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Original Research Article

Absorption Efficiency of Oxygen Scavenger and Shelf-life Prolongation of Bakery Product

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ABSTRACT

The oxygen scavenger is a type of active packaging technique. Oxygen is one of the major causes of food deterioration such as the growth of Aerobic bacteria (molds and yeasts). Consequently, Oxygen is absorbed by the oxygen scavenger and remove oxygen inside the packaging and extend the shelf-life of food products, but oxygen scavenger will immediately react with oxygen when it contacts, so a good system to maintain the efficiency of oxygen scavenger before application is vital. The efficiency of absorption may be questioned on affect the shelf-life of products. The efficiency of absorption of the oxygen scavenger and shelf-life of bakery products after being stored with the oxygen scavenger was studied. The oxygen scavenger (50 mL) was tested on the efficiency and the prolongation of shelf-life. In the efficiency test, one oxygen scavenger sachet was added in a pouch and tightly sealed and stored at 25 °C. The level of oxygen in the nylon pouch was recorded at 0 and 72 hrs and calculated the efficiency of absorption. In the shelf-life test, each oxygen scavenger sachet of 100% (O-100), 80% (O-80) and 60% (O-60) efficiency was kept in a cake package at 25°C to measure the shelf-life compared with a control package (Control) without oxygen scavenger. Then, complete randomized design statistics and ANOVA were used to analyze the differences. Three replications of samples were analyzed for oxygen content, microbiological, total color difference (TCD), moisture content, and sensory. The result presented that the oxygen scavenger at 100% efficiency (O-100) had a longer shelf-life of cake. Shelf-life of Control sample is about 0.2 day storage, but cake of O-100 sample had about 4.3 days storage. Cake of samples had microbiological (total plate count), that were over the specification of standard. Although total color difference (TCD), moisture content and sensory scale of cake in all samples were not significant after 3 days storage.

INTRODUCTION

The oxygen scavenger is a type of active packaging technique. Oxygen is one of the major causes of food deterioration such as the growth of Aerobic bacteria (molds and yeasts). Consequently, Oxygen is absorbed by the oxygen scavenger to remove oxygen inside the packaging and extend the shelf-life of food products.

The preservation of packaged food against degradation is essential to establish and improve food shelf life, customer acceptability, and increase food security. Oxygen absorbers have an important role in the

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removal of dissolved oxygen, preserving the color, texture and aroma of different food products, and importantly inhibition of food spoilage microbes. Active packaging technology in food preservation has improved over decades mostly due to the sealing of foods in oxygen impermeable package material and the quality of oxygen scavenger. Ferrous iron oxides are the most reliable and commonly used oxygen scavengers within the food industry. Oxygen scavengers have been transformed from sachets of dried iron-powder to simple self-adhesive patches to accommodate any custom size, capacity and application. Oxygen concentration can be effectively lowered to 100 ppm, with applications spanning a wide range of food products and beverages across the world (i.e. bread, meat, fish, fruit, and cheese). Newer molecules that preserve packaged food materials from all forms of degradation are being developed, however oxygen scavengers remain a staple product for the preservation of food and pharmaceutical products to reduce food wastage in developed nations and increased food security in the developing & third world. (Cichello, 2015)

Oxygen scavenger will immediately react with oxygen when it contacts, so a good system to maintain the efficiency of oxygen scavenger before use is vital. Absorption efficiency may be questioned to affect the shelf-life of products.

Otero-Pazos, *et al.,* (2018) presented study, an experimental set-up was designed to evaluate the effectiveness of oxygen scavengers, in removing oxygen from butter containers. Two types of oxygen absorbers adhesive labels and sachets and two caps with and without adjustable closure were tested. The plastic caps used in the study were characterized by differential scanning calorimetry and Fourier transform infrared spectroscopy. The oxygen concentration in the headspace of the containers was monitored using a gas analyser. The best results were achieved with the oxygen absorber sachets and using caps with adjustable closure. Under these conditions, the oxygen concentration inside the container remained below 3% during 150 h.

Sangerlaub and Muller (2017) reported, the influence of temperature on oxygen permeation of PET bottles with the oxygen scavenger additives MXD6 or Oxyclear®. PET bottles made of blends of PET with 2, 5 and 8 wt.−% MXD6, respectively, or with 2 wt.−% Oxyclear® were filled with deoxygenated water. The bottles were stored at 5, 23, 38 and 55 °C up to 5 years. Oxygen partial pressure of the water in the bottles was measured regularly. As expected, oxygen partial pressure increased earlier at higher temperature because of faster exhaustion of the oxygen scavenger. Oxygen partial pressure of water in PET bottles with 8 wt.−% MXD6 was below 10 mbar even after 5 years storage time at 5 and 23 °C. Oxygen absorption capacity of activated MXD6 was at least 76 mg/g. This study shows that PET bottles with oxygen scavengers are able to reduce the oxygen ingress for several years, even at elevated temperatures.

For this study, the absorption efficiency of the oxygen scavenger and shelf-life of bakery products after being kept with the oxygen scavenger was studied.

MATERIALS AND METHODS

Materials

Cake made from wheat flour, sugar, fat, milk, egg, vanilla butter flavor, and baking powder in 50%, 20%, 10%, 10%, 5%, 3%, 2% respectively. The oxygen scavenger brought from dud-d.com that is commercial store to put in pouch. Nylon15/LLDPE85 pouch brought from Fresh Bag Company Limited. It's had property in oxygen transmission rate (OTR) and water vapor transmission rate (WVTR) are 2.92 mL/m^2.d and 24.53 g/m^2.d that according to ASTM D3985-05 (ASTM, 2010) and ISO 1510-1 (ISO, 2003) respectively. The level of oxygen were detected by Head space analyzer (Quantek Instruments Model 902D). Efficiency of oxygen scavenger study.

Efficiency of oxygen scavenger study

In the efficiency test, the oxygen scavenger (50 mL) were formed three different efficiency of oxygen absorber which are 100% (code O-100), 80% (code O-80) and 60% (code O-60). One oxygen scavenger sachet was kept in a Nylon15/LLDPE85 pouch (15x15 cm) and tightly closed and stored at 25 °C. The level of oxygen in nylon pouch were detected by head space detector machine at 0 and 72 hrs and calculated the efficiency of absorption.

Set up experiment shelf life of cake

In the shelf-life test, each oxygen scavenger sachet of 100%, 80% and 60% efficiency were kept in a cake package (100g cake in 12x15 cm Nylon15/LLDPE85 pouch) at 25°C to measure the shelf-life compared with a control package that without oxygen scavenger. Then, complete randomized design statistics and ANOVA were used to analyze the differences. Three replications of samples were detected in oxygen content, moisture content, microbiological, total color difference (TCD) and sensory.

Determination of microbiological

The microbiological of cake were indicate by Thai community product standard 459/2555 (TCPS, 2012) Kind of microbiology have followed by

- Total Plate count (cfu/g): BAM Online, 2001(Chapter 3) (BAM, 2001)
- Yeast & mold (cfu/g): AOAC, 2019 (Method 997.02.) (AOAC, 2019)
- *Salmonella spp.:* ISO 6579-1:2017/Amd.1:2020 (ISO, 2022)
- *Staphylococcus aureus* (cfu/g): AOAC, 2019 (Method 2003.07) (AOAC, 2019)
- *Bacillus cereus* (cfu/g): ISO 7932: 2004 (ISO, 2004a)
- *Clostridium perfringens* (cfu/g): ISO 7937: 2004 (ISO, 2004b)
- *Escherichia coli* (MPN/g): BAM Online, 2017/ Updated 2020. (Chapter 4) (BAM, 2020)

Determination of total color difference

Cakes were measured L* a* b* values and calculated the total color difference (TCD) or ΔE with formula (1)

$$\Delta E = [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]\ ½ \quad (1)$$

Determination of moisture content

Moisture content of cake according to AOAC (1998). Cake 5 g, weighed to the nearest 0.001g, were placed in a moisture can and heated in an oven at 105±2°C for least 16 hrs to constant weight.

Sensory evaluation

Cake, sampling from the actual condition, were presented ten trained panelists to measure intensity appearance, color, odor, taste,

texture and overall scale. The panelists practiced rating the intensity using satisfaction scale 1-9 (1= dislike extremely to 9= like extremely)

Statistical analysis

The experiments were conducted in three replications of each treatment. Statistical analysis was performed using Student's a one-way ANOVA test followed by Duncan test comparison of multiple means. Statistical analysis was performed using the SPSS for Windows version 15.

RESULTS AND DISCUSSION

Efficiency of oxygen scavenger study

The level of oxygen of 50 mL oxygen scavenger in 15x15 pouch (Table 1.) showed 20.90 % at start (0 hr.) and decreased to 0.33 % after 72 hrs. The efficiency of absorbers were decreased to 1.57 in 72 hrs. The efficiency of oxygen absorber (%) showed 99.52% 80.62 % and 62.71% at start (0 hr) 1 hr and 3 hrs respectively. So, 99.52% 80.62% and 62.71% efficiency of oxygen scavenger were studied in shelf life cake experiment.

Table 1. Oxygen (%) and Oxygen scavenger efficiency (%) in pouch.

Time (hrs)	Oxygen (%)	Oxygen scavenger efficiency (%)
0	20.90±0.10 ^{a}	99.52±0.48^{a}
1	16.93±0.55^{b}	80.62±2.62^{b}
3	13.17±0.42^{c}	62.71±1.98^{c}
5	8.87±0.21^{d}	42.24±0.99^{d}
7	7.00±0.26^{d}	33.33±1.26^{e}
24	2.73±0.11^{e}	13.00±0.53^{f}
31	0.83 ±0.06^{e}	3.95±0.00^{g}
48	0.40±0.10 ^{e}	1.90±0.27^{g}
52	0.40±0.10 ^{e}	1.90±0.48^{g}
55	0.37±0.12 ^{e}	1.76±0.55^{g}
72	0.33±0.06 ^{e}	1.57±0.27^{g}

a-g Means with different letter within the same column were significant difference ($p \leqslant 0.05$)

Shelf life evaluation

Control sample presented black and green spot of mold (Figure 1.) after 6 days storage but O-60 O-80 and O-100 didn't have mold. After 9 days storage time, pouch of Control sample swelled due to its have higher of carbon dioxide and oxygen (Figure 2-3) than O-60 O-80 and O-100. So, pouch of O-60 O-80 and O-100 were good appearance at 0 and after 3, 6 and 9 days storage. (Table 2.)

The level oxygen in headspace (Figure 2.) of Control sample (without oxygen scavenger) after 3 days storage showed highest level and decreasing trend while O-60, O-80 and O-100 high decreased from 20.55% to 2.75%, 1.25% and 0.5% respectively. This result presented highest capacity of O-100 on absorbing oxygen when compared with O-80 and O-60. O-80 and O-100 decreased to 0.25% after 6 days and 9 days storage but O-60 showed 5.30% after 9 days storage. The level of oxygen increased again for O-60 when kept in long time because it had low absorbing oxygen capacity.

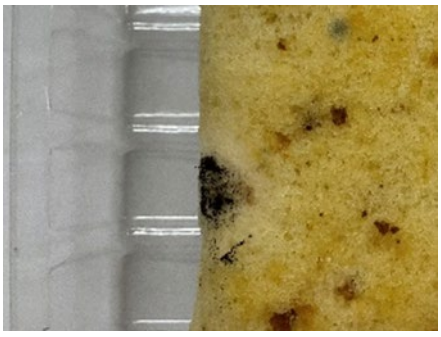

Figure 1. Mold on cake in control sample after 6 days storage.

The carbon dioxide content (Figure 3.) in headspace of every samples showed increasing trend. Carbon dioxide content of Control sample were highest (30 %) after 9 days storage while O-60, O-80 and O-100 were 4.35% 0.5% and 0.15% respectively. The level of carbon dioxide may made produced from microbial growth that microbial growth highest in Control and high in O-60 after 9 days storage.

For microbial result presented in Table 3, after 3 days storage, Control, O-80 and O-60 sample had total plate count $2.17x10^{7}$, $3.02x10^{6}$ and $4,97x10^{6}$ cfu/g respectively. While O-100 sample was $3.40x10^{5}$ cfu/g of total plate count after 3 days storage that only sample according to specification of Thai community product standard 459/2555 (TCPS, 2012) that were $<1x10^{6}$ cfu/g. when prediction storage time that had $1x10^{6}$ cfu/g total plate count (figure 4.) of Control O-80, O-60 and O-100 had 0.2, 1.7,1.8 and 4.3 days. Moreover O-100 had lower level of yeast & mold than O-80 and O-60 and O-100 was only sample that had the result according to <100 specification of standard (TCPS, 2012). Yeast & mold of O-100 after storage at 0, 3, 6 and 9 days were 1x10 cfu/g, 4.0x10 cfu/g, 4.6x10 cfu/g and 8.33x10 cfu/g respectively. While yeast & mold of Control sample showed over specification for 6 days after storage, they had 1x10 cfu/g, 5.33x10 cfu/g, $8.93x10^{4}$ cfu/g and $1.57x10^{5}$ cfu/g after 0, 3, 6 and 9 days storage. The level of Salmonella in every sample according to specification of standard (TCPS, 2012) were ND. *Staphylococcus aureus* of every sample had <10 cfu/g that over specification of standard since after 3 days storage but O-100 and O-80 had less level of *Staphylococcus aureus* than O-60 when they were compared with the Control sample. The level of *Bacillus cereus* of the Control and O-80 presented <100 cfu/g on every day storage that on specification of standard (TCPS, 2012). *Clostridium perfringens* and *Escherichia coli* of every sample had <100 cfu/g and <3 MPN/g respectively that were on specification of standard (TCPS, 2012). Conclusion of application of oxygen absorber could reduce yeast & mold and *Staphylococcus aureus* according to reported of Cruz *et al.*2006, oxygen scarvengers reduced microorganism growth by 1–1.5 log (i.e. molds and yeasts and *Staphylococcus spp*.) (Cruz et al.2006).

Table 2. Appearance of cake during storage

Appearance	Storage duration (days)			
	0	3	6	9
Control				
O-100				
O-80				
O-60				

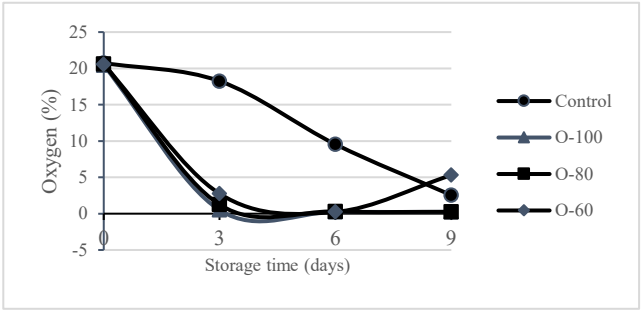

Figure 2. Oxygen content in headspace of cake pouch after storage.

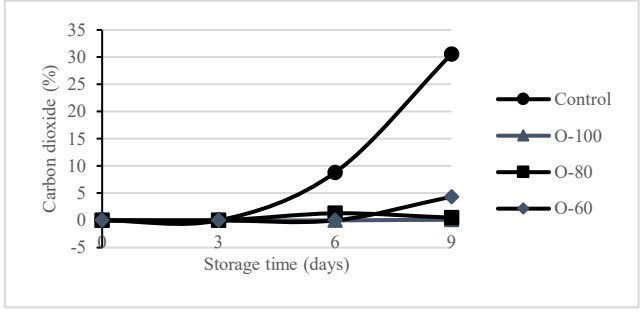

Figure 3. The carbon dioxide content in headspace of cake pouch after storage.

Total color difference (TCD) of cake resulted in Table 4, TCD value of every sample were increased trend and Control sample had the highest 2.69 after 9 days storage. They did not show significantly with O-100 O-80 and O-60 presented 2.41 2.33 and 2.61 respectively. However clearly change of color according to TCD more than 5.0 could be easily detected by unaided eyes and TCD more than 12 a clearly different shade of color (Chen and Yang, 2019). So, cake in every sample, the people cannot see difference color.

Moisture content of cakes (Table 5.) are started 37.23% in each sample. O-100, O-80 and O-60 decreased to 35.29% 34.55% and 35.33% respectively ($p > 0.05$) after 9 days storage. This result according to some reported that moisture losses from cake crumb caused a rigidification of the crumb structure as a primary firming process (Razak *et al.* 2020) and Aguirre *et al.* 2011 reported during storage, the starch molecules re-associated and generate a new crystalline that effect on moisture decreasing. In Addition, the moisture in the packaging begins to interact with the iron powder inside of the oxygen absorber sachet. This interaction creates rust. Typically, at least 65% relative humidity in the surrounding environment is required before the rusting process can begin to remove oxygen (FoodVacBagsTm, 2022). So, moisture content of cake in O-100, O-80 and O-60 sample, its were decreased but increased significant in control sample.

Table 3. Microbiological of cake

Type	Specification	Storage duration (days)			
		0	3	6	9
Total Plate count (cfu/g)	$<1x10^6$				
Control		$7.5x10^3$a	$2.17x10^7$a	$10.33x10^7$a	$22.20x10^7$a
O-100		$7.5x10^3$a	$3.40x10^5$c	$1.91x10^6$c	$5.03x10^7$b
O-80		$7.5x10^3$a	$3.02x10^6$b	$15.80x10^7$a	$2.35x10^7$b
O-60		$7.5x10^3$a	$4.97x10^6$b	$3.63x10^7$b	$5.20x10^7$b
Yest&Mold (cfu/g)	<100				
Control		1x10a	5.33x10a	$8.93x10^4$a	$1.57x10^5$a
O-100		1x10a	4.0x10a	4.6 x10c	8.33 x10d
O-80		1x10a	$1.31x10^3$b	$1.07x10^3$b	$4.776x10^3$b
O-60		1x10a	1x10a	4.16x10c	$5.78 x10^2$c
Salmonella	ND				
Control		ND	ND	ND	ND
O-100		ND	ND	ND	ND
O-80		ND	ND	ND	ND
O-60		ND	ND	ND	ND
Staphylococcus aureus, (cfu/g)	<10				
Control		1x10a	$2.96x10^5$a	$6.16 x10^5$a	$3.81 x10^6$b
O-100		1x10a	$1.821 x10^3$b	$1.19 x10^4$b	$5.73 x10^5$a
O-80		1x10a	$1.94 x10^3$b	$1.36 x10^4$c	$1.66 x10^5$b
O-60		1x10a	$2.32x10^5$a	$1.99x10^5$ b	$2.49 x10^6$a
Bacillus cereus (cfu/g)	<100				
Control		1x10a	1x10b	1x10b	1x10c
O-100		1x10a	1x10b	5.30 $x10^2$a	$1.93 x10^2$b
O-80		1x10a	2.0 x10b	2.0 x10b	2.0 x10c
O-60		1x10a	$3.26x10^2$a	2.0 x10b	$1.20 x10^3$a
Clostridium perfringens (cfu/g)	<100				
Control		<10	<10	<10	<10
O-100		<10	<10	<10	<10
O-80		<10	<10	<10	<10
O-60		<10	<10	<10	<10
Escherichia coli (MPN/g)	<3				
Control		<3	<3	<3	<3
O-100		<3	<3	<3	<3
O-80		<3	<3	<3	<3
O-60		<3	<3	<3	<3

a, b, c… Means with different letter within the same column were significant difference ($p \leq 0.05$); ND= Not Detected

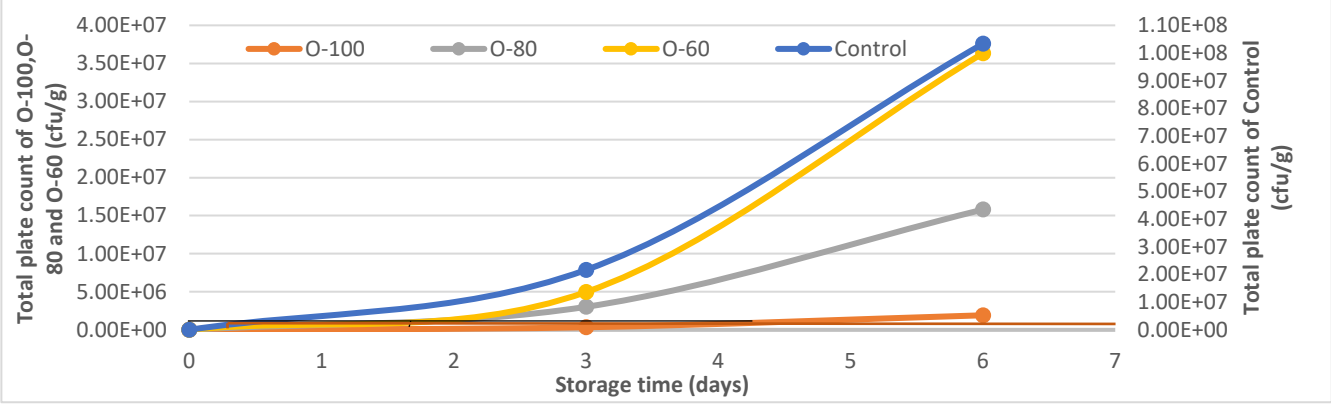

Figure 4. Storage time of samples that have total plate count $1x10^6$ cfu/g

Sensory evaluation of cake were measured intensity appearance, color, odor, taste, texture and overall scale and results showed in Table 6-11. The panelists practiced rating the intensity using satisfaction scale 1-9 (1= dislike extremely to 9= like extremely). This experiment used satisfaction scale ≥6 to indicate consumer satisfaction. Cake of every samples had decreased scale for appearance, color, odor, taste, texture and overall in all time storage. After 3 days storage, Control, O-100, O-80 and O-60 have consumer satisfaction of appearance, color, odor, taste, texture and overall scale upper than 6 but after 6 and 9 days storage showed lower scale than 6 that meaning non accept. However cake of O-100 showed higher scale than O-80 and O-60 for appearance, color, odor, taste, texture and overall. Although scales that there were not significantly different (p>0.05)

Table 4. Total color difference of cake.

Sample	Storage duration (days)			
	0	3^{ns}	6^{ns}	9^{ns}
Control	0.00 ±0.00	1.30 ±0.73	2.00 ±0.93	2.69 ±1.52
O-100	0.00 ±0.00	1.35 ±1.22	2.28 ±1.86	2.41 ±0.85
O-80	0.00 ±0.00	1.25 ±0.66	1.32 ±0.69	2.16 ±1.11
O-60	0.00 ±0.00	1.97 ±0.97	2.04 ±1.12	2.33 ±1.15

a, b, c… Means with different letter within the same column were significant difference (p≤0.05)
ns Means within the same column were not significantly different (p>0.05)

Table 5. Moisture content of cake.

Sample	Storage duration (days)			
	0^{ns}	3	6^{ns}	9
Control	37.23 ±0.54	35.77 ±0.67^{a}	35.72 ±0.29	38.61 ±1.22^{b}
O-100	37.23 ±0.54	36.28 ±0.11^{ab}	35.66 ±0.31	35.29 ±1.85^{a}
O-80	37.23 ±0.54	35.99 ±0.36^{a}	36.18 ±0.29	34.55 ±0.12^{a}
O-60	37.23 ±0.54	36.91 ±0.25^{b}	36.56 ±1.07	35.33 ±0.71^{a}

a, b, c… Means with different letter within the same column were significant difference (p≤0.05)
ns Means within the same column were not significantly different (p>0.05)

Table 6. Appearance scale of cake.

Sample	Storage duration (days)			
	0^{ns}	3^{ns}	6^{ns}	9^{ns}
Control	7.50 ±1.08	6.80 ±1.55	-	-
O-100	7.50 ±1.08	7.20 ±1.03	5.30 ±2.0	6.22 ±1.39
O-80	7.50 ±1.08	6.60 ±1.58	4.40 ±2.07	5.33 ±1.73
O-60	7.50 ±1.08	7.20 ±1.62	5.70 ±1.83	5.11 ±1.69

a, b, c… Means with different letter within the same column were significant difference (p≤0.05)
ns Means within the same column were not significantly different (p>0.05)

Table 7. Color scale of cake.

Sample	Storage duration (days)			
	0^{ns}	3^{ns}	6^{ns}	9^{ns}
Control	7.10 ±1.37	6.70 ±1.64	-	-
O-100	7.10 ±1.37	7.20 ±1.14	5.40 ±1.96	6.22 ±2.05
O-80	7.10 ±1.37	6.70 ±1.49	5.10 ±2.13	5.78 ±1.92
O-60	7.10 ±1.37	7.40 ±1.35	5.90 ±1.66	5.22 ±2.05

a, b, c… Means with different letter within the same column were significant difference (p≤0.05)
ns Means within the same column were not significantly different (p>0.05)

Table 8. Odor scale of cake.

Sample	Storage duration (days)			
	0^{ns}	3^{ns}	6^{ns}	9^{ns}
Control	6.80 ±1.81	5.70 ±2.16	-	-
O-100	6.80 ±1.81	5.90 ±0.99	4.50 ±2.64	5.22 ±1.72
O-80	6.80 ±1.81	6.30 ±1.64	3.40 ±2.12	4.78 ±1.20
O-60	6.80 ±1.81	6.80 ±1.55	4.50 ±2.64	3.78 ±1.30

a, b, c… Means with different letter within the same column were significant difference (p≤0.05)
ns Means within the same column were not significantly different (p>0.05)

Table 9. Taste scale of cake.

Sample	Storage duration (days)			
	0^{ns}	3^{ns}	6^{ns}	9^{ns}
Control	7.20 ±1.81	6.40 ±1.90	-	-
O-100	7.20 ±1.81	6.10 ±1.85	5.20 ±2.30	5.33 ±1.87
O-80	7.20 ±1.81	6.30 ±1.95	3.70 ±2.26	4.78 ±1.20
O-60	7.20 ±1.81	6.70 ±2.06	5.10 ±2.23	3.89 ±1.54

a, b, c… Means with different letter within the same column were significant difference ($p \leq 0.05$)
ns Means within the same column were not significantly different ($p > 0.05$)

Table 10. Texture scale of cake.

Sample	Storage duration (days)			
	0^{ns}	3^{ns}	6^{ns}	9^{ns}
Control	5.90 ±2.02	6.70 ±1.34	-	-
O-100	5.90 ±2.02	6.50 ±1.43	5.00 ±2.62	5.44 ±1.94
O-80	5.90 ±2.02	6.30 ±1.42	3.90 ±2.02	5.00 ±2.00
O-60	5.90 ±2.02	6.90 ±1.60	5.10 ±2.51	4.44 ±1.59

a, b, c… Means with different letter within the same column were significant difference ($p \leq 0.05$)
ns Means within the same column were not significantly different ($p > 0.05$)

Table 11. Overall scale of cake.

Sample	Storage duration (days)			
	0^{ns}	3^{ns}	6^{ns}	9^{ns}
Control	7.00 ±1.83	6.00 ±1.94	-	-
O-100	7.00 ±1.83	5.90 ±1.91	4.80 ±2.44	5.44 ±1.81
O-80	7.00 ±1.83	5.90 ±1.91	3.40 ±1.71	4.67 ±1.12
O-60	7.00 ±1.83	6.30 ±2.36	5.10 ±2.38	4.11 ±1.45

a, b, c… Means with different letter within the same column were significant difference ($p \leq 0.05$)
ns Means within the same column were not significantly different ($p > 0.05$)

CONCLUSIONS

The oxygen scavenger (50 mL) was tested on the efficiency and shelf-life prolongation. In the efficiency test, one oxygen scavenger sachet was kept in a pouch and tightly closed and stored at 25 °C. The level of oxygen in the nylon pouch was recorded at 0 and 72 hrs and calculated the efficiency of absorption. In the shelf-life test, each oxygen scavenger sachet of 100% (O-100), 80% (O-80) and 60% (O-60) efficiency were kept in a cake package at 25°C to measure the shelf-life compared with a control package (Control) without oxygen scavenger. This experiment were detected in oxygen content, moisture content, microbiological, total color difference (TCD) and sensory. The result presented that the oxygen scavenger at 100% efficiency package had a longer shelf-life. Cake of Control, O-80 and O-60 sample had microbiological (total plate count) $>1x10^6$ after 3 days storage that were over the specification of Thai community product standard 459/2555 (TCPS, 2012). Shelf-life of Control, O-80 and O-60 were about 0.2, 1.7 and 1.8 days respectively, although, cake of them showed total color difference (TCD), moisture content and sensory scale were not significant when compared the cake with O-100 sample after 3 days storage. O-100 sample had microbiological (total plate count) $<1x10^6$ after 3 days storage that was in the criteria according to specification of standard but over specification after 6 days storage. Shelf -life of O-100 sample was about 4.3 days. The summarize of oxygen scavenger application, oxygen scavenger at 100% efficiency (O-100) could prolong shelf life of cake because of reducing yeast &mold and *Staphylococcus aureus*.

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