



An Analysis of Odors in Traditional Market in Wonju, Gangwon-do

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Abstract

Purpose: As interest in odor increases, odor complaints are also rapidly increasing. Traditional markets are not included in malodor control areas and are not easy to manage, so measure the odor substances generated in traditional markets and analyze the cause of high concentration points. **Research design, data and methodology:** The average value was presented by continuously measuring the combined odor, TVOC, hydrogen sulfide, and ammonia for 5 minutes at 100m intervals in Joong-ang traditional market, Jayu traditional market, Doraemi traditional market, and Sundae Alley in Wonju, Gangwon-do. In each market, up to the third highest concentration point for each measurement item was marked and analyzed. **Results:** The Joong-ang traditional market, Doraemi traditional market, and Sundae Alley had high readings at the intersection. The Jayu traditional market had high measurements around restaurants and clothing stores. In addition, the concentration of complex malodors was also high at the points where the hydrogen sulfide concentration was measured. **Conclusions:** Odor generated in traditional markets is an important indicator for merchants and consumers. Therefore, in future studies, analysis that can supplement the limitations of measurement data and seasonal effects is needed.

Keywords : Traditional markets, odors, Complex malodors, TVOC, Hydrogen sulfide, Ammonia

JEL Classification Codes : I15

1. Introduction

There are a total of 1,402 traditional markets (including permanent markets and regular markets), and the items

handled vary widely from agricultural products, livestock products, processed foods, clothing to restaurant and other retail industries (SEMAS, 2022).

The traditional market was the cause of decline due to

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the emergence of various distributors, operational and management problems, customer outflows to department stores and large discount stores, and physical aging. In order to solve this problem, the government began to support traditional market modernization projects, and separate arcades, convenience facilities, and public relations facilities (Lee et al., 2015).

These traditional market modernization projects are mainly focused on arcade installation projects and parking lot creation projects, and they are found to have a positive effect on the revitalization of traditional markets (Kim & Chung, 2013).

Odor complaints are rapidly increasing to 7,247 in 2010, 14,816 in 2014, and 32,452 in 2018 (MOE, 2022), and odor management areas announced by the Odor Prevention Act are industrial complexes and industrial complexes, and traditional markets are not included in odor management areas. The odor generated in traditional markets is managed as a living odor, but it is not easy to manage the odor of traditional markets generated at low concentrations in a large area.

Therefore, this study intends to investigate odorous substances generated in traditional markets and analyze points generated at high concentrations. In the future, this study is expected to be the basic data for reducing the odor of traditional markets.

2. Literature Review

In the study of Kim et al. (2009), merchants and consumers' satisfaction in the traditional market after facility modernization was analyzed. Among the reasons for dissatisfaction with traditional markets, the third place

was filthy sanitary facilities, odors, and noise. In addition, 32.7% of merchants thought it was an opportunity to bring consumers back to the traditional market after the modernization of facilities (removing uncleaning, odor noise, etc.). 41.3% of consumers said they were satisfied with the removal of odors and noise after facility modernization.

In a study by Lee et al. (2015), 32.7% of customers answered that hygiene management should be paid attention to revitalizing the traditional market.

In a study by Lim & Lee (2021), 72% of merchants said that the hygiene of the market affected business satisfaction, and there were many opinions that the odor needs to be improved. It is said that the better the hygiene of the market, the higher the business satisfaction of merchants, which affects the expected sales.

In a study by Son and Ryu (2021), it was said that the overall satisfaction of consumers increased as the level of cleanliness increased with facility modernization.

As above, as a result of the survey of previous studies, the

odor that occurs in traditional markets is one of the important problems of traditional markets recognized by merchants and consumers, and there was a sense that it should be solved. Therefore, this study aims to find out how much odorous substances are generated in traditional markets.

3. Research Methods and Materials

3.1. Location and Duration

In July 2022, odorous substances were measured for Joong-ang Traditional Market, Jayu Traditional Market, Doraemi Traditional Market, and Sundae Alley in Wonju, Gangwon-do. The measurement points of the central market, the free market, the arrival rice market, and the sundae alley are shown in Figure 1, Figure 2, Figure 3, and Figure 4.



Figure 1: Joong-ang Traditional Market Measurement Point



Figure 2: Jayu Traditional Market Measurement Point



Figure 3: Doraemi Traditional Market Measurement Point

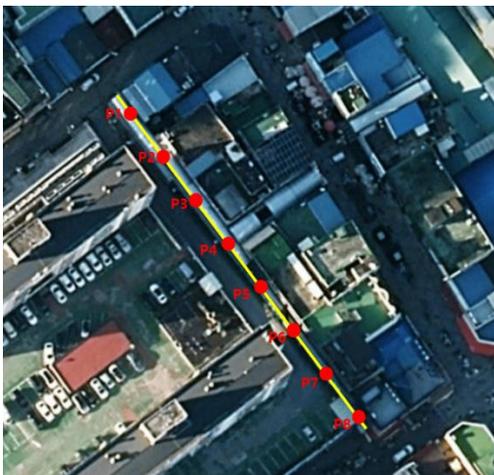


Figure 4: Sundae Alley Measurement Point

Measurement points were set at intervals of about 100 m. In the central market, one area is currently under construction due to a fire, so it was measured excluding the area.

3.2. Measuring Equipment



Figure 5: Odor Measurement Equipment AOMS-1000

Table 1: Measuring Equipment Specifications

Model	AOMS-1000
Fluid	Air
Sampling method	Forced suction method
Sensor array module	Basic 4 types, up to 8 types
Field data display	Built-in LCD
Screen size	8" touch-operated (Tablet PC)
Display contents	Quantitative measurement value for each substance, dilution factor, complex malodors
Appropriate operating temperature	-20°C ~ 65°C

The specifications of the direct-reading odor measuring device are as shown in Table 1, and complex malodors, TVOC, hydrogen sulfide, and ammonia were continuously measured for 5 minutes, and the results were averaged and presented.

4. Results

4.1. Measurement Result

The odor measurement results of the Joong-ang Traditional market, the Jayu Traditional market, the Doraemi Traditional market, and the sundae alley are shown in Table 2, Table 3, Table 4, and Table 5. For each measurement item, in the order of highest concentration, it is indicated in bold to the third point.

Table 2: Joong-ang Traditional Market Measurement Results

Measurement Points	Compound odor(times)	TVOC(ppb)	H ₂ S(ppb)	NH ₃ (ppb)
P1	11.99	8.01	27.75	1.55
P2	11.05	12.24	24.49	0.00
P3	9.40	66.61	19.11	0.00
P4	10.07	28.17	21.28	0.00
P5	8.92	18.05	17.65	0.00
P6	8.08	0.65	15.21	0.00
P7	8.52	22.37	16.48	0.00
P8	8.18	18.75	15.47	0.00

P9	8.08	33.00	15.21	0.00
P10	8.09	11.16	15.21	0.00
P11	7.55	18.54	13.71	0.00
P12	7.37	58.88	13.20	0.00
P13	7.12	8.79	12.60	0.14
P14	7.12	23.10	12.53	0.00
P15	8.53	42.88	16.51	0.00
P16	16.22	106.61	33.08	0.00
P17	14.60	105.15	31.85	0.00
P18	18.32	71.37	38.90	0.00
P19	15.27	65.68	32.79	0.00
P20	19.17	51.65	39.44	0.00
P21	6.23	23.06	10.27	0.00
P22	12.15	31.74	28.29	0.00
P23	11.71	146.98	26.77	0.00
P24	9.50	121.79	19.46	0.00
P25	12.31	366.97	28.85	0.00
P26	8.06	29.41	15.62	0.00
P27	5.45	0.34	8.37	0.00
P28	8.63	35.40	17.05	0.00
P29	6.67	49.37	11.38	0.00
P30	10.59	182.32	22.91	0.00
P31	12.06	87.23	27.99	0.00
P32	12.40	117.47	29.18	0.00
P33	6.88	13.09	12.47	0.00
P34	5.10	197.22	7.67	0.00
P35	8.82	513.44	17.32	0.00
P36	11.73	159.97	26.88	0.00
P37	12.26	166.64	28.67	0.00
P38	11.71	34.32	26.78	0.03
P39	5.28	38.43	8.02	0.00
P40	6.63	140.74	11.24	0.00
P41	5.52	49.79	8.55	0.00
P42	7.64	233.31	14.22	0.00
P43	9.53	262.00	19.55	0.00
P44	12.20	108.89	28.45	0.00
P45	6.85	14.07	12.03	0.00

In the Joong-ang traditional market, complex malodors and hydrogen sulfide were high in the order of P20, P18, and P16. TVOC was high in the order of P35, P25, and P43. Ammonia was high in the order of P1, P13, and P38, and was not measured at the remaining points.

P16, P18, and P20, which have high complex malodors

and hydrogen sulfide, are central passages, and unlike other passages in the form of buildings, arcades are installed, and are the widest passages. In addition, it is a place where a wide passage in four directions meets, and the intersection in the middle of the central passage is not easily ventilated, so the atmosphere is likely to stagnate.

Table 3: Jayu Traditional Market Measurement Results

Measurement Points	Compound odor(times)	TVOC(ppb)	H ₂ S(ppb)	NH ₃ (ppb)
P1	11.25	122.29	25.16	0.56
P2	10.16	129.23	21.51	0.00
P3	12.41	181.38	29.17	0.00
P4	12.28	340.60	28.75	0.00
P5	12.26	392.47	28.67	0.00

P6	12.42	284.00	29.25	0.08
P7	11.87	574.34	27.25	0.47
P8	12.74	1144.55	30.42	0.00
P9	12.63	1058.96	29.92	0.00
P10	12.08	632.10	28.00	0.00
P11	12.38	437.80	29.08	0.00
P12	12.45	368.15	29.33	0.90
P13	12.07	394.45	28.00	0.00
P14	12.38	354.86	29.08	0.00
P15	12.20	345.65	28.43	0.00
P16	12.16	304.11	28.31	0.00
P17	12.45	257.91	29.33	0.00
P18	12.38	425.09	29.09	0.00
P19	12.47	518.54	29.42	0.00
P20	15.48	1446.59	28.92	0.00
P21	12.07	575.74	28.00	0.00
P22	12.35	363.63	29.00	0.00
P23	12.45	797.52	29.33	0.00
P24	12.04	691.48	27.92	0.00
P25	11.97	579.11	27.67	0.51

In the Jayu traditional market, the complex malodors and TVOC were high in the order of P20, P8, and P9. Hydrogen sulfide was high in the order of P8, P9, and P19. Ammonia was high in the order of P12, P1, and P25, and was measured at 0.08ppb and 0.47ppb at P6 and P7, respectively. Ammonia was not measured at the remaining points.

Jayu Traditional Market is an underground market, and recently, construction to improve ventilation facilities and

ducts was carried out. The P20, which has a high complex malodor and TVOC, appears to have been high because the odor generated by the restaurant cannot escape toward the entrance and is stagnant through a wide passage near the place where the restaurant is gathered. P8 and P9, which have high levels of hydrogen sulfide, are concentrated in clothing stores, and it is estimated that they smell from new clothes.

Table 4: Doraemi Traditional Market Measurement Results

Measurement Points	Compound odor(times)	TVOC(ppb)	H ₂ S(ppb)	NH ₃ (ppb)
P1	10.66	0.08	23.24	0.09
P2	11.68	55.77	26.72	0.05
P3	10.03	39.14	21.14	0.25
P4	10.06	69.68	21.24	0.03
P5	12.14	74.42	28.28	0.00
P6	12.15	103.19	28.25	0.43
P7	11.93	59.16	27.60	0.00
P8	8.12	0.86	15.32	0.00
P9	8.53	73.38	16.52	0.39

In the Doraemi market, the complex odor was high in the order of P6, P5, and P7. TVOC was high in the order of P6, P5, and P9. Hydrogen sulfide was high in the order of P5,

P6, and P7. Ammonia was high in the order of P6, P9, and P3. Doromi Market is a place where arcade roofs are installed, and in the case of P6 points, atmospheric

congestion can occur as an intersection point.

Table 5: Sundae Alley Measurement Results

Measurement Points	Compound odor(times)	TVOC(ppb)	H ₂ S(ppb)	NH ₃ (ppb)
P1	12.71	240.27	30.25	0.23
P2	11.96	169.74	27.60	3.55
P3	12.64	23.07	30.00	3.79
P4	12.14	49.27	28.25	4.69
P5	12.35	114.66	29.00	1.92
P6	12.94	12.00	31.08	1.73
P7	11.57	17.80	26.32	0.06
P8	12.24	40.82	28.64	0.34

In Sundae Alley, the complex odor was high in the order of P6, P1, and P3. TOVC was high in the order of P1, P2, and P5. Hydrogen sulfide was high in the order of P6, P1, and P3. The ammonia was high in the order of P4, P3, and P2, and ammonia was measured at all measurement points.

Sundae Alley is a place where arcade roofs are installed, and is an alley where stores that deal with pork and its by-

products are concentrated. P3, P4, and P5 are points at which atmospheric congestion may occur as intersection points. In particular, ammonia levels were measured very high in P4, which seems to be hovering at the intersection point without escaping the smell of by-products from pork stores.

5. Discussion and Conclusions

This study attempted to investigate odorous substances generated in traditional markets and analyze the location of high concentrations. The odor measurement was conducted with a direct reading odor measurement device in July 2022 for Joong-ang Traditional Market, Jayu Traditional Market, Doraemi Traditional Market, and Sundae Alley in Wonju-si, Gangwon-do, and the results of this study are summarized as follows.

Except for the Jayu traditional market in the basement, Joong-ang traditional market, , Doraemi traditional market, and Sundae Alley were generally measured to have a high concentration of odor substances at the intersection point. This was similar to the studies conducted by Lee et al. (2021). The paper investigated floating microorganisms in the arcade-type traditional market, and explained that the concentration of floating microorganisms was higher at the intersection than at the entrance due to atmospheric congestion. Similarly, the measurements were high in the central passageway of the Joong-ang traditional market (P16, P18, P20), the Doraemi traditional market (P5 and P6), and the Sundae Alley (P3).

In addition, the point where hydrogen sulfide was high also had a high tendency to have a high complex malodors indicating that hydrogen sulfide had a large effect on the complex malodors concentration.

As emphasized by several previous studies on ways to revitalize traditional markets, it can be seen that the problem of cleanliness in the market (odor, noise, etc.) is becoming a very important indicator for merchants and consumers.

This study is meaningful in that it presented measurement data on odor substances generated in traditional markets and analyzed the cause of the highest point.

However, there is a limitation in that the measurement point is small compared to the market size, and the data is also insufficient and the reliability of the data is low because it is not continuous measurement data. In future studies, it is necessary to further analyze the correlation between the measurement results and the internal environment of the market (structure, area, year of establishment, passage length, ventilation method, sales type, measurement point and exit distance, etc.) and the external environment (temperature, humidity, wind direction, etc.).

It is thought that this study can be the basic data when research on the odor problem of traditional markets is actively conducted.

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