

Prevalence of *Salmonella Spp.* Contamination in Hen egg and Relationship among  
Sociodemographic Knowledge and Behavior of the Egg Consumer in Bangkok Thailand

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บทคัดย่อและแฟ้มข้อมูลฉบับเต็มของวิทยานิพนธ์ตั้งแต่ปีการศึกษา 2554 ที่ให้บริการในคลังปัญญาจุฬาฯ (CUIR)  
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ความซุกของการปนเปื้อนเชื้อซาลโมเนลล่าในไข่ไก่ และความสัมพันธ์ระหว่างพื้นฐานทางสังคม  
ประชากร ความรู้และพฤติกรรมของผู้บริโภคไข่ไก่ในกรุงเทพมหานคร ประเทศไทย



วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต

สาขาวิชาวิทยาศาสตรศาสตร

วิทยาลัยวิทยาศาสตร์ศาสตร จุฬาลงกรณ์มหาวิทยาลัย

ปีการศึกษา 2560

ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย



พลวัฒน์ ศรีเรืองสุข : ความชุกของการปนเปื้อนเชื้อซาลโมเนลล่าในไข่ไก่ และความสัมพันธ์ระหว่างพื้นฐานทางสังคมประชากร ความรู้และพฤติกรรมของผู้บริโภคไข่ไก่ในกรุงเทพมหานคร ประเทศไทย (Prevalence of *Salmonella Spp.* Contamination in Hen egg and Relationship among Sociodemographic Knowledge and Behavior of the Egg Consumer in Bangkok Thailand) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: รศ. ดร.วัฒนสิทธิ์ ศิริวงศ์, 93 หน้า.

ไข่ไก่เป็นแหล่งโปรตีนหลักในการประกอบอาหาร และยังเป็นแหล่งวัตถุดิบหลักที่มักจะพบการปนเปื้อนของเชื้อ ซาลโมเนลล่า อยู่บ่อยครั้ง งานวิจัยชิ้นนี้มุ่งศึกษาถึง ความชุกของการปนเปื้อนของเชื้อซาลโมเนลล่าในไข่ไก่ซึ่งวางขายอยู่ในเขตสุขุมวิท กรุงเทพมหานคร และความสัมพันธ์ระหว่างปัจจัยทางด้าน พื้นฐานทางสังคมประชากร อันมีผลต่อ ระดับความรู้ และพฤติกรรมในการบริโภคไข่ไก่ ของผู้บริโภคในเขตกรุงเทพมหานคร ประเทศไทย โดยงานวิจัยชุดนี้ ได้ทำการเก็บตัวอย่างไข่ไก่ประเภทต่างๆอันได้แก่เกรดธรรมดา เกรดปลอดซาลโมเนลล่า และเกรดปลอดสารเคมี ที่วางขายอยู่ใน ตลาดสด และ ซูเปอร์มาร์เก็ตในเขตสุขุมวิท และ นำไปทำการตรวจหาเชื้อซาลโมเนลล่าในไข่ไก่เหล่านั้นด้วยวิธีการ ISO6579 ในส่วนการวัดความสัมพันธ์ระหว่าง ปัจจัยทางด้าน พื้นฐานทางสังคมประชากร ต่อ ระดับความรู้ และ พฤติกรรมในการบริโภคไข่ไก่ นั้นจะมีการใช้แบบสอบถามที่ได้รับการตรวจสอบแล้วโดยผู้เชี่ยวชาญทางด้านความปลอดภัยทางอาหาร แล้วจึงนำมาคำนวณหาความสัมพันธ์ต่อปัจจัยทางด้านต่างๆด้วยวิธีการทางสถิติ

ในส่วนผลลัพธ์ที่ได้จากการศึกษานี้ได้เผยให้เห็นว่าไข่ในแต่ละระดับเกรดนั้นล้วนมีความชุกของซาลโมเนลล่าในไข่ในระดับที่ไม่แตกต่างกันอย่างมีนัยสำคัญทางสถิติ สำหรับในส่วนของการปัจจัยพื้นฐานทางด้านสังคมประชากรต่างๆที่มีผลต่อระดับความรู้ในการบริโภคไข่ไก่นั้นการศึกษาได้เผยให้เห็นว่า อายุ, ระดับการศึกษา, รายได้ของครอบครัวล้วนมีผลต่อระดับของความรู้ในการบริโภคไข่ไก่ แต่อย่างไรก็ตามการศึกษานี้เผยให้เห็นว่าปัจจัยทางด้านสังคมประชากรเหล่านี้ล้วนไม่ส่งผลใดๆต่อ พฤติกรรมในการบริโภคไข่ไก่ของประชากร

สาขาวิชา สาธารณสุขศาสตร์

ลายมือชื่อนิสิต .....

ปีการศึกษา 2560

ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

# # 5878849653 : MAJOR PUBLIC HEALTH

KEYWORDS: SALMONELLA / EGG / CONSUMPTION BEHAVIOR / CONSUMPTION HYGIENE / CONSUMER

POLLAWAT SRIRUENGSAK: Prevalence of *Salmonella Spp.* Contamination in Hen egg and Relationship among Sociodemographic Knowledge and Behavior of the Egg Consumer in Bangkok Thailand. ADVISOR: ASSOC. PROF. WATTASIT SIRIWONG, Ph.D., 93 pp.

Hen egg is the main of protien source in food ingredient and frequently contaminated by *Salmonella spp.* This research was aimed to study about the prevalence of Salmonella in egg sold in Sukhumvit area and the relationship between socio-demographic knowledge and behavior of the egg consumer in Bangkok, Thailand. This study was collected the egg samples of each grade such as Ordinary, Salmonella free and Chemical free grades that being sold in fresh market or supermarket in Sukhumvit area. Then all samples were isolated to detect *Salmonella spp.* according ISO6579 method. For the second part to find the relationship between socio-demographic factors affected on knowledge level and egg consumption behavior. This study was used the questionnaire reviewed by food safety expert then taken the result to calculate the relation between each other socio-demographic factors using statistical method.

This study was indicated the prevalence of *Salmonella spp.* was not significant different in each grade of the collected eggs. The socio-demographic factors were shown the age ,education level and household income effected on knowledge of egg hygiene level however there were reveal that no any socio-demographic factor effected on egg consumption behavior.

Field of Study: Public Health

Student's Signature .....

Academic Year: 2017

Advisor's Signature .....

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# CHAPTER I

## Introduction

### 1.1 Background and Rationale

During the late of the 20<sup>th</sup> century until now, *Salmonella Enteritica* is the one of most serious foodborne pathogen caused gastrointestinal illness in human (World Health Organization & Food and Agriculture Organization of The United nations, 2002). The typical clinical sign was composed by the series of symptoms mainly based on gastrointestinal system signs such as nausea, vomiting, diarrhea and abdominal pain however systemic sign such as fever and collapse can occur as well. The life-threatening was due to the severity of losing fluid and electrolyte balance (World Health Organization, 2013). It's was shown the illness estimated 1 million cases and 400 deaths in the United States for every year (Scallan et al., 2011). *Salmonella* infection is the infectious disease can cause of food poisoning in a lower than 5 years children and elderly in the United States (Centers for disease control and prevention & Foodborne Diseases Active Surveillance Network, 2014). In 2003 Thailand had 1,115,244 reported cases as a diarrheal disease that *Salmonella* play role as a major pathogen (Food and Agriculture Organization of The United nations & World health organization, 2004). According to the official report from the Thai ministry of public health in 2008 the number of food poisoning patient's stool was showed 95.06% positive result from non Typhoidal *Salmonella* (National Institute of Health of Thailand, 2008).

Oral route was considered as a main way of *Salmonella* transmission into the human body, It was closely associated with the consumption of contaminated foods (Tauxe, 1991). They were found on raw or processed poultry and swine product such as egg, meat, sausages and others (Mead et al., 1999). The major *Salmonella* main infection

source were eggs and poultry meats accounted 47% of total case and the other based on contamination in pork, beef, plants and others at 12%, 8%, 13% and 20%, respectively. Salmonella case does not decrease in latest 15 years (Centers for disease control and prevention, 2009). Regarding Bangkok's study in 1986, it revealed 17% of food samples in Bangkok were found the Salmonella positives and 88% of diarrhea caused by Salmonella infection in children under 5 years have also the same serotype as the isolated food of animal origin (Rasrinaul et al., 1988). Infection risk in humans associated with the consumption of contaminated food, mainly eggs (European Food Safety Authority, 2014). The prevalence of contaminated egg by Salmonella in worldwide is uncertainly caused by multiple factors triggered the contamination at every step along the food chain. The environment hygiene and good practice in poultry farm play role as a major key in this case (World Health Organization & Food and Agriculture Organization of The United nations, 2002). The previous studies showed the prevalence of Salmonella in eggs is 0.9% in England (Little, 2006), 86% in Bangladesh (Mohammad, Luthful, Sabbir, Mortuza, & Syeda, 2015), 9.4% in Hawaii (Myra, Katz, Sasaki, & Minette, 1991), 17.2% in Republic Korea (Im et al., 2015) and 9.4% in central region of Thailand (Seksom, Aurathai, Sujate, Wilailak, & Wirat, 2006).

Commercial poultry is the most rapidly growing sectors in animal agri-business worldwide (Herren, 2000). In 2015, more than 96 billion eggs were produced in United states (U.S. Department of agriculture, 2016) and more than 15 billion eggs were produced in Thailand average growth rate 9% annual (Mongkol, 2016). The 46% of egg production farm were located on the junction between Bangkok outskirts province and eastern region of Thailand such as Chachoengsao, Nakhon Nayok, Chonburi, Nakhon Pathom and Phra Nakhon Si Ayutthaya. The most egg production province is

Chachoengsao covered 15.9% of total egg production nationwide and most of them were sold to Bangkok (Department of livestock development Thailand, 2014).

The demanding of egg production was caused by the increasing of animal protein demand. In 2030, The annual demand of eggs will be increased from 6.5 to 8.9 kg per capita in developing country and from 13.5 to 13.8 kg per capita in developed country's sector (Food and Agriculture Organization of The United nations, 2003). The top five egg consumption rate nations are Mexico, Japan, Ukraine, China and Russia with 358, 329, 305, 295 and 260 eggs per capita in 2011 respectively (International Egg Commission, 2013). In Thailand, the foreign travelers were estimated around 56.8 million persons in the year 2015, and increasingly every year. Majority of foreign travelers come from China, Malaysia , Germany , United kingdom and Japan and most of them have higher egg consumption rate than local Thai people at 144 eggs per capita in 2011(International Egg Commission, 2013) and the higher egg consumption rate may lead to higher exposure rate with Salmonella-contaminated eggs as well (World Health Organization & Food and Agriculture Organization of The United nations, 2002). It may be one of the other factors that may cause 11.5% of foreign tourists fall sick after taking food in Thailand (Jarmon, 2015).

In recent day, the Salmonella serovar caused the significant health problem and under the strict control of public health under the European union regulations are *Salmonella* Enteritidis and *Salmonella* Typhimurium. Both of them must not be found in fresh poultry product. But in processed poultry product must not exist all of *Salmonella* spp. in the final products (European Union, 2005). Thailand was already established agriculture standard of consumption egg. It used the same *Salmonella* criteria with EU to support the national vision as a kitchen of the world. However the implementation still limited (National bureau of agricultural commodity and food standards, 2010). To fulfill the

consumer' need of food safety the organic or natural concept create the attitude for more harmless and healthier than the normal commercial egg. It has been used in some of egg producer and now they can penetrate and gain the market share in some European country with average 12% in market share and trigger the trend of organic in worldwide (Research Institute of Organic Agriculture, 2016). However, Thailand, the organic agriculture area was expanded estimated 7% from 2012-2013. However, the government certified organization and official standard criteria still not clearly exist. (Sunatthavee, 2015) And the 88% of consumers in Thailand believe the organic foods were better for health than normal foods (Brigit, Darnhofer, Somsook, & Christian, 2007) but the safety of organic poultry product still unclear due to some studies was reveal the organic free-range management in poultry farming can increase the prevalence of Salmonella than normal commercial practice at 31-64% compare with 9.1-12.8% respectively (Bailey & Cosby, 2005). On the other hand some study was shown the contamination rate of Salmonella were decreased in case of organic farm system compared with commercial caged system (Denagamage Thomas, 2015) Due to the lack of study, that indicated and compare about Salmonella contamination prevalence between ordinary egg, Premium chemical free (Organic egg) and Premium brand indicated themselves as Salmonella free brand and combines with measurement of egg consumer knowledge and egg consumption behavior before. This study was conducted to find the prevalence among the ordinary and premium brand of egg in Bangkok Thailand. It also found the relationship between Knowledge and egg consumption behavior with the socio-demographic factors that will be the baseline for other study about Salmonella contamination in egg and risk on the health of consumer in the future study.

## 1.2 Research question

1.2.1. What is Salmonella prevalence among Premium Salmonella free grade?

Premium chemical free grade and Ordinary grade egg in Sukhumvit area of Bangkok Thailand?

1.2.2. What is the pattern and proportion of Salmonella serovar in hen egg?

1.2.3. What is the association of egg consumption knowledge in the term of hygiene?

related to food poisoning and Eating behavior of Egg consumer in Bangkok

1.2.4. What is the relationship among socio-demographic, knowledge about eggs?

Consumption hygiene and egg consumption behavior of consumer in Bangkok?

## 1.3 Research objective

1.3.1. To investigate the prevalence and serovar of Salmonella among Premium

Salmonella-free grade, Premium chemical free grade and Ordinary grade egg in Sukhumvit area of Bangkok Thailand.

1.3.2. To find the level of egg consumption hygiene knowledge and consumption

behavior of egg consumer in Sukhumvit area of Bangkok Thailand.

1.3.3. To find the association among socio-demographic factors, level of egg

consumption hygiene knowledge and egg consumption behavior.

1.3.4. To find the correlation between level of egg consumption hygiene knowledge and

egg consumption behavior.

#### 1.4 Research gap

No research studies about the prevalence of Salmonella in Premium Salmonella-free grade, Premium chemical free grade and Ordinary grade egg table egg in Thailand before. The study about knowledge and consumption behavior that specify on the egg in Thailand still not exist in Thailand as well.

#### 1.5 Hypothesis

1.5.1. *Salmonella spp.* prevalence among Premium salmonella free grade, Premium chemical free grade and Ordinary grade egg are not different.

1.5.2. Socio-demographic factors have association with level of egg consumption hygiene knowledge and consumption behavior

1.5.3. The level of knowledge about egg hygiene and egg-related food poisoning has positive relation with egg consumption behavior.

1.5.4 The level of egg consumption hygiene knowledge has positive correlation with egg consumption behavior



## 1.6 Conceptual framework

This study was divided into two phases and served the research objective as detail below.

### 1.6.1 The first phase (Procedure to detect the *Salmonella spp.* prevalence in eggs)

Base on Salmonella isolation and identification from table egg. according to the guideline from ISO (ISO 6579:2002), the isolation steps Kauffman and White classification scheme (World Health Organization, 2007) at identification steps. the result would show the Salmonella prevalence and Serovar proportions.

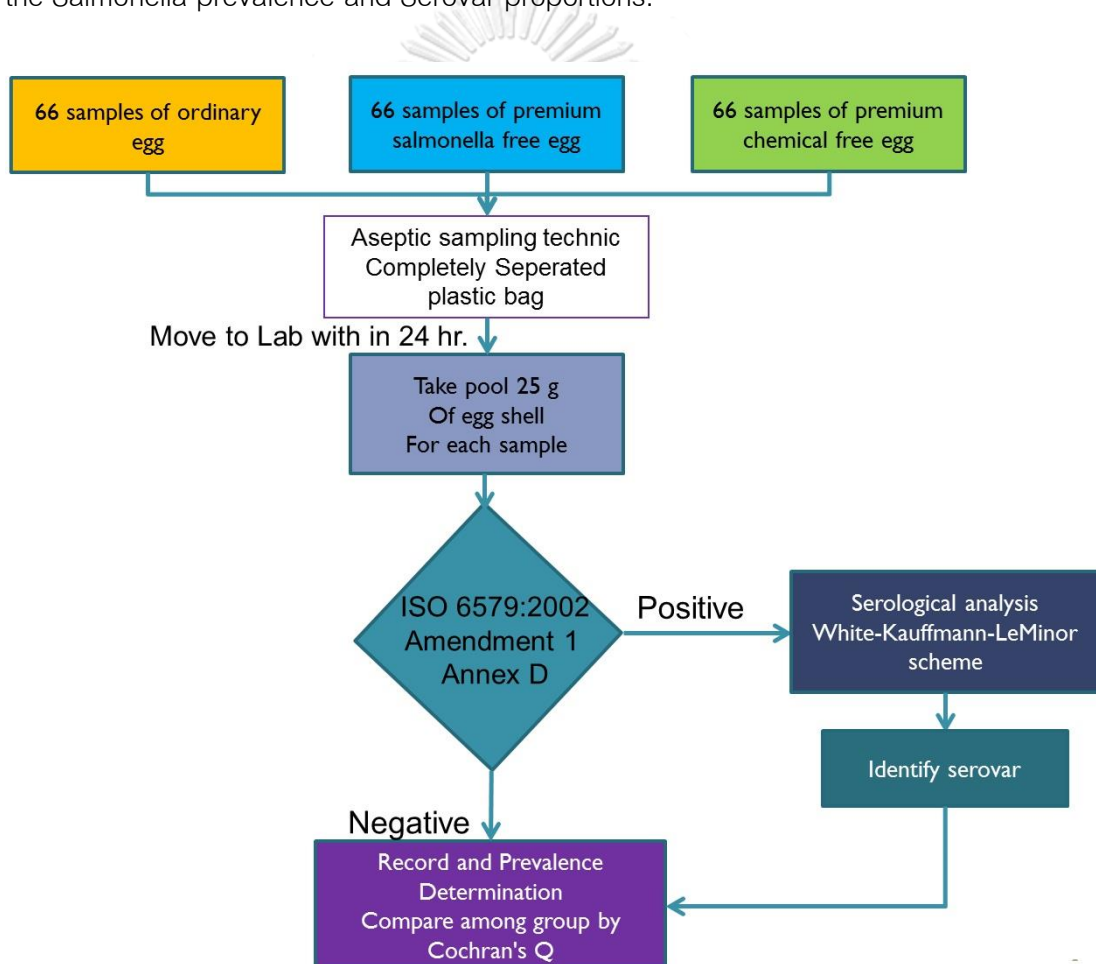


Figure 1 Salmonella isolation and identification workflow in first phase.

(International Organization for Standardization, 2014)

### 1.6.2 Inclusion criteria for first phase

For including criteria and sample grouping, we divided the egg sample, into three group, Ordinary egg, Premium Salmonella free egg, and Premium Chemical free egg.

Ordinary egg	Premium Salmonella free egg	Premium Chemical free egg
<ul style="list-style-type: none"> <li>-Price</li> <li>- less than 4.5 THB/egg (&lt;125% from official annouce price)</li> <li>-Label</li> <li>-May be no label</li> </ul>	<ul style="list-style-type: none"> <li>-Price</li> <li>- Equal or more than 4.5THB/egg</li> <li>-Label</li> <li>- Found the wording "Salmonella free" on their label</li> </ul>	<ul style="list-style-type: none"> <li>-Price</li> <li>- Equal or more than 4.5THB/egg</li> <li>-Label</li> <li>- Found the wording that related they not use chemical to treat salmonella such as               <ul style="list-style-type: none"> <li>- "No Antibiotic"</li> <li>- "Organic"</li> <li>-Etc.</li> </ul> </li> </ul>

Figure 2 Including criteria and grouping of each egg sample.

### 1.6.3 Exclusion criteria for First phase

Cracked, Expired, damaged package, cracked during the transport, rotten or changing in physical, egg from other species that not from *Gallus Gallus Domesticus* must be excluded from this study.

### 1.6.2 The second phase (The conceptual frame work of relationship among socio-demographic, knowledge and behavior of the egg consumer)

This study was focusing on to determine the knowledge about egg eating hygiene and egg eating behavior by use questionnaire, as the main tool to obtain the data and combine all of that data to become the attitude of eating egg and risk of Salmonella for the egg consumer.

#### Independent variable

#### Dependent variable

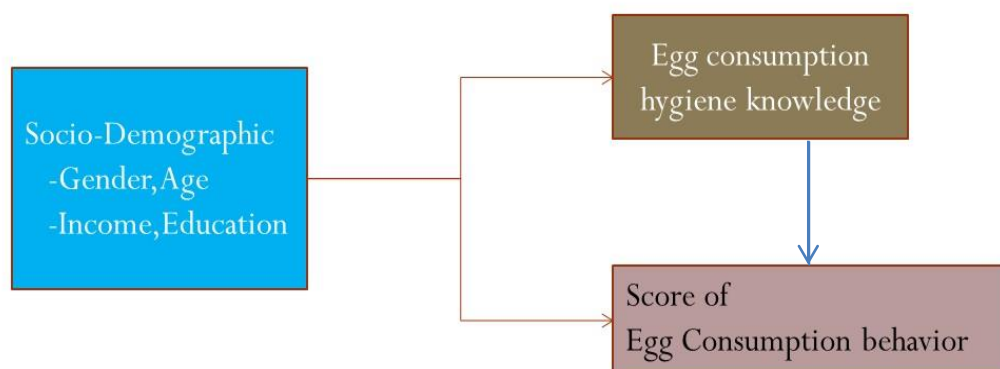


Figure 3 Conceptual framework for all of variable that concern in the second phase.

### 1.6.3 Inclusion Criteria

1. Able to communicate with Thai language fluently
2. Native Thai people

### 1.6.4 Exclusion Criteria

1. Mental health and Psychological problem

## 1.7 Operation definitions

**Salmonella:** Salmonella, a rod-shaped gram-negative bacterium belonging to the family Enterobacteriaceae, is the causative agent of salmonellosis. In most cases associated with serovar of *Salmonella Enterica*. Clinical sign is characterized by two major syndromes such as systemic septicemia and gastrointestinal illness (Walter, 2015).

**Salmonellosis:** The zoonosis can be transmitted directly or indirectly between animals and humans. Usual symptoms of human salmonellosis include fever, diarrhea and abdominal cramps. If it infects the bloodstream it can be life-threatening (European Food Safety Authority, 2014).

**Table Egg:** Egg from Hen (*Gallus gallus domesticus*) completed albumen and yolk surrounded by eggshell. and not processed (National bureau of agricultural commodity and food standards, 2010).

**ISO6579:2002 Amd 1 : 2007:** Standard has been the bacteriological standard method used in the European Union for the detection of *Salmonella spp* (Mainar et al., 2013).

**Kauffman and White classification scheme:** The system that classifies the genus Salmonella into serotypes, based on surface antigens. First the "O" antigen type is determined based on oligosaccharides associated with lipopolysaccharide. Then the "H" antigen is determined based on flagella proteins (World Health Organization, 2007).

**Organic:** All synthetic chemical inputs including veterinary medicines and synthetic hormones are prohibited in livestock production. In this study, we call them as Premium Chemical free egg (Organic Agriculture Certification of Thailand, 2016).

**Salmonella-free:** Absence of Salmonella in 25 gram of sample. By using ISO 6579:2002 method (European Union, 2005) In this study we use 10 eggs pool as a sample.

**Food poisoning:** The illness occurs after intake the food or water contaminated by food poisoning causative agent such as chemical, bacterial etc. in this study refer to Salmonella infection (Bureau of epidemiology 2014).

**Egg consumption hygiene knowledge level :** The result of measurement the basic of food hygiene that use the question set that modified from five key to safer food guideline (World Health Organization, 2015). To determine the level of consumer knowledge about food hygiene before intake the egg or egg related product.

**Fresh market :** The permanent or temporary place that prepared for multiple entrepreneurs to selling the food stuffs for both raw and cooked such as meats , fruits or ready to eat meal (Ministry of Public health Thailand, 2008).

**Supermarket:** Big retail and whole sales shop. With single or a few of entrepreneurs. With a lot of variety in goods. And have the good system to manage warehouse and supply chain. And have the device that satisfied the customer (Department of Internal trade Thailand, 2006).

## CHAPTER II

### BACKGROUND AND LITERATURE REVIEW

#### 2.1 Salmonellosis in general

Salmonellosis is one of the most common and widely found foodborne diseases around the world. It's caused by bacteria, named *Salmonella Enteritica*. The bacteria characteristic is gram-negative bacilli shape with some of the flagella. There are the two antigen group significantly to concern and used as a key classification the serovar of Salmonella. The first one is O antigen (Somatic antigen) were located on the cell wall of bacteria. the second one is H antigen (Flagellate antigen) were located on the flagella. The both antigens provide the unique agglutination pattern when it was exposed to anti-serum, This characteristic was used to identifies the Salmonella of the world with more than 2,500 serovar. However, the serovar that significantly concern and cause the illness in human are Salmonella Enteritidis (Group D) and Salmonella Typhimurium (Group B) are the most common and in some standard such as the processed poultry meat required more Salmonella Hadar, Salmonella Virchow and Salmonella Infantis in addition to restrict list (European Food Safety Authority, 2014).

The onset of disease symptoms normally occurs within 6 - 72 hours after consuming the food or drink the beverages contaminated of Salmonella, and the duration of illness normally for 2-7 days long with DALY is 3 (World Health Organization, 2013).

The clinical sign of salmonellosis is relatively mild and the patients will make a recovery without specific treatment in most cases. In the case of very young and elderly, it causes dehydration resulted it more severe and life-threatening (Centers for disease control and prevention & Foodborne Diseases Active Surveillance Network, 2014).

## 2.2 Sources and transmission

Salmonella bacteria can survive and replicate in a very varied range of hosts such as in human, Avian, Reptile and Mammal but, it can survive for a long time in the proper environment in the case outside the host. It can break through and contaminate the entire food chain from animal feed, primary production and all the way to households or food-service agent. In human, the salmonellosis case is often caused by consumption of contaminated food of animal origin especially poultry product such as chicken meat and hen eggs, however the other foods source, such as beef or pork including vegetables and spice contaminated by manure, also contaminated by Salmonella as well (Centers for disease control and prevention & Foodborne Diseases Active Surveillance Network, 2014).

For the other route transmission by the fecal-oral route can also possible. Due to individuals have contact with Salmonellosis patient stool, infected animals, including pets. The bacterial entry to the body is along the gastrointestinal tract.

### 2.3 Treatment

The symptomatic treatment is the key, electrolyte replacement to provide electrolyte, such as sodium, potassium and chloride ions, lost through vomiting and diarrhea to prevent the appearance of hypovolemic shock. The antibiotic use is not recommended for the ordinary case not severe. Antibiotic may not completely eliminate the bacteria due to their avoidance mechanism in macrophage and may trigger them to adopt the resistant ability to antibiotic however the health risk groups such as infants, the elderly and immune-compromised patients may need to receive antimicrobial therapy (Centers for disease control and prevention & Foodborne Diseases Active Surveillance Network, 2014).

### 2.4 Prevention methods

Prevention requires control measures at all level along the food chain, from farm to fork in both commercial production units and at households. Preventive measures for Salmonella in the home are similar to those used against other foodborne bacterial diseases can use some element of the five key to safer food guideline to control it (World Health Organization, 2015) such as Cook thoroughly more than 70 Celsius degree to eliminate the Salmonella or separated the cook and raw food.



## 2.5 The mechanism of contamination in egg

Salmonella is contaminated through the eggs by two routes trans-ovarian (vertical transmission) and trans-shell (horizontal transmission). For vertical transmission, Salmonella infected in hen gastrointestinal tract move through villi and survived in macrophage and dendritic cell. Then it will use macrophage as a transport shuttle along the bloodstream then later infect the ovaries or oviduct tissue to eggs prior to shell formation. *Salmonella* Enteritidis has more ability to infect the egg by this route compared with the other serovar.

In another route, the horizontal trans shell infection is usually derived from fecal contaminated on the eggshell. It also includes contamination through environmental vectors such as human, animal or objects. After some time, in the environment, the water evaporates out from the eggshell and causes inside as a negative pressure may accelerate the bacteria to move faster through the eggshell to egg content inside. In some situation, the vertical transmission is considered to be the major route of Salmonella contamination and harder to control due to a lot of factor, while horizontal transmission can be effectively reduced by cleaning and disinfection of the environment (World Health Organization & Food and Agriculture Organization of The United nations, 2002). In some study mentioned the chance found the Salmonella in egg content is significantly lower than on the eggshell. The eggshell should be more focused (Mohammad et al., 2015).

## 2.6 Control strategy for Salmonella

In every year, Salmonella cause, 1,000,000 of illness and 380 deaths in the United States of America (Centers for disease control and prevention & Foodborne Diseases Active Surveillance Network, 2014). Salmonella causes illness more than 100,000 cases in European Union (European Food Safety Authority, 2014). Most foodborne S. Enteritidis infection was related with the eating of undercooked eggs or foods containing raw eggs such as homemade eggnog, biscuit batter, homemade ice cream, mayonnaise, Caesar salad dressing and Hollandaise sauce. The 77% to 82% of S. Enteritidis outbreaks have been associated with grade A shell eggs, or egg-containing foods undercooked eggs and products containing undercooked eggs such as soft custards, French toast, soft-fried and poached eggs (World Health Organization & Food and Agriculture Organization of The United nations, 2002).

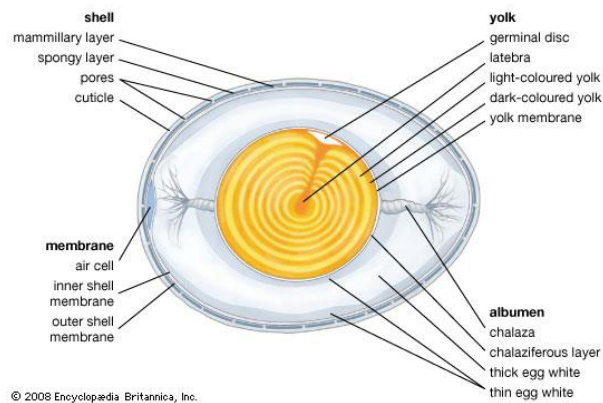
Some country is more concern about Salmonella problem, they developed their own way and strategy to control Salmonella problem such as in the European Union for any poultry fresh product that willing to access the EU market with strictly regulation that product must be an absence of both *Salmonella* Enteritidis and *Salmonella* Typhimurium. For eggs, meats, and breeding flocks, the higher standards were implemented that required the absence with *Salmonella* Enteritidis, *Salmonella* Typhimurium, *Salmonella* Hadar, *Salmonella* Virchow and *Salmonella* Infantis due to it has higher chance to cause human illness (European Union, 2005).

Currently, Thailand is the one of biggest poultry meat exporter in the world. with the main market in European Union and Japan (Department of livestock development Thailand, 2014) For the egg producer, Thailand still have not clearly direction about Salmonella issue according to the official report from Bureau of epidemiology in 2015 reported from January to February 2015. Thailand has the 1,060,000 cases of diarrhea calculated at 1.64% of total population (Bureau of epidemiology 2014) and when combined that report with another report from Thailand ministry of public health in 2008. The number of non Typhoidal Salmonella isolated from food poisoning diarrhea patient's stool is 95.06% (National Institute of Health of Thailand, 2008).The result may give us about how big of Salmonella problem in Thailand compared with the policy still affected.

## 2.7 General information of Egg

The egg is a biological structure intended by nature for reproduction of the chicken. It protects the developing chick embryo and provides a complete diet for it and serves as the principal source of food for the first few days of the baby chicken's life (United State Department of Agriculture, 2000). according to Thailand's law on the hen egg standard. Egg by the definition of law is mentioned to the egg from Hen only species *Gallus gallus domesticus* with completed albumen and yolk surrounded by eggshell and not processed (National bureau of agricultural commodity and food standards, 2010). The egg is one of the most nutritious and easy to use for human foods chickens now produce eggs inadequate enough for retaining demand, this source of food has become extremely important throughout the world, nutritionally as well as economically (United State Department of Agriculture, 2000).

For the Physical Structure, eggs are average weights around 55-60 grams, the major parts of an egg are the yolk, the albumin, the shell membranes and the shell (United State Department of Agriculture, 2000).



**Figure 4** The major composition of Egg (Encyclopedia Britannica 2008)

The yolk content represented approximately 31 percent of the total weight of the egg and albumen represented about 58 percent of the weight of the egg. The eggshell is constituted approximately 11 percent of the egg and the space between shell membrane and eggshell was called air cell usually located at the large end of the egg, The fresh egg, as laid, normally has no air cell or small and the size of air cell will be larger according to the time after laid. The size of air cell is the one of the main indicators that us to evaluate about egg freshness (United State Department of Agriculture, 2000). To evaluate the general quality of egg, which have two main major elements must be the concern, the one is exterior quality and the second is interior quality (National bureau of agricultural commodity and food standards, 2010). Exterior quality is direct external observation for the appearance of the whole egg. Interior quality involves the contents of the egg. When the eggs are broken out and measured the freshness and quality of albumen by the Haugh unit method combined with visual observation of the yolk (United State Department of Agriculture, 2000).

### 2.7.1 Exterior quality factor

-**Shell Shape and Texture.** The normal egg has an oval shape with one end larger than the other and it tapers toward the smaller end. The ends of an egg are commonly called the large end (air cell end) and the small end (United State Department of Agriculture, 2000).

-**Egg shell.** Must be a good distribution of pigment and clean. Have no spot or area of any crack and leak and absence of mold (National bureau of agricultural commodity and food standards, 2010).

### 2.7.2 Interior quality factor

-**Air Cell.** When the egg is first laid, it has only a small air cell. The reason of increase in the size is due to evaporation of water from the egg. For the acceptable quality egg, the air cell size must not larger than 0.8 cm. Air cell must be on the larger end of egg and cannot move freely (National bureau of agricultural commodity and food standards, 2010).

-**Yolk.** The yolk must have homogeneous yellow or reddish color. Have no the sign or abnormal color also have no pungent odor. Dome shape on the flat plate (National bureau of agricultural commodity and food standards, 2010).

-**Albumen.** Must be clear and have no any foreign bodies floating in it,

and should be firm with sufficiently thick or viscous to prevent the yolk outline of being more than slightly defined or indistinctly indicated when the egg is twirled. With respect to a broken-out egg, a firm albumen has a Haugh unit value of 72 or higher when measured at a temperature between 45 and 60 °F (United State Department of Agriculture, 2000).

-**Haugh unit.** The Haugh unit developed by Raymond Haugh in 1937 and consists of a correlation of the height of the thick albumen, the weight of the egg, and the internal egg temperature. At one time, the use of Haugh meter to measure the height of albumen. this method was part of USDA's quality control program (United State Department of Agriculture, 2000).

<b>SPECIFICATIONS FOR EACH QUALITY FACTOR</b>			
<b>Quality Factor</b>	<b>AA Quality</b>	<b>A Quality</b>	<b>B Quality</b>
<b>Shell</b>	Clean  Unbroken. Practically Normal.	Clean  Unbroken. Practically Normal.	Clean to slightly stained.*  Unbroken. Abnormal.
<b>Air Cell</b>	1/8 inch or less in depth.  Unlimited movement and free or bubbly.	3/16 inch or less in depth.  Unlimited movement and free or bubbly.	Over 3/16 inch in depth.  Unlimited movement and free or bubbly.
<b>White</b>	Clear. Firm.	Clear. Reasonably firm.	Weak and watery.  Small blood and meat spots present.**
<b>Yolk</b>	Outline slightly defined.  Practically free from defects.	Outline fairly well defined.  Practically free from defects.	Outline plainly visible.  Enlarged and flattened.  Clearly visible germ development but no blood. Other serious defects.
<b>For eggs with dirty or broken shells, the standards of quality provide two additional qualities.</b>			
<b>Dirty</b>		<b>Check</b>	
Unbroken. Adhering dirt or foreign material, prominent stains, moderate stained areas in excess of B quality.		Broken or cracked shell, but membranes intact, not leaking.***	
<p>* Moderately stained areas permitted (1/32 of surface if localized, or 1/16 if scattered.).</p> <p>** If they are small (aggregating not more than 1/8 inch in diameter).</p> <p>*** Leaker has broken or cracked shell membranes, and contents leaking or free to leak.</p>			

Table 1 Summary of U.S. standards for quality of individual shell eggs  
(United State Department of Agriculture, 2000)

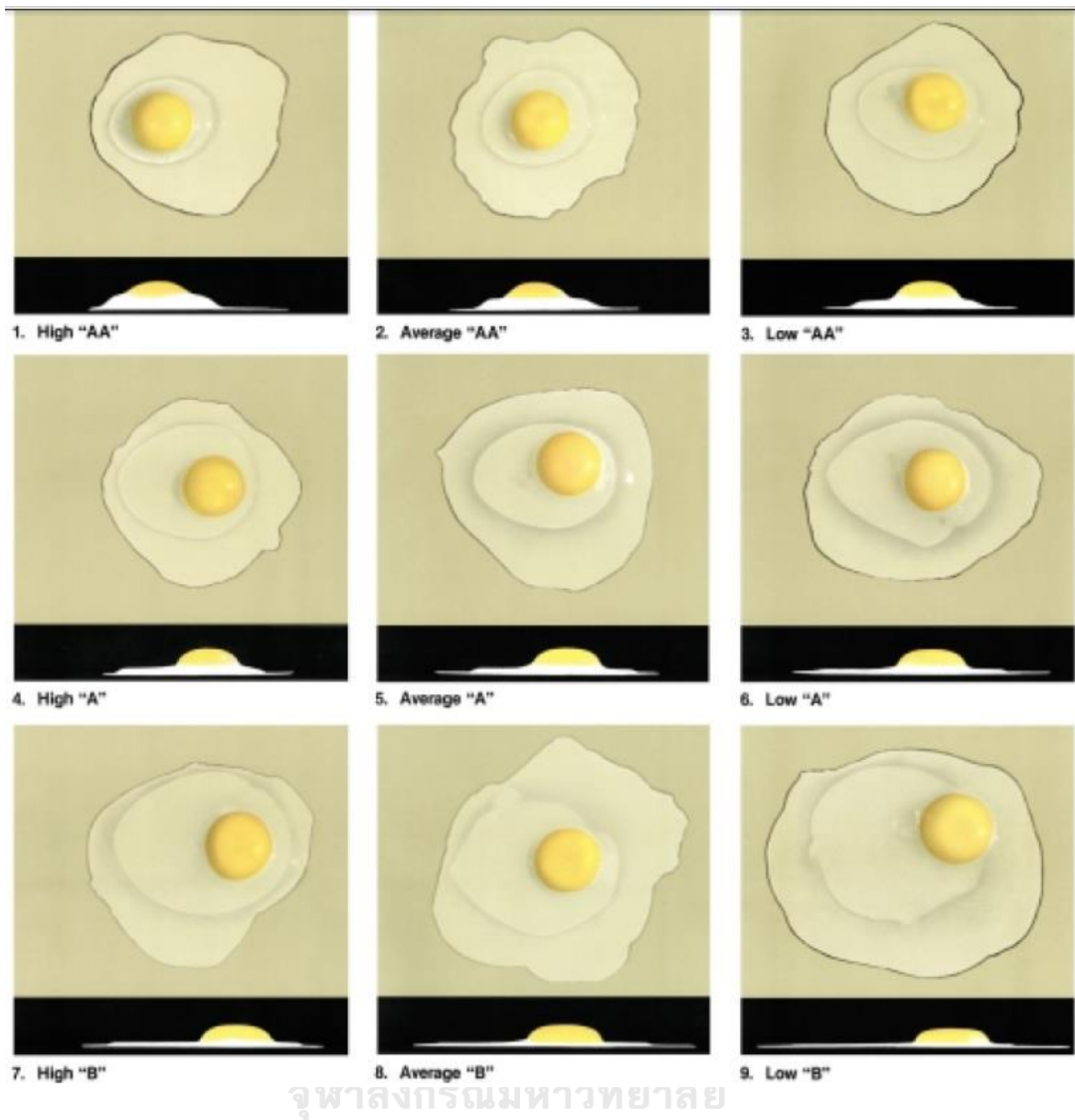


Figure 5 Chart demonstrate the interior quality of broken-out eggs for each of designated grades as specified in the U.S. Standards with respect to white and yolk quality (United State Department of Agriculture, 2000).



## CHAPTER III

### METHODOLOGY

#### 3.1 Study Design

The study was a cross-sectional study which conducted during January – April 2017.

#### 3.2 Study Area

Sukhumvit area , Bangkok Thailand.

#### 3.3 Study Population

-The first phase (Salmonella contamination rate in egg)

-Egg brands that indicated themselves as Premium Salmonella free randomly selected

-Egg brands that indicated themselves as Premium Chemical free randomly selected

-Egg brand that indicated themselves as Ordinary egg

-The second phase (Relationship among Socio-demographic, Knowledge and Behavior of the egg consumer)

-Native Thai Egg consumer that found in Sukhumvit area

### 3.4 Sample and Sampling size

3.4.1 For the first phase, **Salmonella contamination rate in egg** was based on the survey and take egg samples from local fresh markets and convenient stores inside the Sukhumvit areas of Bangkok Thailand using laboratory method to detect the existence of Salmonella in egg samples, according to the guideline from ISO (International Organization for Standardization, 2014).

The first step based on simple random sampling between three groups of egg brands, the first group was the common egg, the second was the egg brand indicated themselves as Salmonella-free on their label and the last was egg brand indicated as the chemical-free wording on their label, for example, organic, antibiotic-free, etc. This study was classified by three criteria; the first criteria was the price of those brands compared with the market base price announced by the department of internal trading of Thailand as a reference. Any brand sets its price more than 25% with an official baseline, it automatically moved to the second criteria used the "Salmonella-free" wording if the word exists on their label brand indicated as Salmonella free premium grade. On the other hand, if that word not exist but the other premium declaration wording on their own labels such as antibiotic-free, organic and etc., that brand counted as a premium chemical free criteria. The sample size for estimated proportion of Salmonella in egg was calculated by simple formula as below at 95% confidence level and margin of error at 0.075 and expected prevalence at 10% refer to the prevalence of Salmonella in egg at central region was 9,4% (Seksom et al., 2006).

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where: n = sample size

Z = Z statistic for a confidence level

P = expected prevalence


d = margin of error (in proportion of one; if 7.5%, d = 0.075)

Calculate:

Z = 1.96 (Z at 95% confidence level)

P = 0.1

d = 0.075



$$n = \frac{1.96^2 0.1(1 - 0.1)}{0.075^2}$$

Total sample size = 62 egg samples/group

+5% For spare = 66 egg samples/ group

According to the calculation result, we required 66 samples for each egg brand group. We use 10 eggs without crack, expired and damaged packed as a pooled sample with 11 samples from six random brand and do duplicate for each sample. To obtain the sample, two plastic bags used to pack with 10 egg per each inside at randomly as 1 sample and 1 duplicate. This study was used three dimensions simple random sampling for each shelf of egg in fresh market or supermarket. For example, if the shelf of brand A

egg has 6 boxes in width, 3 boxes in height and depth. So we random the number 1-6 for width, 1-3 for height and 1-3 for depth by row the dice. If the results were shown 3 for width, 1 for height and 2 for depth. Then took the box that locates on position 3 for width, 1 for height and 2 for depth as a sample. (Figure 6)

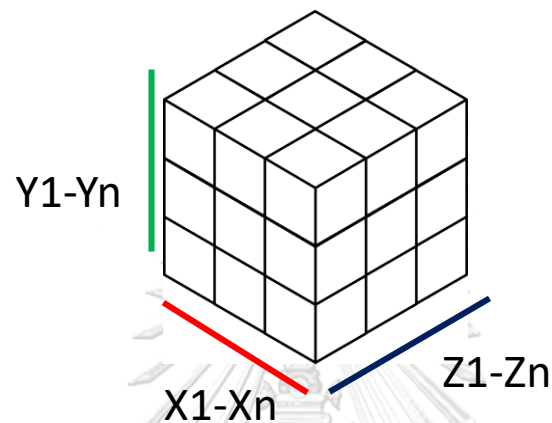


Figure 6 Egg sampling from shelf in marketplace concept.

Put it in the plastic bags completely sealed after placed it in ice container controlled the temperature at 2-7 Celsius degree. then sent the container to ISO certified laboratory within 24 hours. The isolation of the Salmonella from the eggshell ISO was used by 6579:2002 Amd 1:2007 method to detect the existence Salmonella of Salmonella in each sample. For each positive samples, the study used Kauffman and White classification scheme to classify the serovar group of each sample (World Health Organization, 2007). (Figure 7,8 and 9)



Figure 7 Using alcohol to disinfection of latex glove

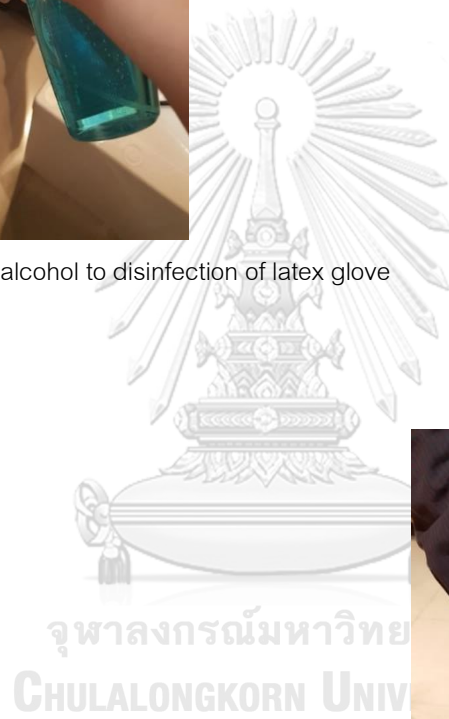


Figure 8 Show collected egg package  
in zip lock sterile plastic bag



Figure 9 The cool container with cooling gel



### 3.4.1.1 ISO 6579:2002 Amd 1:2007 procedure in detail

The ISO 6579 method for detecting the Salmonella is national reference method that widely used to detect and confirm the existence of Salmonella in food material or environment (Public Health England, 2014). This method composed of four major steps as below.

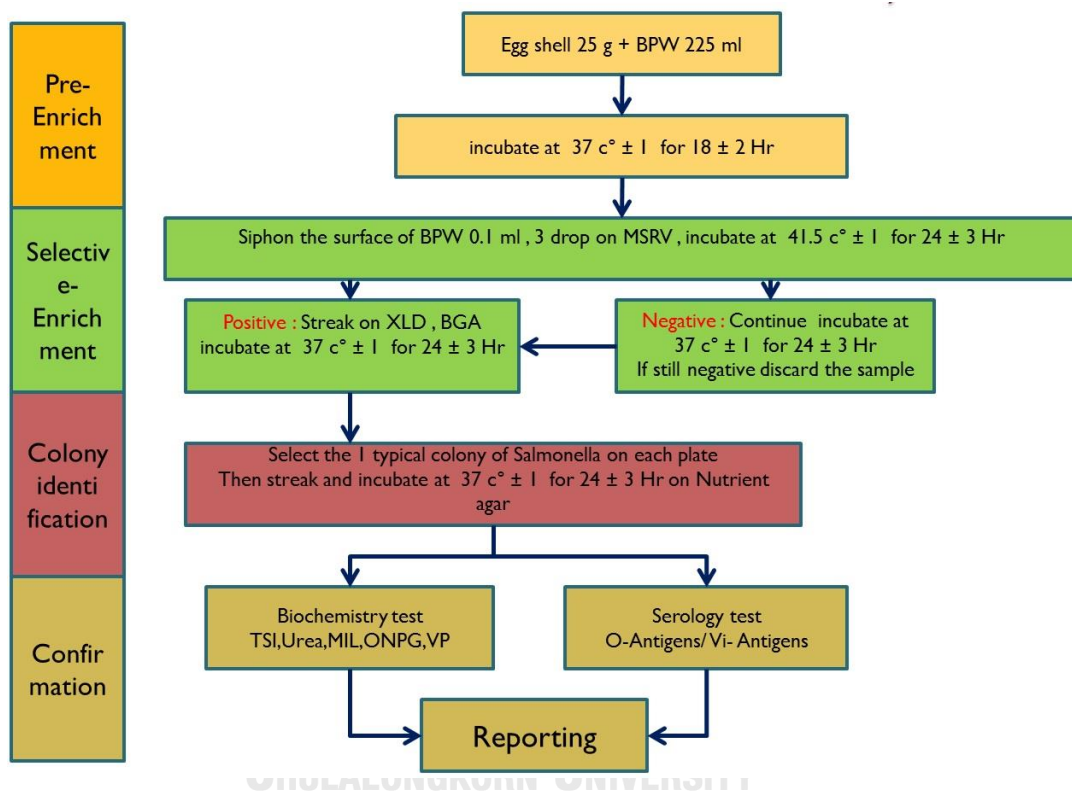


Figure 10 The diagram of each step of ISO6579 2002:Amd D as conventional method for Salmonella detection (International Organization for Standardization, 2014).

#### 3.4.1.1.A Sample preparation and pre-enrichment

The 10 eggs for 1 pooled sample including shells without shell disinfection or exposed directly to the sunlight, place the whole eggs can in sterile plastic bag and put it in stomacher to prevent the risk of contamination, and add an equal weight of buffered peptone water. Break the contents of the eggs into a stomacher bags and transfer the shells to a separate sterile plastic bag. Add a sufficient Buffered Peptone Water to cover the shells to give an approximate 10-1 dilution. Mix carefully by hand for a minimum of 2 minutes. Place all enrichment cultures in an incubator at  $37 \pm 1^\circ\text{C}$  for  $18 \pm 2$  h (Public Health England, 2014). (Figure 11)

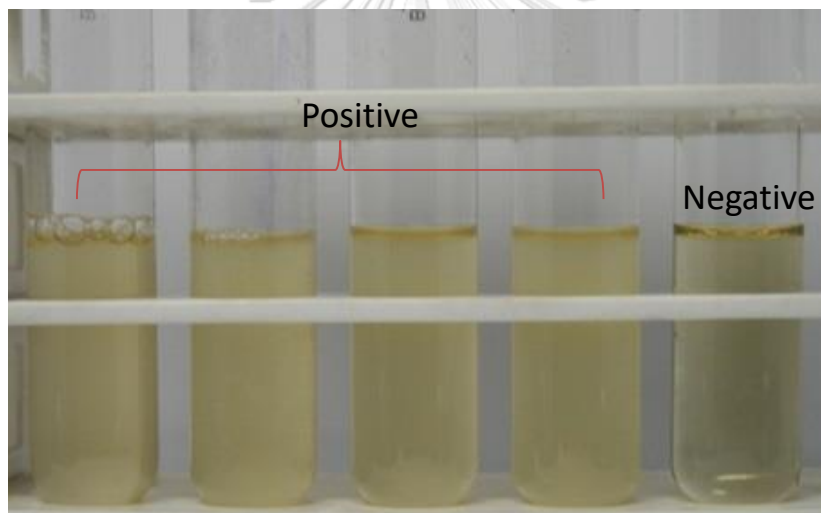


Figure 11 The result on BPW after incubated at  $37 \text{ c}^\circ \pm 1$  for  $18 \pm 2$  Hr



### 3.4.1.1.B Selective enrichment

After pre-enrichment buffered peptone water broths were incubated overnight (18 hr.), it was sub-cultured to a selective enrichment broth. The sub-culture of Modified semi-solid Rappaport-Vassiliadis (MSRV) were placed in an incubator at  $41.5 \pm 1^\circ\text{C}$  for  $48 \pm 3$  h (Public Health England, 2014).(Figure 12)

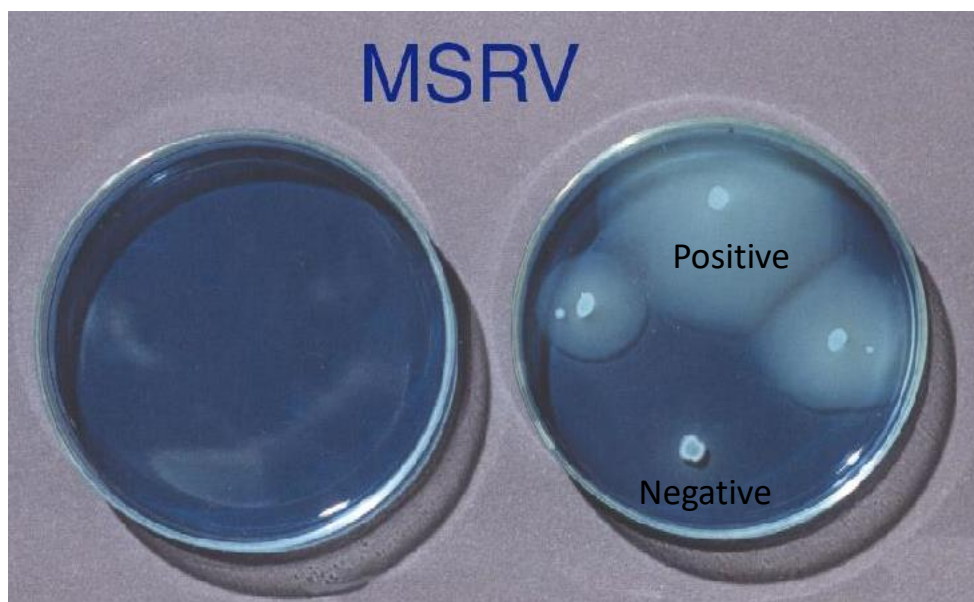


Figure 12 The result on MSRV after incubated at  $37^\circ\text{C} \pm 1$  for  $24 \pm 3$  Hr  
(International Organization for Standardization, 2014)

### 3.4.1.1.C Subculture to selective media

The selective enrichment were cultured to XLD, BGA using a 10  $\mu$ L loop by using a separate sterile stick or loop streak out to obtain discrete colonies. The cultured plates were placed in an incubator at  $37 \pm 1^\circ\text{C}$  for  $24 \pm 3$  h. Re-incubate negative plates for a further  $24 \pm 3$  h (Public Health England, 2014). (Figure 13 and 14)



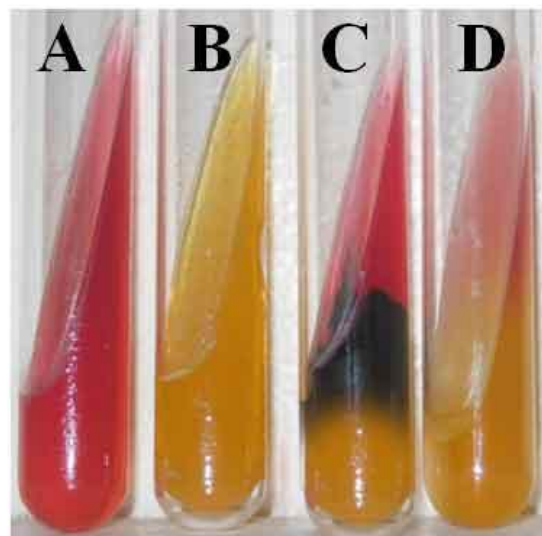
Figure 13 Typical colony of Salmonella on XLD Agar from ISO 6579 method  
(International Organization for Standardization, 2014)



Figure 14 Typical colony of Salmonella on BGA Agar from ISO 6579 method  
(International Organization for Standardization, 2014)

### 3.4.1.1.D Recognition of colonies

After  $24 \pm 3$  h, the selective agar plates were examined for typical and atypical colonies of Salmonella (Public Health England, 2014) for fermented xylose, normally decarboxylate lysine and produce hydrogen sulphide. Characteristic colonies are red with black centers. Isolated colonies may appear yellow with black centers. Salmonella species that produce little or no hydrogen sulfide eg: *S. Typhi*, *S. Senftenberg*, *S. Pullorum* grow as red colonies with or without black centers. Red colonies may also be produced by some strains of *Proteus* species and *Pseudomonas* species. Strains of *S. Paratyphi A* do not decarboxylate lysine and so appear as yellow colonies usually with a black centre. Lactose fermenting strains may also appear yellow with or without black centers. (Figure 15 and 16)



- A) *Pseudomonas aeruginosa*:** Gluc (-), Lac/Suc (-), H<sub>2</sub>S (-)  
**B) *Escherichia coli*:** Gluc (+), Lac/Suc (+), H<sub>2</sub>S (-)  
**C) *Salmonella typhimurium*:** Gluc (+), Lac/Suc (-), H<sub>2</sub>S (+)  
**D) *Shigella boydii*:** Gluc (+), Lac/Suc (-), H<sub>2</sub>S (-)

Figure 15 TSI pattern for biochemistry test

Source: <https://s-media-cache>

[ak0.pinimg.com/originals/2c/a9/e0/2ca9e0559051cde6a7ed7944efd5e90d.jpg](https://ak0.pinimg.com/originals/2c/a9/e0/2ca9e0559051cde6a7ed7944efd5e90d.jpg)

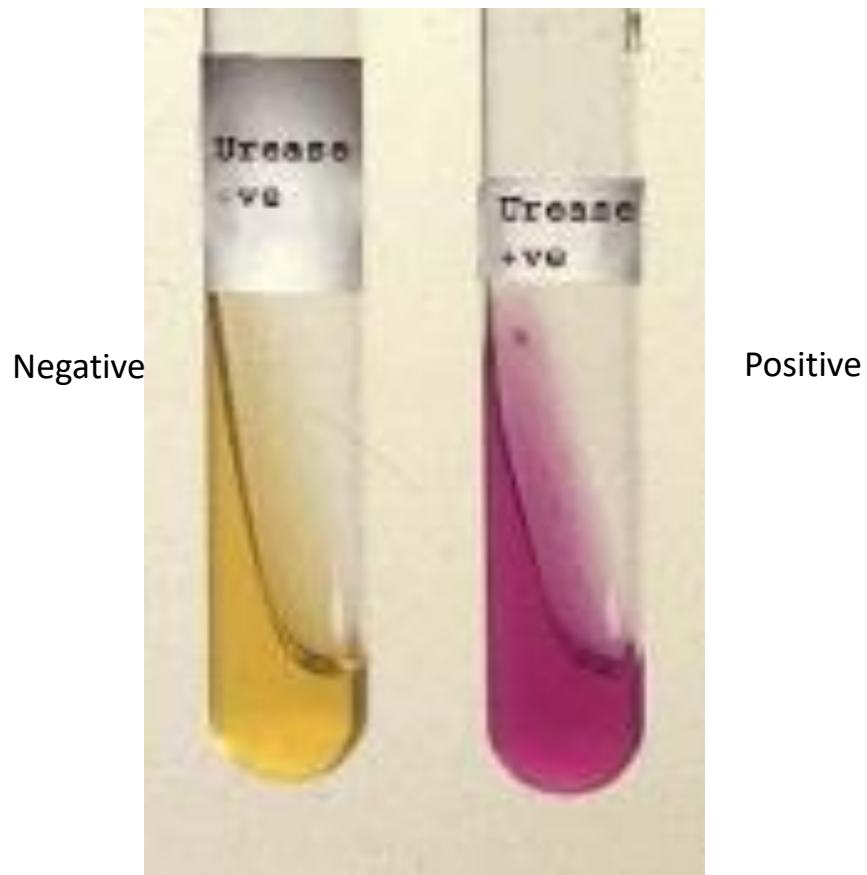


Figure 16 Urease pattern for biochemistry test (Salmonella was negative for urease test)

Source : [http://people.upei.ca/bdespres/html/5a\\_demo.html](http://people.upei.ca/bdespres/html/5a_demo.html)

### 3.4.1.1.E Confirmatory tests

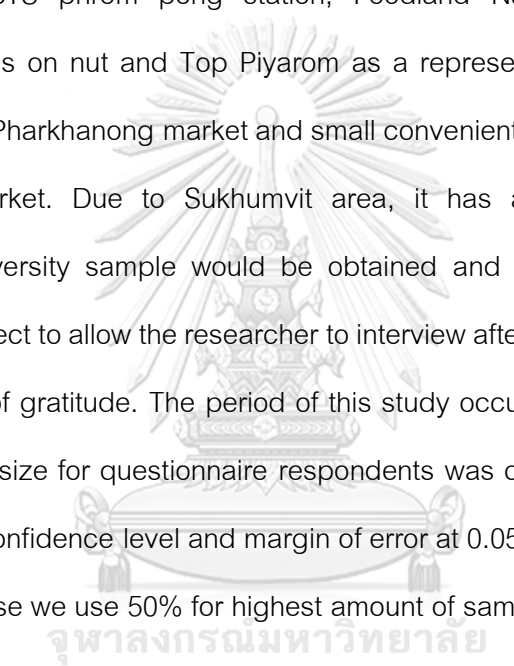
Typical colonies from each plate were subjected to serological confirmation by identification of specific lipopolysaccharide ('O') and flagella ('H') antigens on the surface of presumptive *Salmonella* isolates using specific antisera is carried out prior to biochemical identification. Live cultures of *Salmonella* are used and must be taken to avoid infection or cross contamination. We used Kauffman and White classification scheme along with ISO/TR 6579-3 that is the next step from ISO6579 (International Organization for Standardization, 2014; World Health Organization, 2007). (Figure 17)



Figure 17 Result of *Salmonella* positive sample in antiserum for serology test

### 3.4.2 The second phase (relationship among socio-demographic, knowledge and behavior of the egg consumer)

The population of this phase was recruited from Thai supermarket and fresh market's customer, the convenience sampling for this study consisted of 404 respondents who visited and bought something in the super market or fresh market along with Sukhumvit area such as Villa market, Gourmet market Emporium and Em quartier and nearby area of BTS phrom pong station, Foodland Nana, Thong Lo, Max Valu pharkhanong, Lotus on nut and Top Piyarom as a represent of supermarket area and Udomsuk market, Pharkhanong market and small convenient store nearby as a represent area of fresh market. Due to Sukhumvit area, it has a lot of demographic and socioeconomic diversity sample would be obtained and used ordinary conversation approach ask subject to allow the researcher to interview after finished the subject will get a pen as a token of gratitude. The period of this study occurs during April 2017 to May 2017. The sample size for questionnaire respondents was calculated by simple formula as below at 95% confidence level and margin of error at 0.05 and expected different was unknown in this case we use 50% for highest amount of sample size.



$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where: n = sample size

Z = Z statistic for a confidence level

P = expected prevalence

d = margin of error (in proportion of one; if 7.5%, d = 0.075)

Calculate:

$$Z = 1.96 \text{ (Z at 95\% confidence level)}$$

$$P = 0.5$$

$$d = 0.05$$

$$n = \frac{1.96^2 0.5(1 - 0.5)}{0.05^2}$$

Total sample size = 384 respondents

+5% For spare = 404 respondents

The calculation was determined by using Yamane's table (Yamane, 1973) with a 0.05 level of significance and 5% of marginal error.

The respondents were interviewed using Thai language questionnaire with the total collection duration of two months. The questionnaire was reviewed and modified by public health and food safety experts. In this study researcher invited Assoc.Prof. Ratana Somrongthong, Ph.D. from College of Public Health sciences, Chulalongkorn University as public health expert and both Assist.Prof. Sujate Chaunchom Dr.Med.Vet from Graduated school Kasetsart University and Dr.Chantanee Buranathai Dr.Med.Vet senior veterinary expert officer from the bureau of Livestock Standard and Certification Department of Livestock development, ministry of agriculture, Thailand as a food safety expert to review and modify the questionnaires.

The questionnaires in this study divided into three parts, the first part composed of 9 questions about the general demographic information, the second and third part

composed of 13 questions concerning basic knowledge of egg consumption hygiene and behavior respectively.

The sampling method was used convenience sampling technique. In this study, researcher randomly selected 202 samples from fresh market area and other 202 from supermarket. For every subject that met the research, the subject was rolled the dice if the result was the odd number, the interview process was start. For the even number result, the researcher was discarded the subject and move to the next one. By this technique, each subject has an equal chance of 50% to get the interview or not with the dependent variables of this study included gender, age, level of education and income. For independent variables, this study was included basic egg hygiene and egg consumption behavior, the questionnaires designed by adapting and modifying questions based on previous studies (Centers for disease control and prevention, 2011; Nasser, Sameh, & Fohad, 2016; Pei, Kwai, Jerzy, John, & Siti, 2015; Samapundo, Climat, Xhaferi, & Devlieghere, 2015; World Health Organization, 2015) and consultations with Salmonella and food hygiene experts.

For Basic food hygiene and food poisoning knowledge, the respondents were asked to choose from between two options true or false for questions. A right answer considered as 'correct knowledge' and wrong answer as 'no knowledge'. Total scores were calculated and converted into a percent. The score below fifty percent of food hygiene and food poisoning knowledge questionnaire accepted as poor knowledge (Siow & Norrakiah, 2011) and used the Likert scale with three choices among Never, Sometime and Always to measure about egg consumption behavior. Each question had their own score as 2,1,0 for risk-increasing questions type and 0,1,2 for risk-reducing question type. The score below fifty percent of eating behavior questionnaire is accepted as risky egg consumption behavior and after the interview was finished. The researcher explained and



discuss the subject of the good practice for egg consumption hygiene and good eating behavior.

### 3.5 Statistic analysis

This study used Cochran's Q test to compare the prevalence of Salmonella among the Ordinary, Salmonella free and Chemical free egg group. The positive and negative samples were nominal scale then use descriptive statistic to describe the characteristics and frequency of Salmonella serovar group that were found especially in case of any samples showed the positive result as S. Enteritidis, S.Typhimurium, S.Hadar, S.Virchow or S.Infantis it would count as a public health concern serovar due to it has higher chance caused illness in human than the other serovar (European Union, 2005). At p-value of  $<0.05$ , it was indicated as cut off point for statistic difference.

At p-value of  $<0.05$ , the total of 30 pilot samples from the adjacent area with Sukhumvit that called as Pathumwan area were tested to achieve a reliability test more than the recommended level of 0.70 to guarantee the reliability of the questionnaire. The relationship between the level of egg consumption hygiene knowledge and egg consumption behavior and socio-demographic factors this study used descriptive statistics utilized in this research included percentage, frequency, and Fischer's exact test. In case of the data not showed the normal distribution result and may have a lot of outliers that related with some socio-demographic factor such as very elderly or young respondents. This study used the p-value at  $<0.05$  to indicate the statistical significance of the level of egg consumption hygiene knowledge, egg consumption behavior relationship on each socio-demographic factors. To find the correlation between egg consumption knowledge and egg consumption behavior, this study used Spearman's correlation and used p-value at  $<0.05$  to identify the statistically significant correlation

between egg consumption knowledge and egg consumption behavior. The statistic package, SPSS version 17.0 licensed was used for data analysis.

### 3.6 Ethical consideration

3.6.1. Informed the consent of each participant in accompany with confidentiality is anonymous. The information about participant was kept strictly confidential and results of this study was shown in the table and the figure.

3.6.2. The study has no risk/ inconvenience and any negative effect of participant in this study which may cause by the unwell effect to physical, mental, social, and belief of participants.

3.6.3. The decision of participants to participate in this study was depended on their willingness to participate the study.

3.6.4. This research was approved by Ethics Review Committee for Research

Involving Human Research Subjects, Health Science Group., Chulalongkron

CHULALONGKORN UNIVERSITY  
University Bangkok, Thailand (The Ethic code 020.1/60).

## CHAPTER IV

### RESEARCH RESULTS

The objectives of this study were to find the prevalence of *Salmonella spp.* among in each group of eggs, and the association among socio-demography factors and level of knowledge and behavior of egg consumption. This study was conducted in Sukhumvit area of Bangkok, Thailand, during December 2017 to May 2017.

In order to determine contamination rate of *Salmonella spp.* in various commercial grades, samples of eggs, this study were categorized into three groups by the type of eggs as premium salmonella free, premium chemical free and ordinary egg. A total of 198 samples with 66 samples per each group and 10 eggs per samples were randomly collected from fresh markets and supermarkets in Sukhumvit area, Bangkok. The results were summarized table 2, contamination rate in each group, proportion of positive samples, and serovar found in positive samples. A total of 404 people in Sukhumvit area of Bangkok were randomly selected for face to face interviewed by using questionnaire about egg consumption hygiene and behavior. The results of the second phase were presented and categorized into demographic data, evaluation of basic egg consumption hygiene knowledge and egg consumption behavior.

#### 4.1 Contamination rate of *Salmonella spp.* in hen egg

The result showed frequency of *Salmonella spp.* positive in each egg groups. The serovar name were found in table 2. The result not found positive samples of premium chemical free eggs and found the same contamination rate at 7.6% for both *Salmonella* free and ordinary eggs. However, the contamination rate was not significantly different among each egg groups, For the public health concerned serovar, this study was revealed *S.Hadar* and *S.Typhimurium* at 4.5% of contamination rate in ordinary eggs. Those two serovar were shown in the restriction list of European Union importing law. Because it has more chance to cause the illness in human than other serovar (European Union, 2005), however, the result was not shown statistical difference among each other egg groups in this study.

**Table 2** Percentage of Salmonella positive sample and serovar name

Egg group	Salmonella Positive sample (%)	Serovar name (Group)	Public health Concerned serovar(%)
Premium Salmonella free n=66	5/66(7.6%)	S.Lomita (2/5)(Gr.C) S.Djugu (2/5) (Gr.C) S.Bredeney(1/5)(Gr.B)	0%
Premium Chemical free n=66	0/66(0%)		0%
Ordinary egg n=66	5/66(7.6%)	S.Typhimurium(1/5)(Gr.B)* S.Hadar (2/5)(Gr.C)* S.Lomita (1/5)(Gr.C) S.Newport(1/5)(Gr.C)	3/66 (4.5%)
<i>P-Value</i>			
(Cochran's Q test)	0.082		0.050
Total	10/198 (5.05%)		3/198(1.5%)

\*Restricted Serovar from COMMISSION REGULATION (EC) No 2073/2005 (European Union, 2005)

#### 4.2. Socio-demographic data and finding

This part was revealed frequency distribution of socio-demographic factors that explained about background characteristics of each respondent. Table 3 showed general Socio-demographic information such as age, education level and household income and others.

Regarding gender, the study population had female respondents slightly more than male at 215(53.2%) compare with 189(46.8)

Regarding age, the study population majority age indicated as adult, at between 20-29 years of 142(35%) followed by 30-39 years of 90(22.3%), 40-49 years of 74 (18.3%) and lower than 20 years of 55(13.6%) respectively.

Regarding education level, there were 182(45%) of respondents who had bachelor degree as a majority, followed by senior high school and vocational certificate level at 77(19.1%) and 62(15.3%) respectively. This study also revealed 42(10.4%) of respondents gain higher than bachelor degree and nearly 10% of respondents count as a lower than senior high school level.

Nearly half of respondents 197 (48.8%) were shown the income level at between 10,000-30,000 Thai baht per month, Followed by nearly equal proportion between 30,000-50,000 Baht and lower than 10,000 per month with amount respondents as 84(20.8%) and 77 (19.1%) respectively. For the minority groups, this study was shown the proportions of household income at higher than 50,000 Baht at 46 (11.4%).

Regarding egg buying place, this study showed the majority of respondents buy egg from the supermarket of 173 (42.8%) and fresh market of 149 (36.9%). Some respondents egg from the convenience store at 55 (13.6%) and grocery 21(5.2%), and for the other place such as from direct buy from farm or egg distributor was shown lower than 1%.

Regarding for egg consumption rate, this study was undercover the result, with more than two-thirds of respondents were eat 1-2 eggs per day of 273 (67.6%). the second and third rank of consumption rate were lower than 1 and 3-4 eggs per day at 97 (24.0%) and 24 (5.9%) respectively. this study also found 7 (1.7%) of respondents indicated themselves as a not egg eater, but still eat other product from eggs such as salad dressing etc.

For the egg storage condition, most of respondents were shown the result of 310 (76.7%) keep its in refrigerator, followed by keep it at room temperature in open container at 72 (17.8%) and at the room temperature in sealed container at 22 (5.4%) Regarding to the buying volume, this study was shown the result of 220 (54.5%) respondents were buy enough eggs for 1 week, then followed with buy for lower than 1 week and buy for 2 weeks

consumption. at nearly equal proportion as 84 (20.8%) and 78 (19.4%) respectively, and slightly more than 5% of respondent buy egg enough for 3 week or more.

This study was shown 349 (86.4%) not had the sign of food poisoning from egg in last 3 months, and 26 (6.4%) of respondents were reveal about the sign of food poisoning after ate eggs, for the last proportion of 27 (6.7%) was suffer from food poisoning but still not sure is it from egg eating or not.

**Table 3** General Socio-demographic characteristic of egg consumer

Socio demographic data	Number	Percentage (%)
<b>Gender (n=404)</b>		
Male	189	46.8
Female	215	53.2
<b>Age (n=404)</b>		
Lower than 20 Years	55	13.6
20-29 Years	142	35.1
30-39 Years	90	22.3
40-49 Years	74	18.3
50-59 Years	27	6.7
Higher than 59 Years	16	4.0
<b>Education level (n=404)</b>		
Lower than high school	14	3.4
Junior high school	27	6.7
Senior high school	77	19.1
Vocational certificate	62	15.3
Bachelor degree	182	45.0
Higher than bachelor degree	42	10.4

Table 4 General Socio-demographic characteristic of egg consumer (Continued)

Socio demographic data	Number	Percentage (%)
<b>Household income per month , 34 THB = 1 USD (n=404)</b>		
Lower than 10,000 THB	77	19.1
10,000 – 30,000 THB	197	48.8
30,001 – 50,000 THB	84	20.8
50,001 – 70,000 THB	27	6.7
70,001 – 90,000 THB	10	2.5
Higher than 90,000 THB	9	2.2
<b>Egg buying place (n=404)</b>		
Supermarket	173	42.8
Fresh market	149	36.9
Convenience store	55	13.6
Other	27	6.6
<b>Egg consumption per day (n=404)</b>		
none	7	1.7
less than 1 egg	97	24.0
1-2 eggs	273	67.6
More than 2 eggs	27	6.6
<b>Egg storage condition at household (n=404)</b>		
Refrigerator	310	76.7
Sealed container at room temperature	22	5.4
Open container at room temperature	72	17.8
<b>Buying volume (n=404)</b>		
Lower than 1 week	84	20.8
1 week	220	54.5
2 weeks	78	19.3
3 weeks	11	2.7
More than 3 weeks	11	2.7

**Table 5** General Socio-demographic characteristic of egg consumer (Continued)

Socio demographic data	Number	Percentage (%)
Food poisoning by egg eating at 3 month ago (n=404)	26	6.4
Yes	349	86.4
No	29	7.2
Yes but not sure from egg or not		

#### 4.2.1 Knowledge toward egg consumption hygiene.

Questions were asked to explore the respondent's knowledge level about egg consumption hygiene, including with 13 questions for knowledge which consisted of both positive and negative questions. Another question on egg consumption hygiene knowledge was asked for positive questions, the respondents got 1 point for the correct answer, 0 point for the wrong answer and vice versa for the negative question. For the unknown choice was indicated as a wrong answer and get 0 point.

**Table 6** Frequency and percentage of respondents who answered true and false to each question about knowledge towards egg consumption hygiene (n=404)

Basic egg hygiene knowledge question	Correct n(%)	Wrong n(%)
1.Eggs with cracked, leaked or dirty are still safe to eat. *	166(41.1%)	238(58.9%)
2.Should buy an egg from shelf that not more than 4 celcius degree temperature.	114(28.2)	290(71.8%)
3.Should eat egg within 3 weeks after manufactured date, *	322(79.7%)	82(20.3%)
4.Cooked egg and Raw egg must keep in separate container	287(71.0%)	117 (29.0%)
5.Broiled egg with or without shell can keep in fridge for 2 weeks. And still safe to eat.	111(27.5%)	293(72.5%)



**Table 7** Frequency and percentage of respondents who answered true and false to each question about knowledge towards egg consumption hygiene (n=404) (Continued)

Basic egg hygiene knowledge question	Correct n(%)	Wrong n(%)
6.The watery albumin is the sign of egg with high freshness.*	294(72.8%)	110(27.2%)
7.Cooked egg with firm albumin is safe enough to eat. Although the egg yolk still liquid.*	257(63.6%)	147(36.4%)
8.Should wash hands carefully. Before and After touching raw egg or the food that contained with raw egg.	293(72.5%)	111(27.5%)
9. Temperature at 65 degree celsius was enough to guarantee the safety of eating egg.*	308(76.2%)	96(23.8%)
10.Cooked egg must not keep at room temperature more than 1 hour .Before eaten.	111(27.5%)	293(72.5%)
11.Kept egg with long time storage. can cause the diarrhea.	321(79.5%)	83(20.5%)
12.Some food was contained with raw egg such as Salad dressing , Ice cream and Mayonnaise.	309(76.5%)	95(23.5%)
13.Should separate the chopping block between raw and cooked egg.	272(67.3%)	132(32.7%)

\*Negative statement

The obtained score converted in terms of score level and is classified into 3 levels (low moderate and high knowledge). Possible scores ranged between 0-13. The cutting point of basic egg hygiene knowledge was categorized into three groups according to Bloom's classification (Bloom,1956). The cutting point of good knowledge was higher than 80% (11-13 points) of total scores, that for moderate knowledge was from 60% to 80% (8-10 points) of total scores and that of poor knowledge was less than 60%(0-7 points) of the total score. (see table 5)

**Table 8** Level of egg consumption hygiene knowledge

Level of egg consumption hygiene knowledge	Frequency	Percentage
Good knowledge (11-13 points)	5	1.4
Moderate knowledge (8-10 points)	105	25.9
Poor knowledge (0-7 points)	294	72.7

In order to show the egg consumption knowledge level, the distribution level of egg consumption knowledge was shown in table 5. About 1.4% of respondents were in the good knowledge level and 25.9% of respondents were in moderate level. Most of respondents (72.7%) were indicated as poor knowledge level.

#### 4.2.2 Behavior towards egg consumption

To explore the behavior towards egg consumption, all the respondents' behavior was asked as always, sometimes and never by the questionnaire. There were 13 questions in this part which consisted of both positive and negative directions. In the positive statement, 2 scores were given for always answer, 1 score for sometimes answer and 0 score for never answer. On the other hand, 0 score was given for always answer, 1 score for sometimes answer and 2 scores for never answer in negative statement. The possible scores ranged from 0-26 for all 13 questions.

Table 9 Frequency and percentage of egg consumption behavior (n=404)

Egg consumption behavior	Never	Some	Always
	Number	Number	Number
	(%)	(%)	(%)
1.You use the egg with more than 2 week in storage to make the food.*	113 (28.0)	269 (66.6)	22 (5.4)
2.You buy the egg without crack ,leak or dirty on the egg shell	43 (10.6)	151 (37.4)	210 (52.0)
3.You buy the egg from verified producer with clear label	44 (10.9)	211 (52.2)	148 (36.6)
4.You eat the soft boiled egg or onsen egg.*	97 (24.0)	250 (61.9)	57 (14.1)
5.You eat the sunny sided up fried egg. *	54 (13.4)	199 (49.3)	151 (37.4)
6.You eat scrambled egg with moisture inside, *	108 (26.7)	209 (51.7)	87 (21.5)
7.You dip the grilled meat in raw egg before eat. *	210 (52.0)	157 (38.9)	37 (9.2)
8.You eat the raw egg with other type of hot food such as steamed rice.*	254 (62.9)	122 (30.2)	28 (6.9)
9.You use the pooled cracked in plastic bag to make the food. *	304 (75.2)	88 (21.8)	12 (3.0)

Egg consumption behavior	Never	Some	Always
	Number	Number	Number
	(%)	(%)	(%)
10. You eat the food was contained with raw egg such as Salad dressing, Ice cream and Mayonnaise. *	57 (14.1)	242 (59.9)	105 (26.0)
11. You eat the fried or scrambled egg in buffet set. *	70 (17.3)	251 (62.1)	83 (20.5)
12. You eat the raw egg or raw egg contained product such as albumin drink. *	293 (73.8)	87 (21.5)	19 (4.7)
13. You eat the bakery or dessert that contained with half cooked egg. Such as Tart, Tiramisu , Custard or egg yolk fudge balls cooked in syrup. *	39 (9.7)	246 (60.9)	116 (29.5)

\*Negative statement

According to the table 6, both question number 2 and 3 that were indicated as positive statements. All the rest questions were indicated as negative statements.

Most of the respondents, 66.6% and 52.0% sometime use egg with more than 2 weeks in storage to make the food and always buy only clean egg without dirt on their shell. 52.2% of respondents buy them from verified producer with complete label on their packaging at sometimes, and 36.6% of respondents always buy it from verified producer.

Majorities of the respondents accept to eat soft boiled eggs, sunny sided up fried egg and moisture scrambled egg at sometimes, at 61.9%, 49.3% and 51.7% respectively

Regarding the result in table 6, Most of the respondents never used the raw egg as dipping for grilled meat and eat it with another type of hot foods, at 52.0% and 62.9% consequently. Those results showed the same direction of question number 9 and 12 that

asked about to using pooled cracked egg to make the food and eat raw egg product directly. Most of the respondents at 76.2% and 73.8% said never do that respectively.

Most of the respondents, 59.9%, 62.1% and 60.9% accepted to eat the food which contained with raw egg such as salad dressing, eat fried egg station in buffet set and eat half cooked egg in bakery product at sometimes.

The obtained score converted in terms of score level and is classified into 3 levels (poor moderate and good behavior). Possible scores ranged between 0-26. The cutting point of basic egg consumption behavior was categorized into three groups according to Bloom's classification (Bloom,1956). The cutting point of good behavior was higher than 80% (21-26 points) of total scores, that for moderate behavior was from 60% to 80% (16-20 points) of the total scores and that of poor behavior was less than 60%(0-15 points) of the total score. The summarized of behavior score was shown in table 7.

**Table 10** Level of egg consumption behavior

Level of egg consumption behavior	Frequency	Percentage
Good behavior (21-26 points)	31	7.7
Moderate behavior (16-20 points)	179	44.3
Poor behavior (0-15 points)	194	48.0

In order to show the egg consumption behavior level of the respondents, about 7.7% of respondents were in the good behavior level and 44.3% of respondents were in moderate level. Most of the respondents, 48.0% were indicated as poor behavior level. That slightly greater number when compared with moderate behavior group. So the proportion of poor behavior group was still nearly same with moderate combined with good behavior as one.

#### 4.2.3 Association between socio-demographic characteristic and knowledge about egg consumption hygiene (n=404)

The association between socio-demographic with egg consumption hygiene knowledge was analyzed by using Fisher's exact test and presented as the table below. This study presented the socio-demographic and egg consumption hygiene characteristics which showed significant association with Fisher's exact test as p-value lower than 0.05. This study showed that association between egg consumption hygiene knowledge with gender (p-value = 1.00), age (p-value = 0.002), education level (p-value = 0.000), household income (p-value=0.000), egg buying place (p-value = 0.026), egg consumption per day(p-value = 0.032) , household egg storage condition(p-value = 0.372) , buying volume (p-value = 0.152) and food poisoning from egg at last 3 month (p-value = 0.194).

The respondents, who lower than 20 years and more than 59 years of age revealed the highest proportion of poor knowledge level as 90.9% and 93.7% respectively. When compared with adult working age at 20-59 year. Education level was directly associated with knowledge level as 84.6% of respondents with lower than high school education showed the poor knowledge compared with 54.7% of respondents with higher than bachelor degree was showed the poor knowledge in the same time. The proportion of poor knowledge about egg consumption hygiene was decreasing when comparing with higher education level.

Household income level was directly associated with egg consumption knowledge. This study was shown the results that higher household income associated with higher egg consumption hygiene knowledge. The proportion of poor knowledge was decreasing and change to the moderate knowledge while household income was increasing instead. The egg consumption rate and buying place also were associated with knowledge level as well. Those results were shown the higher proportion of moderate knowledge buying eggs from fresh market and eat more egg than poor knowledge level group.

**Table 11** Association between Socio-demographic factors and Knowledge about egg consumption hygiene (n=404)

Socio demographic	n	Good	Knowledge		P-Value
			n(%)	Poor	
			Moderate		
<b>Gender</b>					
Male	189	4(2.1)	49(25.9)	136(72.0)	1.000
Female	215	1(0.5)	56(26.0)	158(73.5)	
<b>Age</b>					
Lower than 20 Years	55	0(0.0)	5(9.1)	50(90.9)	.002*
20-29 Years	142	3(2.1)	48(33.8)	91(64.1)	
30-39 Years	90	1(1.1)	21(23.3)	68(75.6)	
40-49 Years.	74	1(1.4)	22(29.7)	51(68.9)	
50-59 Years	27	0(0.0)	8(29.6)	19(70.4)	
Higher than 59 Years	16	0(0.0)	1(6.3)	15(93.7)	
<b>Education level</b>					
Lower than high school	14	0(0.0)	2(14.3)	12(85.7)	.000*
Junior high school	27	0(0.0)	4(14.8)	23(85.2)	
Senior high school	77	0(0.0)	9(11.7)	68(88.3)	
Vocational certificate	62	0(0.0)	11(17.7)	51(82.3)	
Bachelor degree	182	3(1.6)	62(34.1)	117(64.3)	
Higher than bachelor degree	42	2(4.8)	17(40.5)	23(54.7)	

\*Statistic significant within group

**Table 12** Association between Socio-demographic factors and Knowledge about egg consumption hygiene (n=404)(Continued)

Socio demographic	n	Good	Known		P-Value
			ge n (%)	Low	
Household income per month					
34 THB = 1 USD					
Lower than 10,000 THB	77	0(0.0)	11(14.3)	66(85.7)	.000*
10,000 – 30,000 THB	197	3(1.5)	45(22.8)	149(75.7)	
30,001 – 50,000 THB	84	0(0.0)	27(32.1)	57(67.9)	
50,001 – 70,000 THB	27	1(3.7)	16(59.2)	10(37.1)	
70,001 – 90,000 THB	10	1(10.0)	4(40.0)	5(50.0)	
Higher than 90,000 THB	9	0(0.0)	2(22.2)	7(77.8)	
Egg buying place					
Supermarket	173	3(1.7)	57(32.9)	113(65.4)	.026*
Fresh market	149	0(0.0)	35(23.5)	114(76.5)	
Convenience store	55	2(3.6)	8(14.5)	45(81.9)	
Other	27	0(0.0)	5(18.5)	22(81.5)	
Egg consumption per day					
0 egg/day	7	0(0.0)	4(57.1)	3(42.9)	.032*
less than 1 egg	97	0(0.0)	17(17.5)	80(82.5)	
1-2 eggs	273	5(1.8)	75(27.5)	193(70.7)	
more than 2 eggs	27	0(0.0)	9(33.3)	18(66.7)	

\*Statistic significant within group



**Table 13** Association between Socio-demographic factors and Knowledge about egg consumption hygiene (n=404)(Continued)

Socio demographic	n	Knowledge			P- Valu e
		Good	Moderate	Low	
<b>Egg storage condition</b>					
Refrigerator	310	4(1.3)	86(27.7)	220(71.0)	.372
Sealed at room temp.	22	0(0.0)	4(18.2)	18(81.8)	
Open at room temp.	72	1(1.4)	15(20.8)	56(77.8)	
<b>Buying volume</b>					
Lower than 1 week	84	0(0.0)	14(16.7)	70(83.3)	.152
1 week	220	4(1.8)	61(27.7)	155(70.5)	
2 week	78	1(1.3)	24(30.8)	53(67.9)	
3 week	11	0(0.0)	4(36.4)	7(63.6)	
More than 3 week	11	0(0.0)	2(18.2)	9(81.8)	
<b>Food poisoning by egg eating at 3 month ago</b>					
Yes	26	1(3.8)	10(38.5)	15(57.7)	.194
No	349	4(1.1)	86(24.7)	259(74.2)	
not sure	29	0(0.0)	9(31.0)	20(69.0)	

\*Statistic significant within group

#### 4.2.4 Association between socio-demographic characteristic and egg consumption behavior (n=404)

The association between socio-demographic with egg consumption behavior was analyzed using Fisher's exact test and presented at the table below. This study presented the socio-demographic and egg consumption behavior characteristics which showed significant association with Fisher's exact test as p-value lower than 0.05.

This study showed the association between egg consumption behavior with gender (p-value = 0.468), age (p-value = 0.072), education level (p-value = 0.118), household income (p-value=0.418), egg buying place (p-value = 0.111), egg consumption per day(p-value = 0.990) , household egg storage condition(p-value = 0.196) , buying volume (p-value = 0.273) and food poisoning from egg at last 3 month (p-value = 0.172).

The respondents were aged between 20 -29 years that indicated as early adult working age has the highest proportion of poor behavior at 54.3%. then followed with 30-39 year at 52.3%. The teenage age showed 47.3% of poor behavior respondents and elder age has the lowest proportion of poor behavior as 6.2%

Regarding education level, the respondents were shown the highest proportions of poor behavior at 59.3%, 52.8% and 50.0% on junior high school, bachelor degree and higher than bachelor degree respectively.

Regarding household income, the result was shown the significant correlation with egg consumption hygiene in previous part of this chapter. But this part was revealed the result as household income was not associated with egg consumption behavior as well as gender, buying place, storage condition, consumption rate, egg storage condition at household and experienced of food poisoning from egg at 3 months ago.

**Table 14** Association between Socio-demographic factors and Egg consumption behavior (n=404)

Socio demographic	n	Behavior			P-Value
		Good	n (%) Moderate	Poor	
<b>Gender</b>					
Male	189	10(5.3)	82(43.4)	97(51.3)	.468
Female	215	21(9.8)	97(45.1)	97(45.1)	
<b>Age</b>					
Lower than 20 Years	55	5(9.1)	24(43.6)	26(47.3)	.072
20-29 Years	142	8(5.6)	57(40.1)	77(54.3)	
30-39 Years	90	3(3.3)	40(44.4)	47(52.3)	
40-49 Years	74	7(9.5)	35(47.3)	32(43.2)	
50-59 Years	27	2(7.5)	14(51.7)	11(40.8)	
Higher than 59 Years	16	6(37.5)	9(56.3)	1(6.2)	
<b>Education level</b>					
Lower than high school	14	2(7.6)	6(46.2)	6(46.2)	.118
Junior high school	27	3(11.1)	8(29.6)	16(59.3)	
Senior high school	77	4(5.1)	45(58.3)	28(36.6)	
Vocational certificate	62	9(14.6)	26(41.9)	27(43.5)	
Bachelor degree	182	11(6.0)	75(41.2)	96(52.8)	
Higher than bachelor degree	42	2(4.8)	19(45.2)	21(50.0)	

\*Statistic significant within group

**Table 15** Association between Socio-demographic factors and Egg consumption behavior (n=404) (Continued)

Socio demographic	n	Behavior			P-Value
		Good	n(%)	Low	
\					
Household income per month 34 THB = 1 USD					
Less than 10,000 THB	77	7(9.1)	35(45.5)	35(45.4)	.418
10,000 – 30,000 THB	197	13(6.6)	90(45.7)	94(47.7)	
30,001 – 50,000 THB	84	8(9.5)	36(42.9)	40(47.6)	
50,001 – 70,000 THB	27	1(3.7)	9(33.3)	17(63.0)	
70,001 – 90,000 THB	10	1(10.0)	3(30.0)	6(60.0)	
More than 90,000 THB	9	1(11.2.)	6(66.6)	2(22.2)	
Egg buying place					
Supermarket	173	10(5.8)	81(46.8)	82(47.4)	.111
Fresh market	149	15(10.1)	65(43.6)	69(46.3)	
Convenience store	55	5(9.1)	17(30.9)	33(60.0)	
Other	27	1(3.7)	16(59.3)	10(37.0)	
Egg consumption per day					
0 egg/day	7	1(14.2)	3(42.9)	3(42.9)	.990
Lower than 1 egg	97	9(9.3)	41(42.3)	47(48.4)	
1-2 eggs	273	19(7.0)	123(45.0)	131(48.0)	
More than 2 eggs /day	27	2(7.4)	12(44.4)	13(48.2)	

\*Statistic significant within group

**Table 16** Association between Socio-demographic factors and Egg consumption behavior (n=404) (Continued)

Socio demographic	n	Behavior			P-Value
		Good	n(%) Moderate	Low	
<b>Egg storage condition at household</b>					
Refrigerator	310	22(7.1)	141(45.5)	147(47.4)	.196
Sealed box at room temp.	22	1(4.5)	6(27.3)	15(68.2)	
Open box at room temp.	72	8(11.2)	32(44.4)	32(44.4)	
<b>Buying volume</b>					
Lower than 1 week	84	5(6.0)	41(48.8)	38(45.2)	.273
1 week	220	18(8.2)	90(40.9)	112(50.9)	
2 week	78	6(7.8)	37(47.4)	35(14.8)	
3 week	11	0(0.0)	8(72.7)	3(27.3)	
More than 3 week	11	2(18.2)	3(27.3)	6(54.5)	
<b>Food poisoning by egg eating at 3 months ago</b>					
Yes	26	0(0.0)	8(30.8)	18(69.2)	.172
No	349	29(8.3)	159(45.6)	161(46.1)	
Not sure	29	2(6.9)	12(41.4)	15(51.7)	

\*Statistic significant within group

#### 4.2.5 Correlation between egg consumption hygiene knowledge and egg consumption behavior

The correlation between the egg consumption hygiene knowledge and egg consumption behavior scores analyzed by using Spearman's correlation as this tool was suitable for this non-normally distributed data. The Spearman's correlation revealed the weak negative relation between egg consumption hygiene and egg consumption behavior, however is was (P-value = 0.443) as the table below.

**Table 17** Spearman's correlation between egg consumption hygiene knowledge and egg consumption behavior and the scatter plot result.

	Consumption behavior	P-value
Consumption hygiene knowledge	-0.38	.443

## CHAPTER V

### DISCUSSION, CONCLUSION AND RECOMMENDATION

#### 5.1 Discussion

This study composed of the two main phase, the first one was cross-sectional design to observe the contamination rate of *Salmonella spp.* in eggs sold in Sukhumvit area of Bangkok. This phase used a simple random technique to select the egg sample, to limit the error that might occur during the study process. This study used aseptic technique to collect the samples in completely a sealed container and to bring all collected samples to the laboratory within 24 hours to reduce false negative results according to European Union practice (European Union, 2005). The laboratory performed this study is Eastern region veterinary research and development center the certified by ISO under the supervision by Department of Livestock Development, Thailand.

The contamination rate of *Salmonella spp.* were found in premium Salmonella-free eggs and the ordinary eggs was the same rate at 7.6%. This was described by two major sources of contamination along eggs supply chain (World Health Organization & Food and Agriculture Organization of The United nations, 2002). The first one is contamination from laying hen. due to the mechanism of Salmonella infection in hen's body. The pathogen was colonized in gastrointestinal tract and sometimes once eggs were laid those eggshells were contaminated with feces that had Salmonella inside. By that condition, Salmonella could be found on eggs shell as a majority source. For the alternate pathway of Salmonella infection, some serovar such as Salmonella Enteritidis had more pathogenicity to pass through the gut epithelium and move into blood circulation. There after Salmonella was colonized in reproductive tissue of hen and contaminated in the yolk or albumin of eggs. Vaccination is one of the most important methods to control Salmonella in layer farm and reduce the contamination of Salmonella in egg (Denagamage Thomas, 2015), However only group B and D of vaccines were widely used especially in breeder and some in layer. The cross protection capability between serovar

group was not just only an acceptable level (Liliana, 2012). Salmonella group C were founded in a majority proportion (80% of all positive samples) in this study. under Thailand law the Salmonella free policy was focused on only two prominent serovar that effect on the export situation such as *S. Enteritidis* and *S. Typhimurium* (National bureau of agricultural commodity and food standards, 2010). For the second main possibility was the contamination on eggshell after laid, the eggs will be transported from hen house to egg collecting center and packaging along with the supply chain. Each processing step, it had the chance to for Salmonella contamination from environment or operator.

Salmonella had various of vectors such as rodent, fly, cockroach or equipment. The hygiene production side plays role as a very important to reduce the Salmonella contamination rate from layer farms to consumers (World Health Organization & Food and Agriculture Organization of The United nations, 2002). Regarding to the contamination rate of premium chemical free egg (sometimes called organic egg), Those were found not significantly lower number of positive sample caused by the lower flock density. Due to the Thailand ACT organic standard 2016, the guideline recommended the hen flock-density should not more than 5 hens per square meters (Organic Agriculture Certification of Thailand, 2016). It is much lower than an ordinary practice of commercial layers around 10-13 hens per square meter as a standard procedure. It was found the chance of Salmonella positive in hen flocks with more than 30,000 birds had an odd ratio at 14.88 when compare with the flock with 1000 – 2999 birds holding size (Denagamage Thomas, 2015). The lower number of chicken in flock can reduce the flock density caused the lower contamination rate.

For the second phase of this research, it was studying about the relation between socio-demographic data among egg consumption hygiene knowledge and egg consumption behavior score. This study used cross-sectional design and used the questionnaire reviewed by food safety expert as a measurement tool.

The results showed about age, education level, household income, buying place and consumption rate significantly associated with an egg consumption hygiene knowledge score, it represented of knowledge on food hygiene concept. The result had



the same direction with the Haiti's study in 2016 (Samapundo et al., 2015) showed results of higher education level and higher age had tended to higher food safety score as well when compare with lower age and lower education. The household income is the support factor caused higher education and changing in lifestyle to buy eggs from supermarket than conventional fresh market and eat more eggs both direct and indirect (International Egg Commission, 2013).

According with the details in table 4, the question number 1,4 ,8 ,11, 12,13 modified from Five keys to safer food (World Health Organization, 2015) and making food safer to consume (Centers for disease control and prevention, 2011) shown the higher rate of the corrected score with range between 58.9 – 79.5%. All of the questions base on basic hygiene has the same concept with another kind of food compared with another group of question 2,3,5,6,9,10, showed lower correct proportion range between 20.3 - 27.5%. The lower correct questions set modified from Egg-Grading Manual Agricultural Marketing (United State Department of Agriculture, 2000) and risk assessments of Salmonella in eggs and broiler chickens interpretative summary (World Health Organization & Food and Agriculture Organization of The United nations, 2002). Most of the questions based on specific basic knowledge about egg handling and cooking. The egg consumption hygiene, nearly half of respondents showed knowledge of moderate and good knowledge and another half was poor knowledge level especially in specific knowledge concerning egg hygiene and handling categorized by Bloom's classification (Benjamin, 1956).

For example, the question number 2 the statement said, "Should buy an egg from the shelf not more than 4-celsius degree temperature." According to the study from WHO and FAO in 2002, the Salmonella can replicate themselves rapidly in eggs more than 7-celsius degree storage condition. If the storage shelf in egg selling place has temperature control devices. It can inhibit the multiplication of Salmonella and reduce more than 70% chance of Salmonellosis per serving. Regarding question number three "Should eat egg within 3 weeks after manufactured date," Due to the normal storage condition, shelf duration of egg has relation with an initial dose of bacteria including with Salmonella in

egg and completeness of natural wax on eggshell. The average shelf life of egg is about 2 week (World Health Organization & Food and Agriculture Organization of The United Nations, 2002). There are some points of knowledge about the egg product specification the producer should provide enough information to the consumer. For an additional example, question number 6 statement was “The watery albumin is the sign of egg with high freshness” due to the veterinary field, the watery albumin is not the sign of high freshness but it was a sign of some avian disease such as Infectious bronchitis and etc. (Gary & Richard, 1991). The public misunderstanding may be caused by lack of information in public relation.

The results of the egg consumption behavior score, the results were not shown the relationship between socio-demographic factors on egg consumption behavior score. However, the age and education level showed the lowest p-value when compared with other factors. Early adult working-age had the higher proportion of poor behavior compared with the elder age same direction as the study in the United States in 2000. The older age has tended to eat less risky food. furthermore the higher score of egg hygiene knowledge not significantly correlate with of egg consumption behavior score same as the result from the United State in 2000 (Ralph & Scottie, 2000) and from Canada in 2004 (Anne, Maria, Joseph, & May, 2004). Both of them have shown the knowledge of food safety or hygiene not always had positive relationships with consumption behavior or food handling practice due to the personal preferences.

Regarding the egg consumption behavior score, all questions represented the egg eating behavior of people in Bangkok. The result shown 48% of respondents indicated as poor egg consumption behavior. For more detail, the three major points, the first one refers to the question number 2 and 3 Most of the respondents make a buying decision of eggs by using the completeness and clean of eggshell as a key decision factors. These points were the good manner especially to choose the egg without any dirty things on eggshell being reduced the chance of foodborne illness from eggs including with Salmonellosis (United State Department of Agriculture, 2000) and almost of Salmonella can be detected on the eggshell (Denagamage Thomas, 2015). It was the

same direction with the report from Australia by international egg commission in 2013, 51% of Australian people had no preferred brand and in Netherland study was shown the no damaged egg was the most effective factor for making a decision of consumer (International Egg Commission, 2013).

The second and third points also represented by the questions set, questions number 5,6,11 were attempted to determine the risk of acceptance the half cook egg. It was showed the normal egg cooking condition was not enough to completely eradicate the Salmonella Enteritidis and Salmonella Heidelberg from each serving (Alexis, 2007). So the consumers eaten half cook egg dish have chance to get the Salmonella and may cause the illness. Questions number 10 and 13 represented by the consumer acceptance for half cook or raw egg processed product. It was more than 80% of respondents accepted to eat half cook products. Eggs source of product such as mayonnaise or ice-crème contaminated with Salmonella, the final products also contaminated with Salmonella as well. Then combination with the storage condition over than 7-celsius degree, Salmonella is able to replicate in those products content and may cause the foodborne illness (World Health Organization & Food and Agriculture Organization of The United nations, 2002). Due to the limitation of some egg recipes must avoid over cook to keep it original taste smell and texture. It is the case of some egg recipes could not eradicate all the Salmonella so the free from Salmonella egg play role as the important source in this case to reduce the chance of Salmonellosis in human.

## 5.2 Conclusion

The first phase of this study showed the contamination rate of *Salmonella spp.* result from the 196 of egg samples of 10 eggs pooled as one sample of each at Sukhumvit Bangkok in December 2016 to January 2017. All the samples were classified as a three group Premium Salmonella-free, Premium chemical free (Organic) and Ordinary egg. The result revealed the Salmonella contamination rate among each group not significantly different by 7.6% but just only ordinary egg group found the public health concerned serovar (*S. Typhimurium* and *S. Hadar*) at 4.5% of contamination rate.

For the second phase, the data about socio-demographic, egg consumption hygiene knowledge and egg consumption behavior collected by using questionnaire. During April to May 2017, the sample size was 404 of Thai citizens. The result from 404 respondents, 72.7% of respondents were shown the poor knowledge on egg consumption hygiene. The egg consumption behavior scores showed 48.0% of respondents indicated as poor behavior egg consumers. Majorities of respondents would like to avoid eating the raw eggs and buy eggs with clean shell as a main factor of high scores. The egg hygiene knowledge score results showed age (P-value = 0.031), education (P-value = 0.000) and income (P-value = 0.000) was significant association with of egg consumption hygiene score. Eating behavior score results were not shown the relationship with socio-demographic factor, however the correlation between egg consumption hygiene knowledge and egg consumption behavior was not significant.

### 5.3 Recommendation

1. The Royal Thai government or educational sector should provide the information about food safety buyer guide for consumers, especially in some specific data onto each type of food raw materials or processed foods. It may need special practice to keep it, such as eggs and give education to the consumer about eggs food safety knowledge.

2. Researchers should expand the area of this study in the future, they should focus on Salmonella survey at the farm level or egg ended products in the market for the next further study. It would provide more precise pictures along the egg food chain about the Salmonella dynamic in egg cycle. It would be helpful for egg industry and related business to find the source of the problem. Concerning the holistic solution to reduce the Salmonella contamination at the source in the future.

3. Due to the study result, the knowledge did not change into consumer behavior, The Royal Thai government should direct command to the ministry of public health and ministry of agriculture and co-operations to create the national foods safety policy on the supply chain of foods, begin at producers to consumers and Salmonella issue is the one the major topic as major foodborne pathogen. The importance of managing the contamination of Salmonella at producer stages for example, the new policy, it should have the regulation about shelf storage condition in buying place to keep eggs fresh and safe enough for the consumers. The layer farms should have the clearly regulation and directive about the Salmonella control with reliable monitoring and surveillance program by the licensed veterinarian inspector from the ministry of agriculture and co-operation with the officer from the ministry of public health must be necessary at egg distribution centers.

#### 5.4 Limitation

1. Based on a cross-sectional study, the data collected in the period of 3 months in Sukhumvit area. There were two limits of the study in terms of duration and geographic.

2. This study did not observe about egg at both post-harvesting process and housing condition in layer farms. It may incomplete of some important information on overall picture about Salmonella distribution of egg markets.

3. The recalled bias of respondents may cause the errors by forgetfulness or incomplete of recall memory itself.



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## Appendix A

The ethical approval from  
Ethics Review Committee for Research Involving Human Research Subjects,  
Health Science Group., Chulalongkorn University Bangkok, Thailand

(The Ethic code 020.1/60)

And questionnaires





### บันทึกข้อความ

ส่วนงาน คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 โทร.0-2218-3202  
 ที่ จว 464 /2560 วันที่ 18 พฤษภาคม 2560  
 เรื่อง แจ้งผลผ่านการพิจารณาจริยธรรมการวิจัย


เรียน คณบดีวิทยาลัยวิทยาศาสตร์สาธารณสุข

สิ่งที่ส่งมาด้วย เอกสารแจ้งผ่านการรับรองผลการพิจารณา

ตามที่นิติต/บุคลากรในสังกัดของท่านได้เสนอโครงการวิจัยเพื่อขอรับการพิจารณาจริยธรรมการวิจัย จากคณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย นั้น ในการนี้ กรรมการผู้ทบทวนหลักได้เห็นสมควรให้ผ่านการพิจารณาจริยธรรมการวิจัยได้ ดังนี้

โครงการวิจัยที่ 020.1/60 เรื่อง ความชุกของการปนเปื้อนเชื้อซาลโมเนลล่าในไข่ไก่และความสัมพันธ์ระหว่างพื้นฐานทางสังคมประชากร, ความรู้และพฤติกรรมของผู้บริโภคไข่ไก่ในกรุงเทพมหานคร ประเทศไทย (PREVALENCE OF *Salmonella* spp. CONTAMINATION IN HEN EGG AND RELATIONSHIP AMONG SOCIODEMOGRAPHIC, KNOWLEDGE AND BEHAVIOR OF THE EGG CONSUMER IN BANGKOK THAILAND) ของ นายพลวัฒน์ ศรีเรืองสุข

จึงเรียนมาเพื่อโปรดทราบ

  
 (ผู้ช่วยศาสตราจารย์ ดร.นันท์ ชัยชนะงศาโรจน์)  
 กรรมการและเลขานุการ  
 คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน  
 กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย

- ① เรียน ท่านรองฯ (รศ.ดร.รัตนา)  
 เพื่อโปรดทราบและพิจารณา  
 สำเนา-ผอ.ฝ่ายวิชาการ

วันที่ 22 พ.ค. 2560 เวลา 20:20

② 13/5/2017

11/5/2017 + 02 มีบันทึกส่ง

55  
 23/5/17

  
 นายก (รศ.ดร.รัตนา) รองอธิการบดี

  
 23/5/17



คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย  
254 อาคารจามจรี 1 ชั้น 2 ถนนพญาไท เขตปทุมวัน กรุงเทพฯ 10330  
โทรศัพท์/โทรสาร: 0-2218-3202 E-mail: eccu@chula.ac.th

AF 01-12

COA No. 101/2560

## ใบรับรองโครงการวิจัย

โครงการวิจัยที่ 020.1/60 : ความชุกของการปนเปื้อนเชื้อซาลโมเนลล่าในไข่ไก่และความสัมพันธ์ระหว่างพื้นฐานทางสังคมประชากร, ความรู้และพฤติกรรมของผู้บริโภคไข่ไก่ในกรุงเทพมหานคร ประเทศไทย

ผู้วิจัยหลัก : นายพลวัฒน์ ศรีเรืองสุข

หน่วยงาน : วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย

คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย ได้พิจารณา โดยใช้หลัก ของ The International Conference on Harmonization – Good Clinical Practice (ICH-GCP) อนุมัติให้ดำเนินการศึกษาวิจัยเรื่องดังกล่าวได้

ลงนาม.....  
(รองศาสตราจารย์ นายแพทย์ปรีดา ทศนประดิษฐ์)  
ประธาน

ลงนาม.....  
(ผู้ช่วยศาสตราจารย์ ดร.นันทรี ชัยชนะวงศาโรจน์)  
กรรมการและเลขานุการ

วันที่รับรอง : 18 พฤษภาคม 2560

วันหมดอายุ : 17 พฤษภาคม 2561

## เอกสารที่คณะกรรมการรับรอง

- 1) โครงการวิจัย
- 2) ข้อมูลสำหรับกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัยและใบยินยอมของกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย
- 3) ผู้วิจัย
- 4) แบบสอบถาม

## เงื่อนไข

1. ข้าพเจ้ารับทราบว่าเป็นการพิจารณาจริยธรรม หากดำเนินการเก็บข้อมูลการวิจัยก่อนได้รับการอนุมัติจากคณะกรรมการพิจารณาจริยธรรมการวิจัย
2. หากใบรับรองโครงการวิจัยหมดอายุ การดำเนินการวิจัยต้องยุติ เมื่อต้องการต่ออายุต้องขออนุมัติใหม่ล่วงหน้าไม่ต่ำกว่า 1 เดือน หรือส่งรายงานความก้าวหน้าการวิจัย
3. ต้องดำเนินการวิจัยตามที่ระบุไว้ในโครงการวิจัยอย่างเคร่งครัด
4. ใช้เอกสารข้อมูลสำหรับกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย ใบยินยอมของกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย และเอกสารเชิญเข้าร่วมวิจัย (ถ้ามี) เฉพาะที่ประทับตราคณะกรรมการเท่านั้น
5. หากเกิดเหตุการณ์ไม่พึงประสงค์ร้ายแรงในสถานที่เก็บข้อมูลที่ขออนุมัติจากคณะกรรมการ ต้องรายงานคณะกรรมการภายใน 5 วันทำการ
6. หากมีการเปลี่ยนแปลงการดำเนินการวิจัย ให้ส่งคณะกรรมการพิจารณารับรองก่อนดำเนินการ
7. โครงการวิจัยไม่เกิน 1 ปี ส่งแบบรายงานสิ้นสุดโครงการวิจัย (AF 03-12) และบทคัดย่อผลการวิจัยภายใน 30 วัน เมื่อโครงการวิจัยเสร็จสิ้น สำหรับโครงการวิจัยที่เป็นวิทยานิพนธ์ให้ส่งบทคัดย่อผลการวิจัย ภายใน 30 วัน เมื่อโครงการวิจัยเสร็จสิ้น



ข้อมูลสำหรับกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย

1. ชื่อโครงการวิจัย(ไทย) ความสุขของการปนเปื้อนเชื้อซาลโมเนลล่าในไข่ไก่ และความสัมพันธ์ระหว่างพื้นฐานทางสังคมประชากร ความรู้ และพฤติกรรมของผู้บริโภคไข่ไก่ใน กรุงเทพมหานคร ประเทศไทย
2. ชื่อผู้วิจัยหลัก นาย พลวัฒน์ ศรีเรืองสุข ตำแหน่ง นิสิตปริญญาโท  
สถานที่ติดต่อผู้วิจัย (ที่ทำงาน) บริษัท อีแลนโค(ประเทศไทย)จำกัด 689 อาคารกิริช ทาวน์เวอร์  
แอดเด็่มควอเทียร์ ชั้น 17/1-3,9-14 ถ.สุขุมวิท แขวงคลองตันเหนือ  
เขตวัฒนา กรุงเทพฯ 10110  
(ที่บ้าน) 95/1286 เอลลิโอเคลเรย์ สุขุมวิท 64 ถ.สุขุมวิท แขวงบางจาก  
เขตพระ โขนง กรุงเทพฯ 10260  
โทรศัพท์มือถือ 098-2613604 E-mail : pollawat.sri@gmail.com
3. ชื่อผู้วิจัยร่วม ดร. วัฒนสิทธิ์ ศิริวงศ์ ตำแหน่ง รองศาสตราจารย์  
สถานที่ติดต่อผู้วิจัยร่วม(ที่ทำงาน) วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย อาคาร  
สถาบัน 3 ชั้น10 ถ.พญาไท ปทุมวัน กรุงเทพมหานคร 10300  
โทรศัพท์ (ที่ทำงาน) 02-218-8231 โทรศัพท์มือถือ 081-8558502  
E-mail : wattasit.s@chula.ac.th

1.ขอเรียนเชิญท่านเข้าร่วมในการวิจัยก่อนที่ท่านจะตัดสินใจโปรดอ่านข้อมูลว่างานวิจัยเกี่ยวข้องกับอะไร และสามารถสอบถามข้อมูลเพิ่มเติมหรือเพื่อความกระจ่างชัดได้ตลอดเวลา

2.โครงการนี้เกี่ยวข้องกับการศึกษาถึงความสุขของการปนเปื้อนเชื้อซาลโมเนลล่าในไข่ไก่และความสัมพันธ์ระหว่างพื้นฐานทางสังคมประชากรที่มีต่อความรู้ และ พฤติกรรมในการบริโภคไข่ไก่ใน เขต กรุงเทพมหานคร

3.รายละเอียดของกลุ่มประชากรหรือผู้มีส่วนร่วมในการวิจัย โครงการนี้ศึกษาในประชาชนผู้บริโภคไข่ไก่ โดยมีเกณฑ์ในการคัดค้านี้

- เป็นชาย หรือ หญิง ชาวไทย
- สามารถรับรู้ , สื่อสารภาษาไทยได้
- ยินยอมที่จะให้ความร่วมมือในการตอบแบบสอบถาม

:สำหรับเกณฑ์ในการคัดออก

- ผู้พิการหรือ มีปัญหาทางจิต

:จำนวนผู้เข้าร่วมการวิจัยทั้งโครงการจะมีประมาณ 404 คน และ ผู้ตอบแบบสอบถามทั้งหมด จะได้รับปากกาเป็นของที่ระลึก



ศูนย์วิจัยโครงการวิจัย..... 020.1/60  
วันที่รับรอง..... 18 พ.ค. 2560  
วันหมดอายุ..... 17 พ.ค. 2561

คณะผู้วิจัยจะเดินทางไปสำรวจแหล่งค้าขายไข่ไก่ อันได้แก่ตลาดสด และ ซูเปอร์มาร์เก็ต หรือเพื่อเชิญผู้ที่เข้าเกณฑ์คัดเข้ามีส่วนร่วมในงานวิจัย โดยเลือกกลุ่มตัวอย่างแบบไม่เฉพาะเจาะจง ทางคณะผู้วิจัยจะทำการอธิบายเกี่ยวกับเนื้อหาและข้อมูลของโครงการวิจัยโดยละเอียด เพื่อถามถึงความยินยอมในการตอบแบบสอบถาม

4. ผู้วิจัยเป็นผู้ติดต่อประสานงานเพื่อการเก็บข้อมูลในตลาด และ ย่านการค้า ในการดำเนินการเก็บข้อมูลนั้น ผู้วิจัยจะเป็นผู้เก็บข้อมูล โดยการสัมภาษณ์ โดยใช้แบบสอบถามรายบุคคล จำนวน 35 ข้อต่อหนึ่งชุด แบบสอบถามซึ่งแต่ละชุดจะแบ่งเป็นสามส่วน โดยแบบสอบถามนั้นจะเป็นถามคำถามสั้นๆเกี่ยวกับ อายุ เพศ รายได้ และอื่นๆ ในส่วนแรก ในส่วนที่สองและสามนั้นจะเป็นแบบคำถาม ถูก ผิด และ ประเมินความถี่ในการกระทำตามคำถามข้ออื่นๆ โดยจะถามคำถามอันเกี่ยวข้องกับความรู้พื้นฐานด้านสุขอนามัยในการบริโภคไข่ไก่ และ พฤติกรรมในการบริโภคไข่ไก่ ซึ่งใช้เวลาประมาณ 5- 10 นาที ต่อบุคคล
5. ผู้วิจัยจะไม่มีการเปิดเผยข้อมูลส่วนตัว และ เมื่อเสร็จสิ้นการวิจัยแล้วข้อมูลที่เกี่ยวข้องกับผู้มีส่วนร่วมในการวิจัยทั้งหมดจะถูกทำลายทิ้ง และ การนำเสนอข้อมูลนั้นจะเสนอเป็นภาพรวมโดยไม่มีข้อมูลใดๆที่สามารถระบุและโยงไปถึงตัวบุคคลแต่ละบุคคลได้
6. การเข้าร่วมของผู้ให้ข้อมูลเป็นไปโดยสมัครใจ ซึ่งผู้ให้ข้อมูลอาจจะได้รับความเสี่ยงจากการ ไม่สะดวกในพื้นที่ในการทำการสัมภาษณ์ หรือ การเสียเวลาบ้าง อย่างไรก็ตาม ผู้ให้ข้อมูลสามารถที่จะปฏิเสธการเข้าร่วมได้โดยไม่มีผลกระทบแต่อย่างใด
7. ประโยชน์จากผลการวิจัยต่อผู้เข้าร่วมวิจัยคือ ผู้เข้าร่วมจะได้ทราบถึงความเสี่ยงและสุขภาพขณะที่ถูกต้องในการบริโภคไข่ไก่ โดยการอธิบายและสนทนาแลกเปลี่ยนกับผู้ทำการวิจัยภายหลังจากที่ให้สัมภาษณ์เสร็จแล้ว ซึ่งผลการวิจัยนั้นจะกลายเป็นข้อมูลพื้นฐานในการต่อขอมาตรฐานการควบคุมเชื้อซัลโมเนลลาในไข่ไก่ต่อไปในอนาคต
9. หากท่านไม่ได้รับการปฏิบัติตามข้อมูลดังกล่าวสามารถร้องเรียนได้ที่ คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย 254 อาคารจามจุรี 1 ชั้น 2 ถนน พญาไท เขตปทุมวัน กรุงเทพมหานคร 10330 โทรศัพท์/โทรสาร 0-2218-3202 E-mail: [eccu@chula.ac.th](mailto:eccu@chula.ac.th)

เลขที่โครงการวิจัย..... 020.1/40  
วันที่รับรอง..... 18 พ.ค. 2560  
รับหมดอายุ..... 17 พ.ค. 2561



## หนังสือแสดงความยินยอมเข้าร่วมการวิจัย

ทำที่.....  
วันที่.....เดือน.....พ.ศ. ....

เลขที่ ประชากรตัวอย่างหรือผู้มีส่วนร่วมในการวิจัย.....

ข้าพเจ้า ซึ่งได้ลงนามท้ายหนังสือนี้ ขอแสดงความยินยอมเข้าร่วมโครงการวิจัย ชื่อโครงการวิจัย ความชุกของการปนเปื้อนเชื้อซาลโมเนลลาในไข่ไก่ และ ความสัมพันธ์ระหว่าง พื้นฐานทางสังคม ประชากร , ความรู้ และ พฤติกรรมของผู้บริโภคไข่ไก่ใน กรุงเทพมหานคร ประเทศไทย ชื่อผู้วิจัย นาย พลวัฒน์ ศรีเรืองสุข ที่อยู่ติดต่อ วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย อาคารสถาบัน 3 ชั้น 10 ถนนพญาไท ปทุมวัน กรุงเทพมหานคร 10330 โทรศัพท์ 098-2613604

ข้าพเจ้า ได้รับทราบรายละเอียดเกี่ยวกับที่มาและวัตถุประสงค์ในการทำวิจัย รายละเอียดขั้นตอนต่างๆ ที่จะต้องปฏิบัติหรือได้รับการปฏิบัติ ความเสี่ยงอันตราย และประโยชน์ซึ่งจะเกิดขึ้นจากการวิจัยเรื่องนี้ โดยได้อ่านรายละเอียดในเอกสารชี้แจงผู้เข้าร่วมการวิจัยโดยตลอด และได้รับคำอธิบายจากผู้วิจัย จนเข้าใจเป็นอย่างดีแล้ว

ข้าพเจ้าจึงสมัครใจเข้าร่วมในโครงการวิจัยนี้ ตามที่ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย โดยข้าพเจ้ายินยอม ตอบแบบสอบถามหรือให้สัมภาษณ์ ทั้งหมด 35 ข้อ เป็นเวลานาน 5-10 นาที จำนวน 1 ครั้ง

ข้าพเจ้ามีสิทธิถอนตัวออกจากการวิจัยเมื่อใดก็ได้ตามความประสงค์ โดยไม่ต้องแจ้งเหตุผล ซึ่งการถอนตัวออกจากการวิจัยนั้น จะไม่มีผลกระทบต่อข้าพเจ้าทั้งสิ้น

ข้าพเจ้าได้รับคำรับรองว่า ผู้วิจัยจะปฏิบัติตามข้อที่ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย และข้อมูลใดๆ ที่เกี่ยวข้องกับข้าพเจ้า ผู้วิจัยจะเก็บรักษาเป็นความลับ โดยจะนำเสนอข้อมูลการวิจัยเป็นภาพรวมเท่านั้น ไม่มีข้อมูลใดในการรายงานที่จะนำไปสู่การระบุตัวข้าพเจ้า

หากข้าพเจ้าไม่ได้รับการปฏิบัติตรงตามที่ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย ข้าพเจ้าสามารถร้องเรียนได้ที่คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย 254 อาคารจามจูรี 1 ชั้น 2 ถนนพญาไท เขตปทุมวัน กรุงเทพฯ 10330 โทรศัพท์/โทรสาร 0-2218-3202

E-mail: eccu@chula.ac.th

ข้าพเจ้าได้ลงลายมือชื่อไว้เป็นสำคัญต่อหน้าพยาน ทั้งนี้ข้าพเจ้าได้รับสำเนาเอกสารชี้แจงผู้เข้าร่วมการวิจัย และสำเนาหนังสือแสดงความยินยอมไว้แล้ว

ลงชื่อ..... ลงชื่อ.....

(นาย พลวัฒน์ ศรีเรืองสุข)

ผู้วิจัยหลัก



(.....)

ผู้มีส่วนร่วมในการวิจัย

ลงชื่อ.....

(.....)

พยาน

คณะกรรมการวิจัย 020-1/60  
วันรับรอง..... 18 พ.ค. 2560  
วันหมดอายุ..... 17 พ.ค. 2561

แบบสำรวจเรื่อง ความรู้พื้นฐานเกี่ยวกับสุขลักษณะไข่ไก่ และ พฤติกรรมการบริโภคไข่ไก่

ส่วนที่ 1 ข้อมูลส่วนบุคคลทั่วไป : โปรดทำเครื่องหมาย ✓ ลงใน  หรือเติมข้อความในช่องว่าง

1. เพศ  ชาย  หญิง
2. อายุ  น้อยกว่า 20ปี  20-29 ปี  30-39 ปี  40-49 ปี  50-59 ปี  60ปี ขึ้นไป
3. ระดับการศึกษาสูงสุด  ต่ำกว่ามัธยมต้น  มัธยมต้น  มัธยมปลาย  
 อาชีวศึกษา  ปริญญาตรี  สูงกว่าปริญญาตรี  อื่นๆระบุ.....
4. รายได้เฉลี่ย ต่อ เดือน  น้อยกว่า 10,000 บาท  10,000 - 30,000 บาท  
 30,001 - 50,000 บาท  50,001-70,000 บาท  70,000- 90,000 บาท  90,001 บาทขึ้นไป
5. โดยปกติแล้วท่านซื้อไข่ไก่จากสถานที่ไหนมากที่สุด  
 ซูเปอร์มาร์เก็ต  แผงในตลาด  ร้านสะดวกซื้อ  ร้านขายของชำ  
 จากฟาร์ม  ผู้ค้าไข่คนกลาง(ล้ง)  อื่นๆ.....
6. โดยเฉลี่ยแล้ว ท่านบริโภคไข่ไก่วันละกี่ฟอง  
 ไม่มีการบริโภค  น้อยกว่า 1 ฟอง  1-2 ฟอง  3-4 ฟอง  มากกว่า 4ฟอง ขึ้นไป
7. โดยปกติท่านเก็บรักษาไข่ไก่หลังจากที่ซื้อมาแล้วไว้อย่างไร  
 เก็บในตู้เย็น  เก็บไว้ที่อุณหภูมิห้องในภาชนะปิด  เก็บไว้ที่อุณหภูมิห้องในภาชนะเปิด
8. โดยปกติแล้วท่านซื้อไข่ไก่เพื่อการบริโภคเป็นปริมาณที่เพียงพอสำหรับกี่สัปดาห์?  
 น้อยกว่า 1 สัปดาห์  1สัปดาห์  2 สัปดาห์  3 สัปดาห์  มากกว่า 3 สัปดาห์ขึ้นไป
9. ในช่วงสามเดือนที่ผ่านมาท่านมีอาการของอาหารเป็นพิษอันเกิดจากการบริโภคไข่ไก่หรือไม่?  
 มี  ไม่มี  มีอาการอาหารเป็นพิษแต่ไม่แน่ใจว่ามาจากไข่ไก่หรือไม่  อื่นๆ

เลขที่โครงการวิจัย..... 090.1/60  
วันที่รับรอง..... 18 พ.ค. 2560  
วันที่มอบฯ..... 17 พ.ค. 2561



**ส่วนที่ 2 ความรู้พื้นฐานเกี่ยวกับสุขลักษณะการบริโภคไข่ไก่**

คำชี้แจง โปรดทำเครื่องหมาย ✓ ลงในช่องที่ตรงตามความคิดเห็นของท่านมากที่สุด

ความรู้พื้นฐานเกี่ยวกับสุขลักษณะในการบริโภคไข่ไก่	ใช่	ไม่ใช่	ไม่ทราบ
1. ไข่ที่ไก่สดมีรอยแตก หรือ ครอบสกปรกบนเปลือกยังคงปลอดภัยต่อการบริโภค			
2. ควรซื้อไข่จากตู้แช่ หรือ ชั้นวางของที่มีการรักษาอุณหภูมิไม่เกิน 4 องศาเซลเซียส			
3. ควรบริโภคไข่ให้หมดภายใน 3 สัปดาห์นับจากวันที่ผลิต			
4. ไข่ดิบและอาหารไข่ที่ปรุงสุกแล้วต้องแยกเก็บไว้คนละที่			
5. ไข่ต้มหึ่งเปลือก หรือ ปอกเปลือกแล้วสามารถเก็บไว้บริโภคในตู้เย็นได้นานถึง 2 สัปดาห์			
6. ไข่ที่คุณภาพดีสดใหม่ จะมีไข่ขาวที่เหลวและแผ่กระจายเป็นบริเวณกว้างเมื่อตอกออกมา			
7. ไข่ที่ถูกปรุงจนไข่ขาวสุกและแข็งมีความปลอดภัยในการบริโภคถึงแม้ว่าไข่แดงจะเหลวก็ตาม			
8. ควรล้างมือทุกครั้งด้วยน้ำสบู่ ทั้งก่อนและหลังสัมผัสไข่ดิบ หรือ อาหารที่มีส่วนผสมของไข่ดิบ			
9. อุณหภูมิ 65 องศาเซลเซียสขึ้นไปเพียงพอที่จะทำให้อาหารจากไข่ปลอดภัยต่อการบริโภค			
10. อาหารจากไข่ที่ปรุงเสร็จแล้วไม่ควรอยู่ที่อุณหภูมิห้องนานเกิน 1 ชั่วโมงก่อนรับประทาน			
11. ไข่ไก่ที่เก็บเอาไว้เป็นเวลานานสามารถเป็นสาเหตุของอาการท้องเสียได้			
12. อาหารบางชนิดมีส่วนผสมของไข่ดิบเช่น น้ำสลัด , มายองเนส , ไอศกรีม เป็นต้น			
13. ควรแยกเขียง และ อุปกรณ์ทำอาหารของไข่ดิบ และ ไข่ปรุงสุกแยกออกจากกัน			



เลขที่โครงการวิจัย..... ๐๒๐-1/๖๐  
วันที่รับรอง..... 18 พ.ค. 2560  
วันหมดอายุ..... 17 พ.ค. 2561

**ส่วนที่ 3 พฤติกรรมการในการบริโภคไข่ไก่**

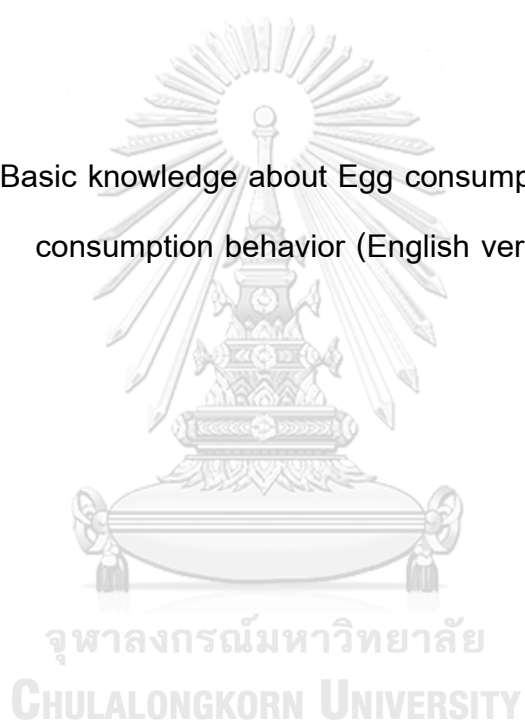
คำชี้แจง โปรดทำเครื่องหมาย ✓ ลงในช่องที่ตรงกับความรู้สึก / ความคิดเห็นของท่านมากที่สุด

พฤติกรรมในการบริโภคไข่ไก่	ไม่เคย	เคย บางครั้ง	เป็น ประจำ
1. ท่านใช้ไข่ไก่ที่ถูกเก็บไว้นานกว่า 2 สัปดาห์ประกอบอาหาร			
2. ท่านเลือกซื้อไข่ที่เปลือกสะอาด ไม่มีรอยแตก หรือ มีมูลติดที่ผิวเปลือก			
3. ท่านซื้อไข่ผู้ผลิตที่ทราบแหล่งที่มาแน่ชัด และมีฉลากชัดเจน			
4. ท่านบริโภคไข่ลวก , ไข่อ่อนเย็น			
5. ท่านบริโภคไข่ดาวทอดด้านเดียวที่ไข่แดงยังคงมีความหนืดเหลว			
6. ท่านบริโภคไข่กวนที่เนียนนุ่ม หมด และมีความฉ่ำ อยู่ภายใน			
7. ท่านจุ่มไข่ดิบ บนเนื้อสัตว์ที่ลวกหรือย่าง ก่อนรับประทาน			
8. ท่านบริโภคไข่ดิบร่วมกับอาหารชนิดอื่นเช่น ข้าวสวยร้อน หรือ ข้าวยำเกาหลี			
9. ท่านบริโภคหรือใช้ ไข่ไก่ตอกแล้วรวมดูง เพื่อการประกอบอาหาร			
10. ท่านบริโภคผลิตภัณฑ์ที่มีไข่ดิบเป็นองค์ประกอบเช่น น้ำสลัด , ไอศกรีม , มายองเนส			
11. ท่านนิยมรับประทานผลิตภัณฑ์จากไข่เช่นไข่ดาว , ไข่กวน ในชุดอาหารแบบบุฟเฟ่ต์			
12. ท่านบริโภคไข่ไก่ดิบ หรือ ผลิตภัณฑ์จากไข่ไก่ดิบแบบเดี่ยวๆ เช่น เครื่องดื่มไข่ขาวเหลว เป็นต้น			
13. ท่านบริโภคผลิตภัณฑ์เบเกอรี่ และ ขนม ที่มีไข่กึ่งดิบกึ่งสุกเป็นองค์ประกอบ เช่น ทาร์ต , ทiramisu , คัสตาร์ด , สังขยา , ทองหยิบ เป็นต้น			



เลขที่โครงการวิจัย..... 020.1/60  
วันที่รับรอง..... 18 พ.ค. 2560  
วันหมดอายุ..... 17 พ.ค. 2561

Questionnaire Basic knowledge about Egg consumption hygiene and Egg  
consumption behavior (English version)



Part 1 Please put a thick ✓ in the box  next to the answer of your choice

1. Gender  Male  Female
2. Age  <20 Yr.  20-29 Yr.  30-39 Yr.  40-49 Yr.  50-59 Yr.  60 Yr.++
3. Education level  Primary school or lower  Lower secondary school  Higher secondary school  Vocational study  Bachelor degree  Higher than bachelor  Other.....
4. Family income per month  <10,000 THB  10,000 - 30,000 THB  30,001 – 50,000 THB  50,001-70,000 THB  70,000– 90,000 THB  90,001 THB and upper
5. Normally where is the place that you most often to buy the egg?
  - Super market  Fresh market  Convenience store
  - Grocery  Hen farm  Egg distributor  Other.....
6. For an average. How many of egg that for each of your family member eat per week?
  - No eat  1-3 Eggs  4-7 Eggs  7-14 Eggs  More than 14 eggs
7. Normally How you can preserve the egg in your house after buying.
  - Keep in fridge  Keep at room temp in sealed  Keep at room temp in open
8. Normally when you buy the egg at enough amount to use for many week?
  - Less than 1 wk  1 wk  2 wk  3 wk  More than 3 wk
9. At three month ago. Did you have any sign of food poisoning from eating the hen egg or not?
  - Yes  No  Yes but not sure that sign cause by egg  Other



Part 2 The basic knowledge about egg consumption hygiene

Instruction : Please put a thick ✓ in the box  next to the answer of your choice

Basic knowledge about egg consumption hygiene	Yes	No	Notk now
1.Eggs with cracked , leaked or dirty are still safe to eat.			
2.Should buy an egg from shelf that not more than 4 celcius degree			
3.Should eat egg within 3 weeks after manufactured date,			
4.Cooked egg and Raw egg must keep in separate container			
5.Broiled egg with or without shell can keep in fridge for 2 week. And still safe to eat.			
6.The watery albumin is the sign of egg with high freshness.			
7.Cooked egg with firm albumin is safe enough to eat. Although the egg yolk still liquid.			
8.Should wash hands carefully. Before and After touching raw egg or the food that contained with raw egg.			
9. Temperature at 65 degree celcius was enough to guarantee the safety			
10.Cooked egg must not keep at room temperature more than 1 hour .Before eaten.			
11.The egg with long time storage. Can cause the diarrhea.			
12.Some food was contained with raw egg such as Salad dressing, Ice cream and Mayonnaise.			
13.Should separate the chopping block between raw and cooked egg.			

Part 3 Egg consumption behavior

Instruction : Please put a thick ✓ in the box  next to the answer of your choice

Egg consumption behavior	Never	Some time	Always
1.You use the egg with more than 2 week in storage to make the food.			
2.You buy the egg without crack ,leak or dirty on the egg shell			
3.You buy the egg from verified producer with clear label			
4.You eat the soft boiled egg or onsen egg			
5.You eat the sunny sided up fried egg.			
6.You eat scrambled egg with moisture inside,			
7.You dip the grilled meat in raw egg before eat.			
8.You eat the raw egg with other type of hot food such as steamed rice			
9.You use the pooled cracked in plastic bag to make the food.			
10. You eat the food was contained with raw egg such as Salad dressing , Ice cream and Mayonnaise.			
11.You eat the fried or scrambled egg in buffet set.			
12.You eat the raw egg or raw egg contained product such as albumin drink.			

13.You eat the bakery or dessert that contained with half cooked egg. Such as Tart , Tiramisu , Custard or egg yoke fudge balls cooked in syrup.			
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**Appendix B: result of basic egg hygiene knowledge score**

Egg consumption hygiene score	Number N=404	Percentage(%)
0	3	0.7
1	8	2.0
2	15	3.7
3	28	6.4
4	34	8.4
5	64	15.8
6	63	15.6
7	79	19.3
8	52	12.9
9	35	8.7
10	18	4.5
11	3	1.0
12	2	0.5
13	0	0.0
Mean = 6.13 Median = 6.00 S.D. = 2.244		
Min = 0 Max = 12		
Score 80-100% (11-13 points) = 5 (1.4%)		
(good knowledge)		
Score 60-79% (8-10 points) = 105(25.9%)		

(Satisfactory knowledge)

Score 0-59% (0-7 points) = 294 (72.7%)

(Poor knowledge)

**Result of egg consumption behavior score**

Egg consumption behavior score	Number	Percentage(%)
	N=404	
4	1	0.2
5	0	0.0
6	2	0.5
7	2	0.5
8	3	0.7
9	7	1.7
10	6	1.5
11	10	2.5
12	28	6.9
13	40	9.9
14	31	7.7
15	65	16.1
16	45	11.1
17	42	10.4
18	43	10.6
19	25	6.2
20	23	5.7
21	14	3.5
22	6	1.5
23	5	1.2
24	5	1.2
25	1	0.2

Mean = 15.79 Median = 16.00 S.D. = 3.34
Score 80-100% (21-26 points) = 31(7.70%)
(Good behavior)
Score 60-79% (16-20 points) = 179(44.30%)
(Moderate behavior)
Score 0-49% (0-15 points) = 194 (48.00%)
(Poor behavior)

### Appendix C : Tabulation of Research Activities and Timeline

Activities	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May -Oct 2017	Nov 2017
1.Literature review and proposal writing									
2.Proposal examination									
3.Ethic consideration from Chulalongkorn University									
4.Research preparation									
5.Data collecting									
6.Data analysis									
7.Discussion research writing									
8.Thesis defense and publication									

Appendix D: Research Budgets : Classified to be

Salmonella free egg sample cost	21,120 THB
Chemical free egg sample cost	26,400 THB
Ordinary egg sample cost	10,560 THB
Laboratory cost (ISO 6579:2002- Kauffmann white scheme)	202,000 THB
Laboratory Assistant fee's	15,000 THB
Transportation fee	7,000 THB
Data analysis and report binding	5,000 THB
Study Material	3,000 THB
Advisor cost	10,000 THB
<u>Total cost</u>	<u>300,080 THB</u>



## VITA

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Education : Veterinarian, Faculty of Veterinary  
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Work experience : Sales representative, Advance pharma  
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