



## Development of Sai Krok E-san Kai (Chicken Fermented Sausages) with Riceberry Rice

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### Abstract

This research aims to (1) study the ratios of sticky rice to Riceberry rice in Sai Krok E-san Kai with Riceberry rice, at 70:30, 50:50 and 0:100 (2) compare the nutritional value between control Sai Krok E-san Kai and Sai Krok E-san Kai with Riceberry rice and (3) carry out consumers' acceptance test of Sai Krok E-san Kai with Riceberry rice. The study showed that the most accepted ratio of sticky rice to Riceberry rice is 50:50, with overall liking score of  $7.48 \pm 1.14$  (moderately like to like very much). From the comparison of nutritional value in control Sai Krok E-san Kai and Sai Krok E-san Kai with Riceberry rice, it was found that the control sample had 181.29 kcal of energy, 8.29 g fat, 13.12 g carbohydrate, 2.58 g dietary fiber, 0.45 mg iron and 0.69 mg zinc. On the other hand, Sai Krok E-san Kai with Riceberry rice had 163.65 kcal of energy, 7.49 g fat, 10.34 g carbohydrate, 4.86 g dietary fiber, 0.97 mg iron and 0.75 mg zinc. Moreover, the consumer acceptance test of Sai Krok E-san Kai with Riceberry rice showed that, out of 100 panelists, 89% accepted the product and 75% decided that they would purchase the product.

### Introduction

Sai Krok E-san, or fermented pork sausage, is made by packing pork meat, pork fat, cooked rice and seasonings into pork intestine, or other edible intestines, before cooking by boiling, frying, or baking. Common Sai Krok E-sans in the market are usually fermented and dried in the sunlight for only 1-2 days, making it less sour than Naem (sour pork) but safer from potentially toxic microorganisms (Thai Industrial Standards Institute, 1995).

Recently, it has been found that there are approximately 1.5 million Muslims, 55 member states, consuming over 3 trillion baht worth amount of food, of

which are halal foods. Therefore, it is understandable that Muslim food entrepreneurs are keen to develop products that conform with halal standards (Halal Institute Prince of Songkhla University, 2014). In general, Halal foods are foods that can be consumed by both Muslims and non-Muslims, however observant Muslims may only consume halal foods that are defined in Islam regarding prohibited and permitted foods. According to principles in Islam, Halal foods are the foods approved by God to be consumed or utilized as they are clean, have nutritional value and are protected from uncleanness since the selection of ingredients, production process, packaging, preservation, distribution and sale. Moreover, Muslims are also prohibited to

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consume animal blood, food derived from all toxic plants, and also any food or drink containing alcohol or hazardous ingredients (Halal Standard Institute of Thailand, 2014).

Vanichpun (2003) found the glutinous rice gave good binding of the mixed ingredients of Thai fermented sausage when compared to rice, glass noodle, mixture of rice and glass noodle and mixture of glutinous rice and glass noodle. In addition, consumers' are increasingly concerned about their health; hence, the use of Riceberry rice, which is obtained from cross-breeding Khao Jao Hom Nil and white jasmine rice no.105, is composed of high antioxidants, such as betacarotene, gamma oryzanol, vitamin E, tannin, zinc and folate; having low to medium sugar index also helps reducing the risk of cancer and lowering cholesterol levels (Akkarawinit, 2016). As a result, it is greatly interesting to use Riceberry rice as an ingredient of Sai Krok E-san Kai, as to increase the nutritional value and the suitability of being a healthy food.

As Halal food has been accepted to be hygienic, there has been an upsurge in its popularity. Therefore, the researchers would like to develop Sai Krok E-san (fermented sausage) using chicken instead of pork as a way to conform to Halal standards. Moreover, addition of Riceberry rice was studied for the optimal ratio between sticky rice and Riceberry rice, in order to develop into a healthy Halal food, so as to add an alternative product for Muslim consumers and any consumers.

The objectives of this research are study of ratio of sticky rice and Riceberry rice in Sai Krok E-san Kai and to compare the nutritional values between control Sai Krok E-san Kai and Sai Krok E-san Kai with Riceberry as well as to test for consumer's acceptance of Sai Krok E-san Kai with Riceberry rice.

## Materials and methods

### Materials

Chicken breast fillet was produced by Betagro Pub Co., Ltd. Riceberry rice was produced by Chia Meng Co., Ltd. (Hongthong brand). Sticky rice was produced by Sandee Rice (Thailand) Co., Ltd.

### Methods

#### 1. Study the ratios of sticky rice to Riceberry rice in Sai Krok E-san Kai with Riceberry rice

This research used chicken as a pork substitute in Standard Sai Krok E-san (Chaisorn, 2009) as shown in Fig. 1 and Riceberry rice as a sticky rice substitute, with

sticky rice: Riceberry rice ratio of 70:30, 50:50 and 0:100. The Sai Krok E-san Kai with various ratios were tested for consumers' liking test with 50 panelists using 9-point hedonic scale (1 = "dislike extremely", 9 = "like extremely"); the tested attributes consisted of appearance, color, aroma, taste, texture and overall liking. The samples were coded with three-digit randomized numbers and served in sequential monadic order (Lawless & Heyman, 1998).

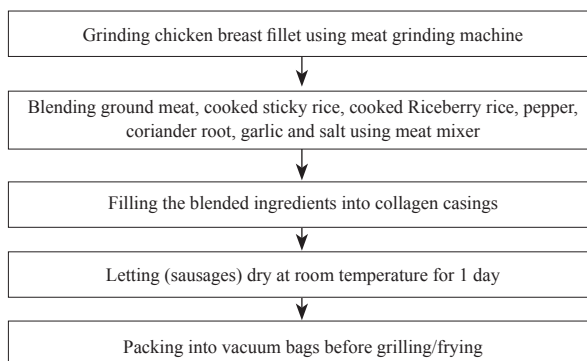


Fig. 1 Fermented sausage processing

#### 2. Comparison of nutritional values between control Sai Krok E-san Kai and Sai Krok E-san Kai with Riceberry rice

Sai Krok E-san Kai and Sai Krok E-san Kai with Riceberry rice which had the highest score from the previous experiment were evaluated in nutritional values, chemical qualities and Microbiological qualities as follows:

Nutritional values and chemical qualities (AOAC., 2012)

- 1) Total Fat
- 2) Total carbohydrate
- 3) Total dietary fiber
- 4) Ash
- 5) Vitamin B1
- 6) Vitamin B2
- 7) Sodium
- 8) Iron
- 9) Zinc
- 10) Total Polyphenol
- 11) Folate

Microbiological qualities

- 1) Aerobic plate count
- 2) Lactic acid bacteria at 30°C

### 3. Acceptance test of consumers for Sai Krok E-san Kai with Riceberry rice

A survey for acceptance test of target consumers, consisting of 50 Muslim panelists and 50 non-Muslim panelists, that consume Sai Krok E-san Kai with Riceberry rice at least twice per month using a questionnaire, including demographic data, data of consumers' liking scores toward the product using the 9-point hedonic scale, and data of 100 panelists' acceptance using the binomial (yes/no) scale.

### 4. Statistical analysis

Data from formulation and nutritional values were subjected to analyses of variance (ANOVA) and t-test. The results of acceptance test were calculated with the frequency (percentage). Statistical difference was established at  $p < 0.05$ .

## Results and Discussion

### 1. The optimal ratio between sticky rice and Riceberry rice in Sai Krok E-san Kai with Riceberry rice

The study of ratios between sticky rice and Riceberry rice in Sai Krok E-san Kai consists of 3 ratios, i.e. 70:30, 50:50 and 0:100. The samples were tested for liking scores with 50 panelists, using 9-point hedonic scale; the results in each attribute are as follows (Table 1).

In visual aspect, the ratio between sticky rice and Riceberry rice of 70:30 and 50:50 had the highest liking score of 7.63 – 7.65 (like moderately to like very much). The liking scores of 0:100 sticky rice to Riceberry rice ratio were averaged to be 6.73 (like slightly to like moderately).

With respect to colors, the ratio of 70:30 sticky rice to Riceberry rice had the highest liking score of 7.51 (like moderately to like very much), the 50:50 ratio had an average liking score of 7.38 (like moderately), and the 0:100 ratio had an average liking score of 6.56 (like slightly to like moderately). Due to the red-violet color of Riceberry rice (Akkarawinit, 2016), the Sai Krok E-san therefore had a dark color, unusual from common Sai Krok E-san.

For aroma, the 50:50 ratio of sticky rice: Riceberry rice had the highest liking score of 7.55 - 7.56 (like moderately to like very much), and the 0:100 ratio of sticky rice: Riceberry rice had an average score of 6.60 (like slightly to like moderately).

Regarding taste, the 50:50 and 70:30 ratios of sticky rice to Riceberry rice had the highest liking score of 7.21 - 7.23 (like moderately), while the 0:100 ratio of sticky rice to Riceberry rice had an average score of 6.55 (like

slightly to like moderately).

For the texture, the 50:50 ratio of sticky rice to Riceberry rice had the highest liking score of 7.31 (like moderately). The 70:30 ratio of sticky rice to Riceberry rice had an average score of 7.10 (like moderately) and the 0:100 ratio of sticky rice to Riceberry rice had an average score of 6.50 (like slightly to like moderately).

In overall liking, the 50:50 ratio of sticky rice to Riceberry rice had the highest liking score of 7.58 (like moderately to like very much). The 70:30 and 0:100 ratios of sticky rice to Riceberry rice had average scores of 7.35 (like moderately) and 6.46 (like slightly to like moderately), respectively.

Considering the results, it can be concluded that the 50:50 ratio of sticky rice to Riceberry rice was the most appropriate for producing Sai Krok E-san Kai with Riceberry rice, as it had the highest liking scores in various attributes, i.e. appearance, aroma, taste, texture and overall liking. Furthermore, the product is able to have up to 50% of Riceberry rice as sticky rice substitute, increasing the nutritional benefits from Riceberry rice; henceforth, making the development of healthy product suitable.

**Table 1** Average liking scores of Sai Krok E-san Kai with different Riceberry rice proportions

Sensory characteristics	Sticky rice : Riceberry rice ratio 70 : 30	Sticky rice : Riceberry rice ratio 50 : 50	Sticky rice : Riceberry rice ratio 0 : 100
Appearance	7.65 ± 1.02 <sup>a</sup>	7.63 ± 0.99 <sup>a</sup>	6.73 ± 1.07 <sup>b</sup>
Color	7.51 ± 1.49 <sup>a</sup>	7.38 ± 0.92 <sup>b</sup>	6.56 ± 1.03 <sup>c</sup>
Aroma	7.55 ± 1.15 <sup>a</sup>	7.56 ± 1.12 <sup>a</sup>	6.60 ± 1.19 <sup>b</sup>
Taste	7.21 ± 1.24 <sup>a</sup>	7.23 ± 1.30 <sup>a</sup>	6.55 ± 1.09 <sup>b</sup>
Texture	7.10 ± 1.27 <sup>b</sup>	7.31 ± 1.05 <sup>a</sup>	6.50 ± 1.04 <sup>c</sup>
Overall liking	7.35 ± 1.17 <sup>b</sup>	7.58 ± 1.14 <sup>a</sup>	6.46 ± 1.12 <sup>c</sup>

**Remark:** Means in rows followed by different letters represent significant differences ( $p < 0.05$ ).

### 2. Nutritional values and chemical qualities of Sai Krok E-san Kai and Sai Krok E-san Kai with Riceberry rice

According to Table 2, the comparison of nutritional values and chemical qualities between that of Sai Krok E-san Kai and that of Sai Krok E-san Kai with Riceberry rice showed that the developed Sai Krok E-san Kai with Riceberry rice had lower energy and higher total dietary fiber, iron and zinc than standard Sai Krok E-san Kai, while having less total fat and total carbohydrate. Therefore, the developed Sai Krok E-san Kai with Riceberry rice is a suitable alternative of healthy products.

**Table 2** Nutritional values and chemical qualities of Sai Krok E-san Kai and Sai Krok E-san Kai with Riceberry rice (per 100 g)

Nutritional values	Sai Krok E-san Kai	Sai Krok E-san Kai with Riceberry rice
Energy (kcal)	181.29 ± 0.12 <sup>a</sup>	163.65 ± 0.10 <sup>b</sup>
Moisture (g) <sup>ns</sup>	62.47 ± 0.02	65.84 ± 0.02
Protein (g) <sup>ns</sup>	13.55 ± 0.08	13.72 ± 0.06
Total Fat (g)	8.29 ± 0.02 <sup>a</sup>	7.49 ± 0.03 <sup>b</sup>
Total Carbohydrate (g)	13.12 ± 0.09 <sup>a</sup>	10.34 ± 0.05 <sup>b</sup>
Total dietary fiber (g)	2.58 ± 0.01 <sup>b</sup>	4.86 ± 0.02 <sup>a</sup>
Soluble dietary fiber (g)	0.16 ± 0.00 <sup>b</sup>	0.20 ± 0.00 <sup>a</sup>
Insoluble dietary fiber (g)	2.42 ± 0.00 <sup>b</sup>	4.66 ± 0.00 <sup>a</sup>
Ash (g) <sup>ns</sup>	2.57 ± 0.02	2.61 ± 0.01
Vitamin B1 (mg) <sup>ns</sup>	0.06 ± 0.00	0.07 ± 0.00
Vitamin B2 (mg) <sup>ns</sup>	0.10 ± 0.00	0.12 ± 0.00
Sodium (mg)	823.08 ± 0.10 <sup>a</sup>	808.84 ± 0.10 <sup>b</sup>
Iron (mg)	0.45 ± 0.00 <sup>b</sup>	0.97 ± 0.00 <sup>a</sup>
Zinc (mg)	0.69 ± 0.00 <sup>b</sup>	0.75 ± 0.00 <sup>a</sup>
Total polyphenol (mg ea GA) <sup>ns</sup>	56.73 ± 0.10	57.52 ± 0.10
Folate (mcg) <sup>ns</sup>	18.00 ± 0.01	18.00 ± 0.01

**Remark:** Means in rows followed by different letters represent significant differences (p<0.05)

<sup>ns</sup> = Means in row are not significant differences (p>0.05).

According to pricings, Sai Krok E-san Kai costs 38.2 baht, and Sai Krok E-san Kai with Riceberry rice costs 38.5 baht. While their costs are somewhat similar, Sai Krok E-san Kai with Riceberry rice contains more insulation fiber. Among numerous health benefits of fiber, a high-fiber diet is associated with a lower risk of many disease, including obesity, cardiovascular disease, diabetes, metabolic syndrome and others. (Lattimer & Haub, 2010)

From Table 3, the results from microbial test in Sai Krok E-san Kai and Sai Krok E-san Kai with Riceberry rice (per 100 g) showed that Sai Krok E-san Kai had an aerobic plate count of  $8.4 \times 10^8$  CFU/g, and lactic acid bacteria of  $1.9 \times 10^8$  CFU/g, while Sai Krok E-san Kai with Riceberry rice had an aerobic plate count of  $1.2 \times 10^9$  CFU/g, and lactic acid bacteria of  $1.1 \times 10^8$  CFU/g, which conforms to Thai Industrial Standards Institute (1995) and Thai Community Product Standard (2003) about "Sai Krok E-san".

**Table 3** Results of microbial test in Sai Krok E-san Kai and Sai Krok E-san Kai with Riceberry (per 100 g)

Microbiological qualities	Sai Krok E-san Kai	Sai Krok E-san Kai with Riceberry rice
Aerobic plate count (CFU/g)	$8.4 \times 10^8$	$1.2 \times 10^9$
Lactic acid bacteria at 30 °C (CFU/g)	$1.9 \times 10^8$	$1.1 \times 10^8$

#### 4. Acceptability test

The respondents of the questionnaire for the study of consumers' acceptance for Sai Krog E-san Kai with Riceberry rice were 74% female and 26% male. 52% of them were aged between 41 – 60 years of age. 36% were between 20 – 40, while 9% were the elders. In terms of income, 38% of the respondents earned 15,000-30,000 Baht per month. 32% earned monthly less than 15,000 Baht, while 32% had no income.

Most respondents pointed out they consumed Sai Krog E-san Kai when they felt like it (53%). 41% reported to have Sai Krog E-san Kai during a trip and 40% during different activities, be they reading or watching TV. The reasons for consuming Sai Krog E-san Kai included desirable aroma and taste (89%), convenience of consumption (40%), reasonable price for the quality (36%). The frequency of consumption entailed once a week (54%), 2-3 times per week (19%) and once a month (13%).

92% of the respondents pointed out that they are interested in the product. Most respondents (89%) accepted Sai Krog E-san Kai with Riceberry rice. 75% of the respondents showed interest in purchasing Sai Krog E-san Kai with Riceberry rice. All were presented in Table 4.

**Table 4** Consumer acceptance of Sai Krog E-san Kai with Riceberry rice

Data items	Percentage
Gender	
Male	26
Female	74
Age	
Below 20	3
20-40	36
41-60	52
Above 61	9
Income	
No income	20
Below 15,000 Baht	32
15,001-30,000 Baht	38
30,001-50,000 Baht	10
Above 50,000 Baht	0
Time of consumption	
Feeling like	53
As a snack with drinks	27
During a trip	41
During activities, e.g. reading or watching TV	40
Others	2
Reasons for consumption	
Olfactory and gustatory sensation	89
Right pricing for quality	36
Convenience in consumption	40
Nutritional value	20
Others	1

**Table 4** Consumer acceptance of Sai Krog E-san Kai with Riceberry rice (Cont.)

Data items	Percentage
Frequency of consumption	
Everyday	0
3-4 times/week	5
2-3 times/week	9
1 time/week	19
1 times/month	54
Others	13
Interest in healthy E-san chicken sausage	
Interested	92
Not interested	8
Do you accept riceberry E-san chicken sausage?	
Yes	89
No	11
Would you buy riceberry E-san chicken sausage, once it is on sale	
Yes	75
No	25

## Conclusion

The results from developing Sai Krok E-san Kai with Riceberry rice showed that the optimal ratio of sticky rice to Riceberry rice is 50:50, which led to the utilization of Riceberry rice which has high antioxidant, but provides low energy, fat, and carbohydrate. It also has other nutritional values such as dietary fiber, iron and zinc, higher than those in standard Sai Krok E-san with 100% sticky rice. The Sai Krok E-san with Riceberry rice product has microbial quality conforming to the regulations. Results of consumers' acceptance test showed that 89% of consumers accepted the developed product and 75% would purchase the product if available in the market. Therefore, Sai Krok E-san with Riceberry rice can be a new product that would respond to the demands from all consumers including Muslim consumers and consumers who are concerned about the health.

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