to be more uniform compared with other market categories. This could be because of the more stable storage conditions of peanut commodities in the city market. Regional markets have the highest variation in moisture content when compared to other market categories, indicating that management or storage conditions are less consistent among peanut traders. Standard deviation was used to measure the spread of the data against the average value (Almashhadani et al., 2023). Test results with a larger range or higher standard deviation indicated a greater variation in the data. The high moisture content is due to lower consumer interest, which affects the long-term storage. Long-term storage can cause an increase in the moisture content owing to the breakdown of food substances into water (Prasetyo et al., 2020). In addition, the market location near the highway will be hotter so that there are many surfaces that absorb heat, which can have an impact on high air humidity and result in a high moisture content. This is in accordance with the opinion of Bakhtavar et al. (2019), who stated that relatively high air humidity causes the moisture content to increase owing to the hygroscopic nature of seeds.

Table 1: Moisture Content and temperature of Peanuts and Gingers in Various Categories of Traditional Markets

Market Categorization	Moisture Content (%)		Temperature (ºC)	
	Peanut	Ginger	Peanut	Ginger
City Market	10.68±0.43	85.52±1.01^{a}	29.52±0.73	29.01±0.38
Regional Market	10.61±0.73	83.81±2.14^{ab}	29.59±0.59	29.16±0.47
Neighborhood Market	10.51±0.52	83.29±2.38^{a}	29.19±1.14	29.00±0.58

Data are presented as mean±SD. Different superscript letters in the columns indicate significant differences (P<0.05).

The average moisture content of ginger was highest in the city market, with a value of 85.52±1.01, while the regional market category had a value of 83.81±2.14, and the neighborhood market had a value of 83.29±2.38 (Table 1). Ginger commodities showed significant differences (P<0.05) in the city and neighborhood market categories. This could be because city markets have better facilities and infrastructure, and stricter controls on storage and distribution. City markets are also the main destinations for traders and distributors because of their strategic position and efficiency; therefore, they have more and fresher ginger stock. During storage, food increases in moisture content, especially hygroscopic food. Conditions in some neighborhood markets located near highways cause hotter temperatures and absorb heat, which is one of the causes of moisture content evaporation. These conditions allow water molecules to overcome the attractive forces between the molecules that keep them in the liquid phase, allowing them to easily escape from the surface of the material and become vapor.

The low average moisture content indicates that the storage methods used by traders are better than those used for peanuts with high moisture content. Peanuts should be stored in a dry room with a humidity of around 70% and airtight conditions (Mlik et al., 2023). Low awareness of peanut handling methods has led to an increase in Aspergillus flavus. Moisture content that can suppress aflatoxin contamination growth is below 10% (Karthikeyan et al., 2025). However, the results of the study show that the average moisture content is above 10%. This is still tolerable because the optimal conditions for the growth of Aspergillus flavus and Aspergillus parasiticus in peanuts are water activity of 0.83–0.97 and moisture content >14% (da Silva et al., 2024). According to Zeng et al. (2022), ginger is susceptible to fungal growth during storage when its moisture content exceeds 90%, while excessive drying occurs when the moisture content falls below 65%. Therefore, the optimal moisture content range for ginger is 75–90% (Kaushal et al., 2017). Ginger with excessively high moisture content is highly prone to fungal contamination, which can lead to spoilage, rendering it unfit for consumption, and may even result in the production of harmful toxins. Conversely, ginger with excessively low moisture content experiences quality deterioration, appearing shriveled and shrunken, with loss of its characteristic aroma and flavor, as well as reduced nutritional value.

Table 2: Physical Condition and Hygiene Sanitation of Peanuts and Gingers in Various Categories of Traditional Markets

Market categorization	Physical Condition		Hygiene Sanitation	
	Peanut	Ginger	Peanut	Ginger
City Market	37.08±1.97	47.20±2.21^{a}	201.30±14.01^{a}	196.90±9.44^{a}
Regional Market	36.59±2.72	45.71±1.42^{ab}	194.20±12.80^{ab}	190.50±8.91^{ab}
Neighborhood Market	36.02±3.17	44.67±1.76^{a}	189.50±16.69^{b}	186.50±10.10^{a}

Data are presented as mean±SD. Different superscript letters in the columns indicate significant differences (P<0.05).

Temperature of Peanuts and Gingers in Various Categories of Traditional Markets

Based on the results of the peanut storage temperature test, the average storage temperature in the neighborhood market showed the lowest test results compared to other market categories, namely 29.19±1.14 (Table 1). City and regional markets showed higher average storage temperatures than neighborhood markets, at 29.52±0.73 and 29.59±0.59, respectively. The averages generated from the three market groups show no significant differences (P>0.05). The smallest variation in the data is shown by the test results for the neighborhood market. The lowest average storage temperature was observed in the peanut storage temperature test in the neighborhood market. A lower density in the neighborhood market may create lower temperatures. This is also true for ginger, where the highest average temperature was in the neighborhood market, with a value of 29.16±0.47 (Table 1). The highest average ginger temperature was in the neighborhood market, with a value of 29.16±0.47. City and neighborhood markets showed lower average temperatures of 29.01±0.38 and 29.00±0.58, respectively. The average temperature of ginger produced from the three market categories was not significantly different (P>0.05). This is due to market conditions and the environment. Regional markets generally have a smaller capacity than city markets and a larger capacity than neighborhood markets, but in certain conditions are denser because they serve the surrounding community with a high intensity of activity. This causes an increase in the temperature around the storage area owing to human

activities and transportation. Crowded conditions can increase the ambient temperature owing to the body heat expenditure. In addition, some markets are more open areas that cause direct sunlight exposure, or in areas that lack shade, causing an increase in storage temperature. High temperatures can cause seed hardening and growth of Aspergillus mold, which occurs mostly between 20°C and 40°C, with optimal growth occurring between 25◦C and 30◦C (Jose et al., 2024).

Table 3: Results of Statistical Analysis of Correlation of Various Parameters in Peanuts and Ginger

Parameter 1	Parameter 2	rho	P (two-tailed)	P (value summary)
Peanut				
Moisture content	Temperature	-0.2151	0.0454	*
Moisture content	Physical quality	0.2700	0.0114	*
Moisture content	Hygiene sanitation	0.3119	0.0033	**
Temperature	Physical quality	0.1113	0.3049	not significant
Temperature	Hygiene sanitation	0.0860	0.4281	not significant
Physical quality	Hygiene sanitation	0.8167	<0.0001	****
Ginger				
Moisture content	Temperature	-0.2339	0.0356	*
Moisture content	Physical quality	0.4376	<0.0001	****
Moisture content	Hygiene sanitation	0.6042	<0.0001	****
Temperature	Physical quality	0.1829	0.1022	not significant
Temperature	Hygiene sanitation	-0.04354	0.6995	not significant
Physical quality	Hygiene sanitation	0.5437	<0.0001	****

not significant = P>0.05; * (significant = P<0.05); ** (significant = P<0.01); **** (significant = P<0.0001).

Peanut storage requires proper temperature, humidity, and air circulation to suppress and prevent mold growth and aflatoxin production. Low temperatures can help maintain peanut viability during storage so that the seeds do not suffer significant damage. Research results on peanuts show that the average temperature is below 30°C. These high temperatures may be due to the high ambient temperature in the research area. The temperature range during that period was 22°C to 36.6°C (BMKG, 2024). Aflatoxin production is most optimal at temperatures of 25–30°C, and when the temperature rises to 37°C, the toxin production capacity of all strains decreases significantly (Su et al., 2025). Proper storage of ginger can inhibit mold growth and maintain the quality of fresh ginger. Temperature and water activity play an important role in preventing mold growth and aflatoxin growth. Aspergillus flavus growth in ginger is optimal at a water activity of 0.98-0.995 and a temperature of 30-35°C (Okereke, 2020). Aspergillus sp. and Penicillium sp. are fungi that appear during storage and are referred to as contaminant fungi; they produce mycotoxins and are transmitted through the air and seeds, so temperature and humidity affect their growth (Putri et al., 2023).

Physical Conditions of Peanuts and Gingers in Various Categories of Traditional Markets

Based on the scoring results of the physical quality of peanuts in various categories of traditional markets in Semarang City, the average physical quality of peanuts in the neighborhood market was the lowest compared to other market categories at 36.02±3.17 (Table 2). The highest-scoring result for the physical quality of peanuts was observed in the city market category, with a score of 37.08±1.97, while the neighborhood market scored 36.59±2.72. The physical conditions of the three market categories showed no significant differences (P>0.05). The low physical quality in the market neighborhood is due to traders paying less attention to peanut storage and low consumer interest. Thus, many peanuts are not sold within a short time span, resulting in a decrease in physical quality owing to water absorption from the environment. High humidity supports mold growth in the field and during storage (Khan et al., 2021). This causes peanuts to spoil easily and does not last long. Humid storage conditions are highly susceptible to hydrolysis because of the interaction between water and fat in peanuts. Hydrolysis is a chemical reaction involving decomposition of molecules in the presence of water molecules (Hachem et al., 2022). Too high a temperature can accelerate the oxidation reaction. Foodstuffs containing fat or oil are very susceptible to oxidation if the storage technique is inappropriate, which can result in a decrease in the taste and nutritional quality of the commodity. Oxidation reactions in food can cause a decrease in aroma, taste, color, and texture (Varedesara et al., 2021).

Based on the scoring results of the physical quality in Table 2, the average of ginger commodities in the city market was higher with a value of 47.20±2.21, while the regional market category had a value of 45.71±1.42, and the neighborhood market had a lower value of 44.67±1.76. The low quality of ginger in various market categories is often due to the presence of dirt and foreign objects on its surface. Dirts such as soil and dust can reduce visual appeal and consumer interest, are considered unhygienic, and trigger microbial growth in the soil. The presence of chemical, biological, or physical contamination, such as products exposed to dirt, dust, insects, and wet, humid environments, can lead to mold growth that endangers consumers (Azad et al., 2019). The presence of mold contamination in ginger is also a loss of quality caused by damp storage and a lack of hygiene. Mold contamination not only damages the appearance of ginger with the appearance of gray, green, or white spots but can also affect the taste and texture of ginger to become rotten. Molds can produce mycotoxins that are harmful to human health and reduce the quality of contaminated foodstuffs, causing losses to business actors (Adeyeye, 2020).

Hygiene Sanitation of Peanuts and Gingers in Various Categories of Traditional Markets

Based on the hygiene and sanitation scores in Table 2, the highest average for peanuts commodities was observed in the city market at 201.3±14.01, whereas the neighborhood market showed the lowest score at 189.5±16.69. Based on ginger commodities, the average hygiene and sanitation score in the city market was higher at 196.9±9.44, while the regional market category had a score of 190.5±891 and the neighborhood market had a lower score of 186.5±10.10. The sanitary hygiene of the three categories showed a significant difference (P<0.05) between the city and neighborhood markets. The most visible difference between city and neighborhood markets is the condition of the building. The condition of the neighborhood market is that the majority of the buildings

are parallel to the outside area of the market and are located on open land; therefore, it is highly vulnerable to inundation. Market conditions with open land during the rainy season are muddy, and there are puddles owing to the absence of additional absorption systems (Parsadanta and Novalinda, 2023). City market buildings usually consist of more than one floor, and the position of the market is not parallel to the road and is tiled.

Factors affecting the level of hygiene and sanitation in traditional markets include location, storage building facilities, traders, supporting facilities, and pest control. Most traditional markets tend to be prone to stagnant water and are further exacerbated if the building is not multistory and has poor drainage. The location of a building should be free from standing water to prevent pollution from becoming a source of disease. In addition, clean water facilities and toilet conditions are still hygiene and sanitation problems in the traditional markets of Semarang City. According to Herwianti and Wijayanti (2023), the condition of water indicators in environmental sanitation facilities in traditional markets in Semarang City is still 60%, and 53% of bathrooms and toilets do not meet health requirements. Market buildings should have sufficient lighting, good ventilation, handwashing facilities, appropriate temperature and humidity, adequate water according to requirements, adequate toilets, and storage areas that are easy to clean and free of pests (Basri and Yelofeva, 2022). Inappropriate support facilities can decrease product quality and safety. Pest control in traditional markets in Semarang City has not yet been optimally implemented. This can be attributed to the fact that there is no effort or means to prevent the spread of rodents, insects, or birds in traditional markets. Rats, cockroaches, and insects are used in several traditional markets.

Sanitation problems in traditional markets include the insufficient availability of clean water for hygiene and sanitation purposes, improper waste management, and inadequate sanitation facilities. Markets that pay little attention to hygiene and sanitation have the potential to become ideal places for the growth of harmful microorganisms, contamination of foodstuffs, and the spread of disease, either directly or indirectly, between sellers, buyers, and market visitors (Fikri and Prameswari 2024). Another factor that influences hygiene behavior is inadequate facilities; even though traders have sufficient knowledge, if the facilities are insufficient, hygiene behavior can be said to have not met standards (Avrilianda, 2016).

Correlation of Various Parameters in Peanuts and Gingers

Statistical analysis showed in Table 3 that the moisture content of peanut and ginger commodities was related ($P<0.05$) to temperature, physical quality, and hygiene and sanitation. Moisture content in traditional markets in Semarang City is influenced by several factors such as temperature, humidity, storage, and trader behavior. The temperature of peanuts in traditional markets ranged from 26.2ºC to 31.5ºC. This affects the increase in peanut moisture content due to more active respiration (Andriani and Karmila, 2019). Moisture content and hygiene sanitation of peanuts are related to the storage techniques used by traders. Hygiene and sanitation are factors that affect moisture content. One aspect that affects the level of hygiene and sanitation is the trader. The low awareness of traders in traditional markets regarding how to maintain quality and food safety, including storage strategies, can cause commodities to be more easily damaged. The proper peanut storage technique is in a closed container with a temperature below 18°C, humidity of no more than 65%, and avoidance of cross contamination. Additionally, we avoided mixing old or poor-quality peanuts with new ones. Sorting peanuts can suppress mold growth and increase the moisture content (Meneely et al., 2023).

The correlation between moisture content and temperature was negative, indicating an inverse relationship with a low correlation. The high moisture content of ginger is due to the absence of evaporation from the surface of fresh ginger. The decreasing moisture content indicates that water inside the ginger surface is released due to respiration. Moisture content has an inversely proportional relationship with temperature. Lower temperatures cause the moisture content in foodstuffs to increase because the process of water desorption slows down. Improper storage of ginger can cause an increase in moisture content and trigger mold growth. This is because rhizomes have hygroscopic properties, meaning they can absorb or release water until their moisture content reaches a balance in air humidity. Moisture content is a reference for the freshness or stability index of ginger. A high moisture content provides an opportunity for the growth of microorganisms, such as molds, during the storage process (Chiewchan et al., 2015). Poor hygiene and sanitation conditions, such as dirty tools and environments, can cause ginger to have a higher moisture content owing to pathogenic microbial contamination and inappropriate humidity; thus, ginger is more vulnerable and can accelerate the deterioration of quality.

Temperature was not associated ($P>0.05$) with physical quality or sanitary hygiene. This indicates that high and low temperatures have no impact on physical quality and hygiene sanitation (Table 3). The factors affecting the temperature of peanuts and ginger are storage conditions, operational costs, and low awareness of business actors. The use of airtight containers such as glass jars can maintain a stable temperature, which retains heat better than plastic. Storage in places exposed to direct sunlight or in rooms with minimal air circulation results in high temperature. In addition, the cost factor may be the reason traders neglect the storage of the commodities sold. Physical quality was significantly related ($P<0.05$) to hygiene sanitation (Table 3). Poor hygiene can lead to the cross-contamination of commodities. In addition, poor sanitation is associated with damp and unclean storage areas, which increase the risk of mold growth and breeding grounds for insects and pests. The molds grew well under warm and humid ambient temperatures. Low levels of sanitary hygiene affect the physical quality of a product and pose risks to human health and safety (Shur and Zaitseva, 2018).

Conclusion

Based on the results, it can be concluded that: (1) A significant difference in peanut commodity market

categorization was observed only in the hygiene sanitation parameter; (2) Ginger commodities showed notable differences in moisture content, physical condition, and hygiene sanitation; (3) Remarkable correlation was found between moisture content and temperature, physical condition, as well as hygiene sanitation in both peanut and ginger commodities.

Limitations

The study had several limitations due to a number of factors. Sampling was non-probabilistic because it was based on the availability of commodities in the field. However, the number of samples and coverage of traditional market points in the study were large enough to represent conditions in the field. This has covered up to 70% of the total. In addition, the number of samples used was so large that it could not be done on the same day, resulting in variations between days. However, the procedures performed were consistent over time. Aflatoxin testing on commodities that show results different from the provisions can be used as a follow-up step to strengthen the research results and enrich information regarding food safety aspects.

DECLARATIONS

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