

EFFECT OF DIFFERENT LEVELS OF SUGAR LIQUOR ON THE QUALITY OF ROAST CRISPY PORK DURING STORAGE

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Abstract –Roast crispy pork was sprayed with different levels of sugar liquor (0, 1, 3, 5%) then roasted at 260°C for 10 min. The final chilled products were vacuum packed and stored at 4°C for 28 days. The physicochemical, microbiology, shear force and sensory panel were determined. During 28 days of storage, pH value of all treatments were not significantly different. TBARS and peak force values (crispiness) decreased with increasing time. Roast crispy pork of all groups showed slightly increase of total plate count value with time. Sensory score: warm-over flavor of roasted pork belly presented higher during storage time while crispy and overall acceptance score were decrease when time increased.

Key Words –roast crispy pork, liquor, peak force (crispiness).

I. INTRODUCTION

Roast crispy pork is well known as a traditional Chinese cuisine derive from Hong Kong. It is characterized by its crispness texture of the rind, which volume highly expanse and pop-up from the surface. In commercial baking method, maltose syrup is sprayed on the top of the pork rind to increase the crispness. However, under Millard Reaction, maltose from syrup can react with the protein of the pork rind and add attractive appearance (Andrade et al., 2010).

In addition, maltose is expensive and difficult to operate in the processing. So, in this study, granulated sugar was selected to replace maltose in syrup. Granulated sugar is a common sugar make up by 99% of sucrose. It is cheaper than maltose, and it can easily dissolved in water.

Therefore, the objective of this study was to evaluate the effect of syrup with granulated sugar on physicochemical, microbiology, peak force (crispness) and sensory of roast crispy pork stored at 4°C for 28days.

II. MATERIALS AND METHODS

Sample preparation

Pork belly with rind were purchased from local meat plant in Taiwan. Pork belly were trimmed and cut into 12 X 20 cm (width X length).

Sugar liquor: 0, 1, 3 and 5% of sugar was separately dissolved at 95-99°C. Finally, 0.3% salt and 10% vinegar were added into each liquor.

1 kg pork belly was swabbed with seasoning mixture including 2.5 % salt, 2 % sugar, 0.5 % monosodium glutamate, 0.15 % sand ginger, 0.08 % licorice, 0.05 % dried tangerine peel and 0.1 % pepper and cured at 4°C for 8-12 hr. The average density of 40 holes / cm² on the skin of pork belly was pierced by a piercer.

Preparation of Roast crispy pork

Cured pork belly were roasted in oven at 180°C for 5 min then different concentrations of sugar liquor was separately sprayed twice on pork skin. Pork belly were roasted at 180°C for 90 min again. Finally, pork belly were roasted at 260°C for 10 min until skin presented puffed and crispy. The chilled final products were packed with vacuum-package and stored at 4 °C for 28 days. Samples at day 1, 3, 5, 7, 14, 21 and 28 were determined TBARS value, pH value, microbiology, texture profile and sensory panel to look an optimum level of sugar liquor for roast crispy pork.

Thiobarbituric acid reactive substances (TBARS) value

TBARS value was analyzed by the method of Faustman *et al.* (1992). 10 g of sample was mixed with 25 mL of 20% trichloroacetic acid (TCA) and 20 mL distilled water. The mixture was homogenized (PT 3100, POLYIRON) for 120 sec and the mixture was centrifuged at 6000 rpm for 20 min. The supernatant was filtered (No.1,

Advantec), then 2 ml of the filtrate was combined with 2 ml of 0.02 M aqueous 2-thiobarbituric acid (TBA) in test tube. 1ml of distilled water, 1ml of 20% TCA, and 2 ml TBA reagent were served as blank.

Samples were cooked at 95°C for 30 min in water bath. Then, it was cooled in running water for 10 min. The absorbance of the resulting solution was measured with spectrophotometer (U3210 Hitachi, Japan) at 532 nm. The standard curve of TBARS was plotted by using 1, 1, 3, 3-tetraethoxypropane (TEP) as a standard for malondialdehyde (MDA) and the amounts of TBARS were expressed as milligrams of MDA /100g of lipid.

Total plate count

10 g of sample was mixed with 90 ml sterile water and homogenized with a stomacher (Stomacher 400, Seward, UK) for 30 sec. A serial dilution of sample was performed. 1 ml of each dilution and 15 ml plate count agar (Merck, Germany) was poured into petri dish and incubate for 48 hr at 35°C.

Sensory evaluation

Samples were pre-heat at 180°C for 15 min and then roasted at 270°C for 5 min. Sample was sliced into 0.5 - 0.6 cm thickness piece and served to 10 experienced panelists. Panel team consisted of 10 graduated students from meat science of Department of Animal Science, National Chungshing University. A 7 point hedonic scale was used to evaluate sensory test including crispness, and overall-acceptability. 7 point hedonic scale indicated that 1 = absolutely dislike and 7 = very like. However, Warm-over flavor presented 1 = extremely weak warm-over flavor and 7 = extremely strong warm-over flavor in study.

Texture profile analysis

Roast crispy pork was separated into skin and meat at first, then the skin was cut into 2.5 cm × 1 cm and meat was cut into 1 cm × 1 cm × 0.5 cm. Texture profile of sample was determined by using Texture Analyzer (Model Compac-100, Sun Rheo Meter, Japan).

Statistical analysis

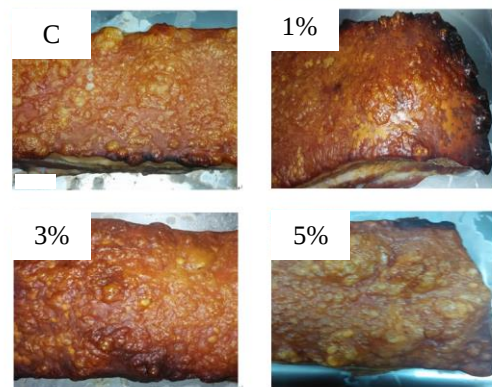
All data were evaluated by using analysis of variance (ANOVA) procedure of statistics analysis system (SAS) 9.3 software. A difference was considered significant at 5 % level using the Tukey's test.

III. RESULTS AND DISCUSSION

Appearance of roast crispy pork

The picture 1 showed the appearance of roast crispy pork with 0, 1, 3, and 5% sugar liquor. A golden to brown color and sponged structure was showed on the rend in roast crispy pork.

Picture 1. The appearance of roast crispy pork with different sugar liquor concentrations



TBARS value

Analysis of data of TBARS value was showed in Table 1. TBARS value of control and 5% sugar liquor was significantly different ($P < 0.05$).
Table 1. The changes of TBARS of roast crispy pork treated with different sugar liquor concentrations during storage at 4°C

Time (Days)	TBARS value			
	Control	1%	3%	5%
1	2.21 ^{Ab}	1.28 ^{Ac}	0.91 ^{Ad}	2.35 ^{Aa}
3	0.92 ^{Cb}	0.63 ^{Ec}	0.76 ^{Bc}	1.36 ^{Ba}
5	0.72 ^{Cc}	0.94 ^{Cb}	0.61 ^{Dd}	1.30 ^{Da}
7	1.50 ^{Ba}	0.73 ^{Db}	0.70 ^{BCb}	0.78 ^{Eb}
14	0.80 ^{Cc}	0.45 ^{Fd}	0.87 ^{Ab}	1.44 ^{Ca}
21	0.71 ^{Cd}	0.98 ^{BCb}	0.86 ^{Ac}	1.47 ^{Ba}
28	1.28 ^{Ba}	1.05 ^{Bb}	0.65 ^{CDc}	0.73 ^{Ec}

Means ± S.D., n=3

a-d: Means within the same row without the same superscript are significantly different ($P < 0.05$)

A-F: Means within the same column without the same superscript are significantly different ($P < 0.05$)

liquor had higher value than others due to higher fat % in green pork belly in the initial. TBARS value of control and 5% sugar liquor 2.21 and 2.35 mg of MDA /100g of fat, individually. During 28 days of storage TBARS value of all treatments kept stable and value was lower 1.50 mg of MDA /100g of fat. This result also agreed with Kerry *et al.* (1998) found that TBARS values of cooked pork packed with vacuum package can remain stable, approximately at 1 mg malonaldehyde /kg during 8 weeks when store at 4°C.

Total plate count

Table 2. The changes of total plate count of roast crispy pork treated with different sugar liquor concentrations during storage at 4°C

Time (Days)	Count (log CFU/g)			
	Control	1%	3%	5%
1	2.53 ^{AB}	2.08 ^B	2.12 ^C	2.42 ^B
3	2.33 ^B	2.00 ^B	2.21 ^C	2.21 ^B
5	3.08 ^{aAB}	2.22 ^{bB}	2.28 ^{bC}	2.17 ^{bB}
7	2.34 ^{abB}	2.00 ^{bB}	2.36 ^{aC}	2.28 ^{abB}
14	2.65 ^{abAB}	2.88 ^{abAB}	3.15 ^{aAB}	2.58 ^{abB}
21	3.36 ^{AB}	3.26 ^A	3.09 ^B	2.83 ^B
28	3.91 ^A	3.76 ^A	3.70 ^A	3.86 ^A

Means ± S.D., n=6

a-b: Means within the same row without the same superscript are significantly different ($P < 0.05$)

A-C: Means within the same column without the same superscript are significantly different ($P < 0.05$)

The total plate counts (TPC) was showed in Table 2. At 1 day of storage TPC value of all samples were 2.08 - 2.53 log CFU/g. TPC value of all treatments significantly increased with increasing time storage ($P < 0.05$). The end of storage TPC value of all samples were 3.70-3.91 log CFU/g. However, this result indicated that the growth of bacteria in this product was slow and limited. Yang *et al.* (2016) also reported that vacuum packaging reduce atmospheric oxygen which limiting the growth of aerobic bacteria.

Peak force (crispness)

In this study crispness of roast crispy pork were presented as peak force of texture profiles. The result of peak force was showed in Table 3. Peak force of all groups decreased with increase of time during storage. At day 1, 5% group had

significantly higher value than other groups. This result indicated improving crispiness of decreased with time. The reason of the decreasing peak force is due to more moisture and lipid absorption of rend of roast crispy pork. This result agreed to Vliet *et al.*, (2007) reported that oil absorption can decrease the crispiness of toasted rusk rolls and Martinez *et al.*, (2002) also reported that water absorption can decrease the stiffness of pork rind.

Table 3. The changes of peak force of roast crispy pork treated with different sugar liquor concentrations during storage at 4°C

Time (Days)	Peak force (g/cm ²)			
	Control	1%	3%	5%
1	2066 ^{bA}	2107 ^{bAB}	2153 ^{bA}	3697 ^{aA}
3	1923 ^{AB}	2338 ^A	2317 ^A	2424 ^B
5	1736 ^{ABC}	2131 ^{AB}	2100 ^A	2456 ^B
7	1297 ^{bBCD}	1834 ^{abAB}	2133 ^{aA}	1846 ^{abBC}
14	1177 ^{CDE}	1337 ^{BC}	1013 ^B	1148 ^{CD}
21	815 ^{DE}	991 ^{CD}	544 ^B	1007 ^{CD}
28	517 ^{bE}	505 ^{bD}	991 ^{aB}	255 ^{bD}

Means ± S.D., n=9

a-b: Means within the same row without the same superscript are significantly different ($P < 0.05$)

A-E: Means within the same column without the same superscript are significantly different ($P < 0.05$)

Sensory-crispness score

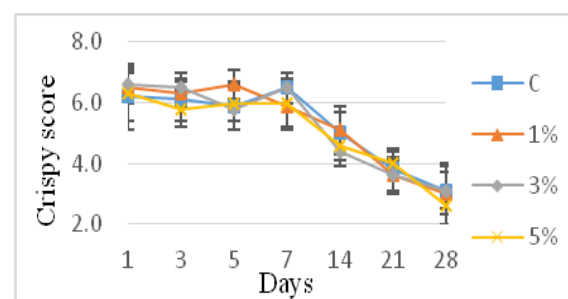


Figure1. Effect of different sugar liquor concentrations on crispness of roast crispy pork during storage

The result of crispness of sensory in roast crispy pork was showed in Figure 1. There was no significant difference among all treatments during storage. The crispness of all treatments still kept higher value (6.0) before 7 days of storage, then decreased with time and lower than 4 after 21 days of storage. It means that roast crispy pork of control and all treatments were

not acceptable by panelist after day 21 of storage. Compared to Table3, peach force of all treatment also kept high value before 7 days of storage then decreased with time and a significant lower value also found after 21days of storage.

Sensory-warm-over flavor score

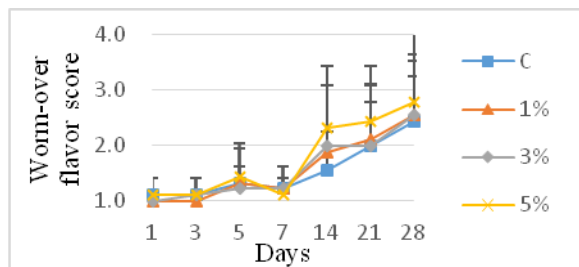


Figure 2. Different sugar liquor concentrations on the warm-over flavor score of roast crispy pork during storage

Warm-over flavor score was showed in Figure 2. Warm-over flavor score of all treatments slightly increase after 7 days of storage. Warm-over flavor score of all groups slightly increased with time increased due to sample had lower degree of lipid oxidation during 28 days of storage (Table1). Kerry *et al.* (1998) reported that a logarithmic relationship was observed between TBARS and warm-over flavor in both aerobically and vacuum packaged cooked pork.

Sensory- overall acceptance score

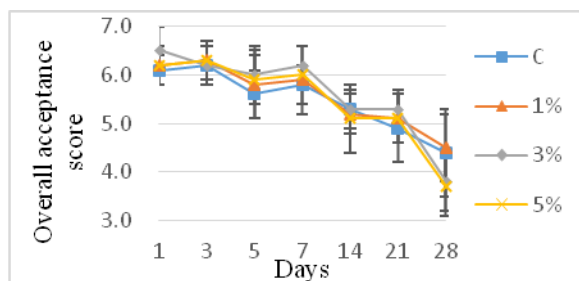


Figure 3. Different sugar liquor concentrations on the overall acceptance score of roast crispy pork during storage

Overall acceptance score was showed in Figure 3. Overall acceptance score of all treatments showed rapidly decreased after 7 days of storage. Furthermore, overall acceptance of all treatments

presented the lowest score at the end of storage. It means that roast crispy pork became unacceptable for panelists at the end of storage due to lower crispness but not warm-over flavor.

IV. CONCLUSION

Except of peak force (crispness), the quality of all roast crispy pork treated with 1, 3 and 5% of sugar liquor kept stable during storage. Although the quality of all roast crispy pork were not significantly different among treatments but overall acceptance of sensory at days 21 demonstrated lower than 5 and at 28days was lower than 4 due to lower value in peak force.

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