

Research Article

Risk evaluation of popular ready-to-eat food sold in Bangkok

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Abstract

Risk evaluation of ready to eat food sold in fresh-markets and by street vendors in Bangkok was conducted. The purpose of this study was to evaluate the food safety situation of ready to eat food and prioritize the significant risks in order to provide preventive measures in ready to eat food preparation. Samples were collected from 5 types of the most favoured foods which are Khanomgeen-namya, Khanomgeen-namprik, Namprik-kapi, Namprik-plaraa and Yum. 24 samples were taken from each type and then analyzed for microbiological quality and heavy metals contamination. Most of food items were contaminated with *Escherichia coli* (48.3%) which had the highest amount of 7×10^4 CFU/g. In addition, *Bacillus cereus* (61.67%) with the highest amount 1.4×10^4 CFU/g, *Staphylococcus aureus* (5.00%) with the highest amount 2×10^3 CFU/g and *Clostridium perfringens* (25.83%) with the highest amount 4×10^3 CFU/g were observed. Among 120 samples there were 7 samples contaminated with *Salmonella*. Total microbiological count were found at $<10^3$ - 3.6×10^8 CFU/g which indicated that 85% of the food sold was under the ready to eat food standards set by the Department of Medical Science, Ministry of Public Health. In the case of heavy metal contamination, food samples were contaminated with lead and cadmium ranging from 0.06 – 2.99 mg/kg and 0.02 – 0.06 mg/kg, respectively. After analysis by the Gumbel method and binomial distribution, the exposure assessment of ready to eat food ranged from low to medium level, depending on the type of

food. The highest risk evaluation was found in Nam prik-plaraa contaminated with *S. aureus* and the probability of illnesses value was 0.952. Yum also had high risk from *S. aureus* with the value of 0.911. Nam prik-kapi was prone to contamination with *B. cereus* and *C. perfringens* with values of 0.086 and 0.098, respectively. The probability of illness from *Salmonella* in Nam prik-kapi was 0.125. In conclusion, although ready to eat food sold in 6 districts of Bangkok are safe to consume, with risk evaluation ranging from low to medium, but stricter control and hygienic practices in preparation and the quality of raw material should be implemented.

Keywords: Foodborne pathogens, *E. coli*, *B. cereus*, *Salmonella*, contamination, Thailand.

Introduction

The definition of Ready to Eat food (RTE) is food being ready for immediate consumption at the point of sale. It could be raw or cooked, hot or chilled, and can be consumed without further heat-treatment including re-heating [1]. Familiarity, taste, low-cost and convenience are some of the appealing factors that make street foods popular as food source. They can also play an important role in the nutritional supply, providing an opportunity for consumers to meet their daily nutritional requirements [2]. The expanding population of highly susceptible people such as elderly and immunocompromised individuals in addition the high consumption of RTE foods due to changes in lifestyle and the global trade food distribution could be the reasons for the observed increase of high risk on food poisoning [3]. Many people had experienced the sickness cause by the consumption of foods produced under unhygienic condition. Other factors such as hygiene education, drought, contaminated waters, inappropriate food storage condition, lack of cleaning, pesticide residue could be the cause of food poisoning. The aim of study was to further investigate risk of RTE foods sold in fresh market and street vendors in six districts in Bangkok in order to prioritize the most risk foods to prevent the cause of illness due to pathogens and some heavy metal contamination.

Materials and Methods

Food samples

The sample collection area was sold in fresh-markets and street vendors from 6 districts in Bangkok (Fig 1.) (name as Bang Khen, Lat Phrao, Bang Phlat, Bangkok Noi, Bang Sue and Phra Nakhon). A total of 120 samples of ready to eat food were collected during November-December 2007. Five types of the most favourite foods (ie. Khanomgeen-numya, Khanomgeen-numprik, Num prik-kapi, Num prik-plaraa and Yum) were chosen. Each type of food was taken 24 samples. Foods were kept in cold storage and taken to laboratory 2 times/week at 11:00 am and 3:00 pm and analyzed immediately.

Microbiological analysis

Then food sample was mixed and a 25 g portion was homogenized by stomacher (IUL, Masticator) with 225 ml phosphate buffer. Serial dilutions were performed as required to detect *Escherichia coli*, *Bacillus cereus*, *Staphylococcus aureus*, *Clostridium perfringens*. Total plate count and 25 g of sample was pummeled with 225 ml Buffer Peptone Water (BPW) (Merck, Darmstadt, Germany) for enrichment step of *Salmonella* detection. The pH was also measured from each sample using pH paper. (Merck, Darmstadt, Germany). Total plate counts were determined on Plate Count Agar (PCA) (Merck, Darmstadt, Germany)

and incubated at 35°C for 48 h. *E. coli* enumeration, serial dilutions of sample homogenates were plated on Chromocult coliform Agar (Merck, Darmstadt, Germany) according to the International Organization for Standardization [4] and incubated at 35°C for 24 h. *B. cereus* detection was determined by surface plating on Mannitol - egg yolk - polymyxin (MYP) agar plates (Merck, Darmstadt, Germany) supplemented with egg yolk and polymyxin B and incubated at 30°C for 24 h following Association of Official Analytical Chemist [5]. Enumeration of *S. aureus* were plated on Baird Parker agar (Merck, Darmstadt, Germany) with 5% egg yolk tellurite and incubated at 35°C for 24 h. Selected typical colonies were tested for coagulase production using Rabbit plasma (BBL, Le Pont de Claix, France) and counted [5]. Determination of *C. perfringens* was plating on Sulfite Polymyxin Sulfadiazine Agar (SPS) (Merck, Darmstadt, Germany) and incubated in anaerobic jar at 35°C for 48 h. according to the Bacteriological Analytical Manual [6]. Typical *C. perfringens* colonies were count and transferred to Motility Nitrate (Merck, Darmstadt, Germany) and Litmus Milk (BBL, Le Pont de Claix, France) incubated at 35°C for 24 h. For *Salmonella* identification after pre-enrichment samples in BPW 225 ml for 24 h at 35°C then removed a 0.1 ml to Rappaport Vassiliadis (RV) medium (Merck, Darmstadt, Germany), and incubated at 42°C for 24 h in water bath, a loopful of suspension from RV medium was streaked on Xylose lysine desoxycholate (XLD) and Hektoen enteric (HE) agar (Merck, Darmstadt, Germany) and incubated the selective agar plates for 24 h at 35°C. After incubation, picked typical colony from each plating agars to Triple sugar iron agar slant (TSI) and Lysine iron agar slants (LIA). Incubated the TSI and LIA slants (Merck, Darmstadt, Germany) for 24 h at 35°C. Then confirmed serology, using antigen A, B and C (CLINAG, Darmstadt, Germany).

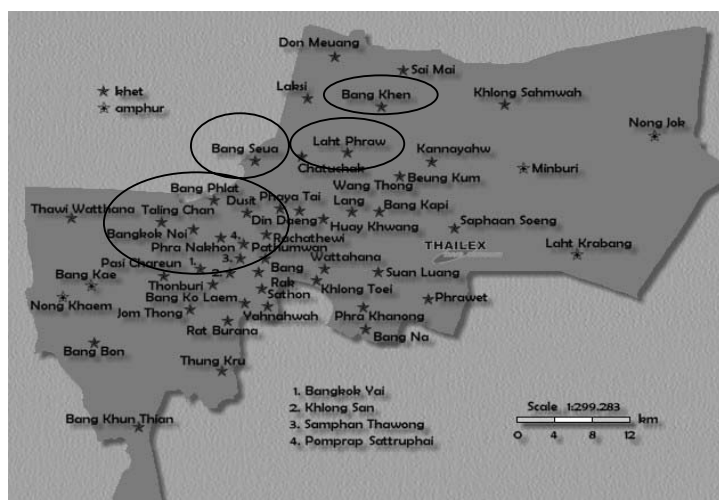


Figure 1. Sampling area in Bangkok.

Microbiological criteria

The standard of ready to eat foods was shown in Table 1 as set by the Department of Medical Science, Ministry of Public Health. [7]

Table 1. Standards for ready to eat food set by Department of Medical Science, Ministry of Public Health (2005).

Type of food		Requirement
General cooked food :	Total plate count/g	$< 1 \times 10^6$ CFU
Chinese noodles,	MPN Coliforms/g	< 500 CFU
Thai noodles (khanomgeen),	MPN <i>E. coli</i> /g	< 3 MPN
Namprik with vegetable,	<i>S. aureus</i> /g	< 100 CFU
Yum, Hotdog,	<i>B. cereus</i> /g	< 100 CFU
Preserved minced pork.	<i>C. perfringens</i> /0.01g	Not detected
	<i>V. parahaemolyticus</i> /25 g	Not detected
	<i>Salmonellae</i> /25g	Not detected

Heavy metal analysis

Lead (Pb) and Cadmium (Cd) were determined according to AOAC (2005) [8] and determined by using ICP-OEP, Optima 5300 DV.

Data analysis

The Windows Excel program was used to calculate the percentage of samples that were contaminated and probability of illnesses was estimated by Gumbel distribution for *B. cereus*, *E. coli*, *S. aureus* and *C. perfringens* and *Salmonella* using Binomial distribution.[9]

Results

The microbiological quality of 120 samples was shown that 85.0% of ready to eat food was under the standard. Numprrik-kapi which contaminated with *C. perfringens* at 3×10^3 CFU/g all sample were under microbial quality 100% (n = 24) (Table 2). Yum which was also contaminated with *S. aureus* at 1.3×10^3 CFU/g failed microbial quality at 91.7%. *E. coli* which was heavily contaminated in Numprrik-plaraa as high as 7×10^4 CFU/g has also failed microbial quality at 45.8% while 58.3% of Khanomgeen-numprrik found *B. cereus* contaminated at 3×10^3 CFU/g has also failed microbial quality.

Table 2. Population of foodborne pathogens found in favourite ready to eat food sold in Bangkok.

Samples	pH	Number of samples unsatisfactory						Unsatisfactory
		TPC	<i>B. cereus</i>	<i>E. coli</i>	<i>Cl. perfringens</i>	<i>S. aureus</i>	<i>Salmonella</i>	
Khanomgeen-numya (n = 24)	5.8±0.62 ^a	14 ^c	13	12	2	0	1	21
	5 – 7 ^b	58.3%	54.2%	50.0%	8.3%	-	4.2%	87.5%
Khanomgeen-numprrik (n = 24)	4.75±0.58	2	12	6	0	0	0	14
	4 – 6	8.3%	50.0%	25.0%	-	-	-	58.3%
Numprrik-kapi (n = 24)	5.2±0.71	6	20	12	18	1	3	24
	4 – 6	25.0	83.3%	50.0%	75.0%	4.17%	12.5%	100%
Numprrik-plaraa (n = 24)	5.7±0.93	12	17	11	3	1	1	21
	4 – 7	50.0%	70.8%	45.8%	12.50%	4.17%	4.2%	87.5%
Yum (n = 24)	4.9±0.49	13	12	17	1	3	2	22
	4 – 6	54.2%	50.0%	70.8%	4.17%	12.5%	8.3%	91.7%

^a Mean ± standard deviation.

^b Range of values

^c Number of samples under Microbiological standard [9].

The cadmium contamination in ready to eat food according to the regulation set by CODEX (1985)[10] showed that most of foods were contaminated Cadmium not over than 0.5 mg/kg. Only 3 samples were contaminated with Cadmium 0.06 mg/kg (Table 3). Besides Lead investigation, all of ready to eat food were contaminated with Lead and found that 2 samples (8.33%) of Numprik-plaraa contaminated with Lead at 2.99 mg/kg, which did not meet the standard of Thai FDA issue 98 [11] mentioned that Lead contamination in food must not more than 1 mg/kg. Heavy metals such Cadmium and Lead may contaminate from raw material, soil, water, air, plant and animal. Improper food handling and selling besides sidewalk with heavily traffic may lead to heavy metal contamination.

Table 3. Amount of Cadmium (Cd) and Lead (Pb) contamination in favourite ready to eat food sold in Bangkok.

Samples	Cadmium (Cd)		Lead (Pb)	
	Contaminated sample	Number of contaminated (mg/kg)	Contaminated sample	Number of contaminated (mg/kg)
Khanomgeen – numya (n = 24)	2 (8.3%)	0.02	20 (83.3%)	0.06-0.59
Khanomgeen – numprik (n = 24)	3 (12.5%)	0.02-0.06	19 (79.2%)	0.06-0.61
Numpri – kapi (n = 24)	10 (41.7%)	0.02-0.058	22 (91.7%)	0.07-0.79
Numprik – plaraa (n = 24)	1 (4.2%)	0.02	22 (91.7%)	0.07-2.99
Yum (n = 24)	2 (8.3%)	0.02-0.04	17 (70.8%)	0.07-0.87

The estimate risk on consumption ready to eat food contaminated with some foodborne pathogens was shown in Table 4. The result showed that the risk on consumption Khanomgeen-numprik from *Salmonella* is at 0 while the highest risk at 95.165 and 91.006 from consumption of Numprik-plaraa and Yum due to *S. aureus*, respectively. However, from 100 times of consumption found that the 95.165 chance of illness from consuming Numprik-plaraa and 91.066 chance of every kind of Yum were not depended on the frequency of consumption but it means 100 times of consumption in whole life that we can consume that kind of food, also depending on eating habit. In this study the chance of illness from consumption of ready to eat food was estimated at point of consumption, which derived from the microbiological quality from sampled foods sold in market.

Table 4. Probability of illnesses caused by foodborne pathogens in ready to eat food sold in Bangkok.

Samples	Exposure assessment in RTE food				
	<i>B. cereus</i>	<i>E.coli</i>	<i>Cl.perfringens</i>	<i>S.aureus</i>	<i>Salmonella</i>
Khanomgeen - numya	19.594	7.606	2.755	- ^a	4.17
Khanomgeen - numprik	13.699	4.238	0.158	- ^a	0.00
Numpri - kapi	8.603	5.080	9.809	- ^a	12.50
Numprik - plaraa	13.818	5.910	2.240	95.165	4.17
Yum	9.943	6.933	1.980	91.066	8.33

^a cannot evaluate the risk

Conclusions

The results found that in general the probability of illnesses from consumption RTE foods sold in 6 areas in Bangkok was safe to consume ranged from medium to low level depending on type of foods. There was the data relevant between microbial quality survey and the risk evaluations found the highest risk food were Numpruk and Yum. From the results suggested that the hygienic preparation and quality of raw material should be concerned. Numpruk-kapi have a chance of illness from *C. perfringens* contamination and Numpruk-kapi have a chance of illness from *B. cereus* contamination and finally Yum mostly in Yum pla tuu was heavily contaminated by *S. aureus*.

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