ECTS OF SPICES ON COLOR STABILITY OF CHINESE-STYLE SAUSAGE

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MARY: Pepper, five spices powder (consists of anise, fennel seed, clove, cassia and cumin seed) are the major spice ingredients used in ese-style sausages produced in Taiwan. Some producers consider that the products added with spices may cause the surface of product n during storage. Thus, this experiment was conducted to investigate the effects of the spices on the color stablility of Chinese-style sausage. amples were prepared with course ground pork mixed with cure, and different spices, separately and processed according to the method used e processors. The samples were hung in the air at ambient temperature, Hunter Lab values, metmyoglobin content (Met Mb) and TBA values e products were determined at 0, 4, 7 days of storage.

ifference was detected in L-value of the samples between the treatments at 0 time. It was observed that L-values for the control and the cts with pepper and five spices dropped slowlier than the products with clove and cassia after 4 days of storage. The changes in lightness of roducts had the same trends after 7 days of storage. Changes in a-and b-values for all treatments were the same trends as L-values. However, amples with clove and cassia changed strikingly, and the control reminded constantly. Delta E for the samples with five spices, clove and a was higher than the control. The result was found that Met Mb content in sausage was at the range of 77 to 79%. Met Mb content in the uct with cassia changed markedly. TBA values for all samples also changed with storage time. TBA value for the products with five spices love increased rapidly at the beginning of the storage, while the control reminded stably. From these results we concluded that the spices in Chinese-style sausage regularly might enhance color change and fat oxidation.

RODUCTION: The color of the finished sausage will depend primarily on the initial color of its ingredients such as raw meat, maturity or of meat animal, spices as well as temperature and humidity of processing. This problem is also trouble with the processors of Chinese-style age, as storage the surface of the product becomes barker. Gerrard (1976) pointed out some spices might have an adverse effect on color of age. Since Chinese-style sausage added with several spices, so this may be the cause of darkening or discoloration of the product. The aim of udy is conducted to investigate effects of the spices on the color stability of Chinese-style sausage during storage.

TERIALS AND METHODS:

liminary study: In order to know effect of spices on color change in meat for formal experiment, lean meat (ham) bought from local market was nd with 1/2 inch in diameter of plate. The ground pork was mixed with pepper, anise, fennel , cassia, cumin and clove and dried at 50 ℃ for . Then color-L value and delta E were measured to select darker products as treatment group.

sage preparation:1) Lean: fat ratio by 4:1 was ground with 1/2 inch plate, 2) the ground pork was mixed with common salt 1.2%, sucrose %, monosodium glutamate 0.8%, sodium nitrite 0.01%, and pepper or five spice powder 0.1%, and cured at 4 ℃ for 24hr, 3) stuffering in ral casing and dried at 50 ℃ for 7 hr.

lysis:

moglobin: the method described by Trout (1988) was used to determine Metmyoglobin content. The concentration of metmyoglobin was ulated according to : Met-Mb% $=\{1.395-[A_{572}-A_{700})/(A_{525}-A_{700})]\} \times 100$, A = absorbance.Iron in heme was determined with the method cribed by King et al. (1990).

obarbituric acid value(TBA) was determined according to the method described by Ockerman(1970) and the color was measured with Hunter rimeter.

SULTS AND DISCUSSION:

lor change in ground pork: Fig. 1 and 2 showed the ground pork added with cassia and clove became darker than the other spices. However, in e of L-value and delta E for most samples changed drastically from second day of storage. Thus, clove and cassia were selected for formal periment.

e final sausage product had 46.7% of moisure content and pH value was 6.35.

ble 1 indicated that addition 0.1% of spices had no effect on color of sausage products at the beginning of storage, but the color of the sausage ed with spices had significantly changed ($p < 0.05$) after four days of storage. Especially, the samples added with pepper, clove as well as pper mixed five spice powder. Until 7 days of storage, the lightness(L-value) tended to be same. Table 2 revealed that a-value(redness) of the ntrol sample was very stable during storage, while other groups increased with the storage time. b-value for the product with clove was the me as the control. They had lower b-value. Lab values are one of three dimension relationship, thus it is neccessary to use delta E to express the lor of product. Table 4 showed that total colorimetric value in ΔE increased with the storage time. The spices except clove, cassia or pepper did

not contribute the color to the products. However, we can propose that darkening of sausage may be caused by chemical reaction of hemoglobin or myoglobin with oxygen, even if spices are not added to the products the darkening of sausage still occurs. Therefore, the spices play an important role in accelerating or catalyzing darkening or discoloration of the sausage products in time course.

Table 5 showed that the changes in fat of the sausage products during storage. TBA value of the sausage added with clove was highest, pepper and five spices were next. Changes in TBA values for the control reminded constantly at the beginning of storage. It also revealed that the TBA value of the control was lower than other treatments after four days of storage. However, the TBA values for all the samples tended to be the same levels. This indicated that addition of spices might enhance fat oxidation. Generally, the sausage products contains denatured hemochromogen, nonheme iron and other compounds which catalyze fat in the products autooxidation. Korczak(1988) found that rosemary and sage could inhibit peroxide and malonaldehyde formation, and marjoram had peroxidizing. Haldeman et al (1987) found garlic juice could lower TBA value of lamb. Wirth (1986) indicated that color of meat changed in reddish brown if metmyoglobin concentration was more than 60% of total pigments. The concentration of metmyoglobin of the products was at the range between 77 and 79% (Table 6). Nonheme-iron was measured with colorimetric method the result was showed in Table 7. It was limited by sensitivity of the spectrophotometry.

Sausage is one of the products with higher fat content, some research workers consider that an increase in fat is one of the factors enhancing fat oxidation. Additionaly, pH, oxygen utilization, temperature, iron and nitrite etc. are also enhancers of oxidation(Renerre & Labas, 1987; Love, 1983). Besides these factors, the reducing system of NADH and NADPH of meat does also play an important role (Giddings, 1974; Faustman, 1988; Arihara et al., 1971). Sausage is an incompletely cooked food product. Eriksson(1975) showed that proteins denaturation increased the ability of the heme-containing proteins, peroxidase and catalase to promote lipid oxidation. They indicated that heat had the greatest effect on the lipid-oxidizing activity of hemes a pH5.5-6.5. pH of the Chinese-style sausage is also at 6.35. Thus fat oxidation and darkening may occur simultaneously,it is so called cooxidation.As above memtioned, it could be concluded that the sausage samples with spices or without spices, dried at 50℃ for 7 hr will become progressively darken during storage. This only indicated that the control (Without spices) changed slowlier than the samples with spices in time course. This also revealed that the sausage still has biochemical activity and spices just act as an enhancer or initiator of cooxidation of pigment and fat. The results also suggested that spices could accelerate darkening of the products due to metals such as manganese, iron, unsaturated fatty acid or essential oil in spices. The reason for sausage darkening needs furthermore studying.

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Table 1. Comparison on L values of different spices added in sausages during storage at room temperature

spices	storage time (days) 1	4	7
control	29.80^{a}	26.91^{a}	25.06^{c}
pepper	29.81^{a}	26.17^{abc}	24.93^{c}
pepper + five spices **	30.35^{a}	26.40^{bc}	24.74^{c}
cassia	31.22^{a}	27.01^{b}	24.45^{c}
cloves	29.70^{a}	25.35^{bc}	24.68^{c}

* The value within same column with different superscripts are significantly different ($p < 0.05$)
** cassia, cloves, anise, cumin seed and fennel seed.

Table 2. Comparison on a-values of different spices added sausages during storage at room temperature

spices	storage time (days) 1	4	7
control	3.87^{abc}	4.17^{abc}	3.67^{abc}
pepper	2.41^{bc}	3.54^{abc}	3.28^{abc}
pepper + five spices **	3.37^{abc}	3.08^{abc}	5.07^{a}
cassia	1.91^{c}	2.77^{abc}	4.47^{ab}
cloves	2.19^{bc}	2.83^{abc}	3.95^{abc}

* The value within same column with different superscripts are significantly different ($p < 0.05$)
** cassia, cloves, anise, cumin seed and fennel seed.

Table 3. Comparison on b-values of different spices added sausages during storage*

spices	storage time (days) 1	4	7
control	7.28^{ab}	5.01^{cde}	3.42^{fg}
pepper	7.50^{a}	5.71^{cd}	4.41^{def}
pepper + five spices **	7.76^{a}	5.17^{cde}	2.97^{g}
cassia	8.08^{a}	6.01^{bc}	4.10^{efg}
cloves	7.17^{ab}	4.19^{efg}	3.07^{fg}

* The value within same column with different superscripts are significantly different ($p < 0.05$)
** cassia, cloves, anise, cumin seed and fennel seed.

Table 4. Comparison on ΔE values of different spices added sauages during storage*

spices	storage time (days) 1	4	7
control	66.13^{f}	69.46^{cd}	71.22^{abc}
pepper	66.11^{f}	68.51^{de}	71.45^{abc}
pepper + five spices **	66.21^{f}	70.38^{acd}	71.54^{abc}
cassia	65.66^{f}	69.58^{bcd}	71.89^{a}
cloves	66.79^{ef}	71.18^{abc}	71.62^{ab}

* The value within same column with different superscripts are significantly different ($p < 0.05$)
** cassia, cloves, anise, cumin seed and fennel seed.

Table 5. Comparison on TBA values of different spices added sausages during storage*

spices	storage time (days) 1	4	7
control	1.51^{cd}	1.69^{bc}	1.86^{ab}
pepper	1.53^{cd}	1.92^{ab}	2.01^{a}
pepper + five spices **	1.23^{e}	1.97^{a}	2.03^{a}
cassia	1.41^{de}	1.99^{a}	1.90^{ab}
cloves	1.37^{de}	1.94^{ab}	2.05^{a}

* The value within same column with different superscripts are significantly different ($p < 0.05$)
** cassia, cloves, anise, cumin seed and fennel seed.

Table 6. Comparison on Met-Mb contents of different spices added sausages during storage*

spices	storage time (days) 1	4	7
control	79.23^{a}	78.46^{ab}	78.57^{ab}
pepper	78.88^{a}	78.63^{ab}	78.99^{a}
pepper + five spices **	78.93^{a}	78.79^{a}	78.79^{a}
cassia	78.97^{a}	79.00^{a}	78.65^{ab}
cloves	77.23^{bc}	78.80^{a}	76.69^{c}

* The value within same column with different superscripts are significantly different ($p < 0.05$)
** cassia, cloves, anise, cumin seed and fennel seed.

Table 7. Comparison on Iron contents of different spices added sausages during storage*

spices	storage time (days) 1	4	7
control	0.23^{de}	0.22^{e}	0.28^{abc}
pepper	0.23^{de}	0.28^{ab}	0.26^{abcd}
pepper + five spices **	0.24^{bcde}	0.27^{abcd}	0.26^{bcde}
cassia	0.23^{de}	0.25^{bcde}	0.24^{bcde}
cloves	0.23^{de}	0.30^{a}	0.26^{abcd}

* The value within same column with different superscripts are significantly different ($p < 0.05$)
** cassia, cloves, anise, cumin seed and fennel seed.

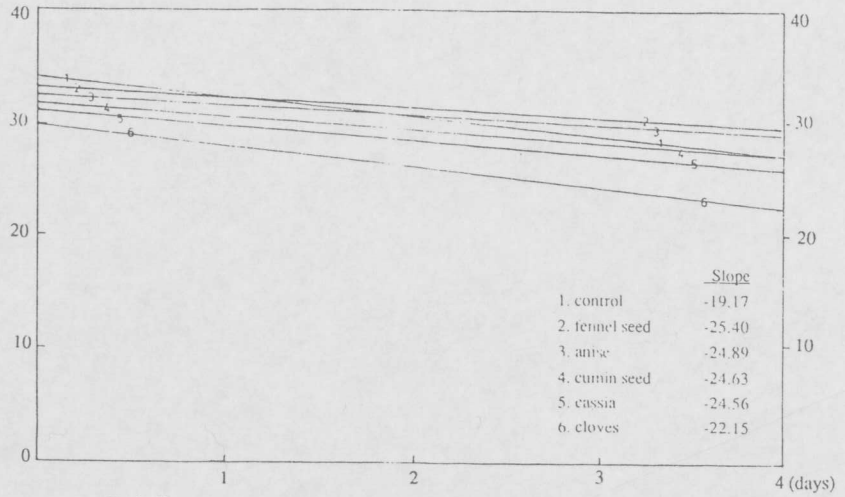

Fig 1. Changes in L-value of the sausaage added with various spices during storage at room temperature.

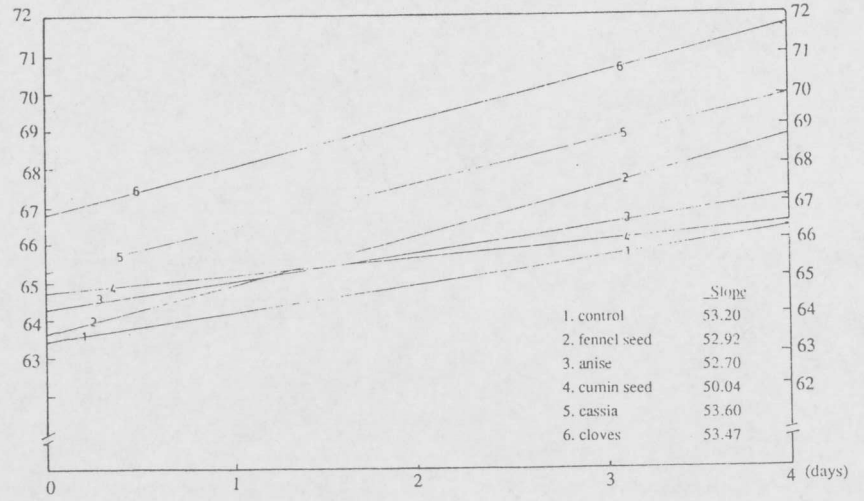

Fig 2. Change in ΔE Value of the sausage product added with various spices during storage at room temperature.