ENCAPSULATION OF ETHANOLIC EXTRACT FROM TOMATO POMANCE AND ITS EFFECT ON CHINESE SAUSAGE QUALITIES

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Abstract – Tomato pomace was used to extract phenolic compound and lycopene using ethanol. Then, matrodextrin was used for encapsulation to obtain the encapsulated ethanolic extract (EEE) powder. Phenolic and lycopene contents in EEE were 5.4±0.49 mg/g and 0.95±0.15 mg/100 g, respectively. The EEE (1%) was incorporated into Chinese sausages and compared their characteristics to that with/without nitrite (100ppm) as noted by positive control (C+)/negative control (C-). In addition, 1% EEE and 50 ppm nitrite was used to prepare the reduced nitrite with EEE sausage (RN-EEE). Addition of EEE resulted in increasing redness and that value of RN-EEE sausage was similar with C+. Proximate analysis revealed that protein content in sample with nitrite was slightly higher when compared to that without nitrite. Water activity of RN-EEE was lowest, suggesting the most stable. Overall acceptability of uncooked samples was similar. Peroxide value of C- and EEE sausages was lowest, while the highest one was C+.

Key Words –Tomato pomace, Encapsulation, Chinese sausage, Ethanolic extract.

I. INTRODUCTION

Chinese sausage is a semi-dried sausage, traditionally made by ancient Chinese as called "Cantonese sausage". It is made from pork mixed with back fat and considered as high fat content (20-30% fat) [1]. Lipolysis during processing developed the unique flavor but oxidation of unsaturated fatty acids generate unpleasant flavor as rancidity [2]. Inhibit oxidation would prolong the shelf life of the products.

The red color with unique flavor is also the dominant characteristics. This rose color is generated from chemical reaction between nitrite compound and pigment in meat (myoglobin). Nitrite compounds are the source to generate nitric oxide and subsequently reacted with ferrous ion in porphyrin of myoglobin, resulting in nitrosyl hemochrome or hemochromagen. When this pigment is heated, the permanent pink color will be formed. Moreover, addition of nitrite compound improves not only the product color but also inhibit the lipid degradation by reacting with polyunsaturated fatty acid [3]. The inhibition of *Crostridium botulinum* by nitrite was reported [4].However, the formation of nitrosamine is also concerned since it is reported as carcinogen [5]. According to Thai regulation, the nitrite residue is allowed in meat products for 125 ppm. This limited amount may not enough to provide all preferable characteristics. Application of natural additives should be sorted out.

Tomato pomace (TP) is a waste from tomato processing factory. It contains both phenols and carotenoids, which are potentially used as natural colorant and antioxidant [6]. Direct addition of TP into sausage has been performed [7]. Extraction and encapsulation of those compounds into powder may provide the convenient form of natural additives. However, encapsulation of extract from tomato pomace has not been investigated. Therefore, the aim of this study was to encapsulate the ethanolic extract from TP for being food ingredient. In addition, its effect on qualities of Chinese sausage was evaluated.

II. MATERIALS AND METHODS

TP was extracted by ethanol using microwave assisted procedure modified from previous method

[8]. TP was mixed with ethanol at the ratio of TP:solvent at 5:100 and extracted the mixture using microwave at 180 W for 90 s. The extracted mixture was centrifuged at 1,000 × g for 10 min, filtered, and evaporated the filtrate to use as ethanolic extract (EE). The maltodextrin solution was mixed with EE by controlling oil:maltodextrin at 1:5. Lyophilization was applied to dry out the mixture to obtain the encapsulated EE (EEE). Color of EEE was evaluated by colorimeter. Lycopene content in EEE were determined using spectrophotometry and phenol content was by Folin-Ceuation method using gallic acid as standard.

Chinese sausage was manufactured by controlling meat, back fat, salt, and sugar at 50, 25, 1.25, and 23.75%, respectively. The negative control (C-) was performed without nitrite, while that with nitrite (100 ppm) was a positive control (C+). The 1.0% EEE was defined as EEE sausage. Finally, a reduced nitrite with EEE (RN-EEE) was prepared by adding 1.0% EEE and 50 ppm of nitrite. To prepare sausage, all ingredients were mixed together before stuffing into collagen casing (2.5cm) and tightening with cotton rope for every 6 cm. The sausage sample were dried at 50 °C for 8 h and left over night at room temperature. The obtained products were kept at 4 °C until used.

Proximate analysis was applied to determine for the chemical compositions including moisture, fat, ash, and protein contents. Water activity of each sample was evaluated. The colorimeter was introduced to evaluate the changes of color among treatments and expressed the results as *L*, *a*, and *b* values. The consumer acceptance for color and overall acceptance were evaluated by 9-points hedonic scale using 30 panelists.

Oxidation of lipid was accelerated by incubating at 50 °C for a week. Crude fat from incubated samples were extract using petroleum ether and peroxide value in extracted fat was evaluated, based on titration technique, in order to determine the primary oxidative products. Thiobarbituric acid (TBA) value was determined the secondary product of oxidation. Sample was distilled in trichloroacetic acid (TCA) solution and absorbance of mixture between the distillate and TBA solution was measured at 532 nm. TBA value was calculated according to previous method [9].

III. RESULTS AND DISCUSSION

Encapsulation of EE was performed successfully and the powder of EEE was obtained. This EEE powder contained phenolic compounds, which are normally observed in the tomato seed and peel [10]. The lycopene and phenolic contents were shown in Table 1. The phenloic content in EEE may inhibit oxidation and reduce the rancidity of sausage. Moreover, lycopene content in EEE could be the natural source of red pigment, which is the desirable color for the product. Based on the color measurement of EEE powder, the red color of EEE was observed as evidenced by the positive *a* value (redness). The redness of EEE may from the lycopene, which is normally found in tomato pomace and its extract [11]. In addition, the yellowness value was found. This may be the results of carotenoids such as lutein, carotene, zeaxanthin as reported previously[10]. Based on the characteristic of EEE, it has a potential to be natural colorant as well as reduce the oxidative rancidity in high fat food products.

Table 1 Characteristics of EEE powder

Characteristics	Value
Phenolic compound (mg/g)	5.4±0.49
Lycopene (mg/100 g)	0.95±0.15
Color value	
L	78.3±0.5
a	18.0±0.3
b	35.6±0.6

The red color of sausage was increased when EEE was added. This was supported by an increasing the *a* value of EEE sausage when compare with the C-. However, this value was lower than the C+ sausage (Table 2).

Table 2 Color values of sausages

Samples	Color value		
	L	*a*	*b*
Control (+)	29.8±1.4^{ab}	10.2±0.8^{a}	87.0±0.4^{b}
Control (-)	28.5±1.0^{b}	05.7±0.3^{c}	87.0±0.8^{b}
EEE	29.2±0.9^{ab}	07.4±0.2^{b}	10.3±0.7^{a}
RN-EEE	30.4±0.7^{a}	09.6±0.4^{a}	09.5±0.2^{b}

*$^{a-b}$ within column indicates statistical different (P<0.05)

This suggested that complete substitution of nitrite with EEE would affect the redness and may not possible to accept by consumers. Addition of EEE could be possible to reduce nitrite for a half (50ppm). This was evidenced by the comparable redness to that of the C. This indicated that EEE could be the natural colorant to produce a reduced nitrite sausage without affecting the redness. However, consumer perception on the color appearance should be further investigated in order to evaluate the acceptability.

The consumer acceptability for uncooked sausages was evaluated. Consumer preference for color, texture and overall acceptability are shown in Table 3. The overall acceptability of sausage was not different (P > 0.05). Thus, reduction of nitrite for a half by addition of EEE, resulted in an acceptable color.

Table 3 Consumer preference for sausages

Samples	Color value		
	Color	Texture	Overall acceptability
Control (+)	7.1±1.4^{a}	6.6±0.8^{a}	6.6±0.4^{a}
Control (-)	6.1±1.0^{b}	6.1±0.3^{a}	5.8±0.8^{a}
EEE	6.6±0.9^{a}	6.2±0.2^{a}	6.2±0.7^{a}
RN-EEE	6.5±0.7^{a}	5.8±0.4^{a}	6.1±0.2^{a}

*$^{a-b}$ within column indicates statistical different (P<0.05)

Chemical compositions of sausage are shown in Table 4. All sausages did not show different in moisture, ash, and crude fat contents. This was similar with that observed previously [12]. Since the EEE was added at low amount, it could not be affected the proximate composition. In addition, extraction of tomato pomace by ethanol resulted in getting rid of those compositions. However, a RN-EEE sausage showed higher crude protein content. This was because it contains high nitrogen content from nitrite addition, which can be detected by the Kjeldahl method [12]. This suggested that addition of EEE did not affect the chemical composition of sausage.

Table 4 Chemical composition of sausages

Sausage	Chemical composition			
	Protein	Ash	Moisture	Fat
Control (+)	16.49±0.31^{ab}	2.22±0.04	73.38±0.71	25.89±1.06
Control (-)	16.65±0.34^{ab}	2.23±0.00	74.02±0.19	25.98±0.29
EEE	16.25±0.38^{b}	2.23±0.05	74.06±0.43	25.55±1.90
RN-EEE	17.29±0.06^{a}	2.29±0.05	74.21±0.79	24.87±1.21

*$^{a-b}$ within column indicates statistical different (P<0.05)

Based on the chemical composition, this product is classified as simi-dried sausage since moisture is still remained at high content. This suggested that the product could be spoiled by either microorganism or chemical reaction, which is governed by the water activity.

Water activity of sausage was therefore determined and found the value around 0.79-0.84. These values were slightly lower than that observed in Chinese sausage incorporated with okra rice [13]. This indicated that incorporation of EEE would be more stable. The low water activity might be due to the synergistic effect of maltodextrin and nitrite compound. However, our sausage is still susceptible for microorganism, especially bacteria and yeast. The most susceptible one would be the control sausage, while the most stable was considered to be RN-EEE sausage. Based on the water activity, addition of EEE in a reduced nitrite sausage improved the potential stability of product.

Table 5 Water activity of sausages

Sausage	Water activity (a_w)
Control (+)	0.84±0.01^{a}
Control (-)	0.83±0.01^{ab}
EEE	0.82±0.01^{b}
RN-EEE	0.79±0.01^{c}

*$^{a-b}$ within column indicates statistical different (P<0.05)

Lipid peroxidation is one of crucial index, indicating the lipid oxidation and rancidity. It is measured by detect the peroxide value (PV), which is a primary product from lipid oxidation. It is often used as indicator of food deterioration, especially high fat product. The PV value of our sausage was listed in Table 6. It can be seen that the PV value of C+ was highest value, while the lowest one was C- and sausage with EEE. It seems like oxidative product in sample without nitrite was found at the lowest extend since PV value was found at the lowest value. However, it is possible that peroxide in sausage may be degraded to be the secondary products. Normally, nitrite is concerned as one of additive that could inhibit the oxidation of lipid in meat product [3]. Thus, high PV value in C+ may not be the absolute indicator of lipid oxidation. Therefore, secondary product of oxidation should be further determined.

Table 6 Peroxide value of sausages

Sausage	Peroxide value (mEq/g)
Control (+)	41.61±0.13[a]
Control (-)	13.52±3.17[c]
EEE	10.99±0.53[c]
RN-EEE	33.35±2.62[b]

*[a-b] within column indicates statistical different (P<0.05)

IV. CONCLUSION

Ethanol was effective to extract lycopene and phenolic compounds from tomato pomace. Encapsulation the ethanolic extract into powder was successfully performed using maltodextrin. The encapsulated ethanolic extract had a potential to be natural colorant in Chinese sausage. It can be substituted with nitrite. This would provide the alternative way to produce the reduced nitrite sausage without affecting the overall qualities and consumer acceptability.

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