

# DISCOVERY TRENDS OF PICKLED FISH ESTABLISHMENT IN KHON KAEN, NORTHEAST THAILAND

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## Abstract

This is action research to develop pickled fish establishments by local participation in Khon Kaen Province. Participants recruited sixty people. There were three processes which were situation analysis, implement, and evaluation. From the 22 pickled fish establishments in the sub-district area, the establishment of a household level 81.8%, 81.8% of pickled fish establishments drain waste water into environment. From the randomized pickled fish samples for laboratory tests, *E. coli*, *Salmonella spp.* And *Staphylococcus aureus* were found 100%, 37.5% and 25.0% respectively. 60% of fish products were infected with fluke. The brainstorming meeting and exchange of knowledge led to the development of measure for pickled fish establishments. These were as follow: 1) Surveillance of pickled fish 2) Prevention and control of liver fluke disease 3) Networks setting. The main outcome after the development of pickled fish establishments was successful such as 1) Increased fluke free pickled fish products and passed the standards for microbiological quality criteria of food and exposed containers; 2) Pickled fish establishment have improved sanitation and achieving to pass the food production criteria. 3) Entrepreneurs have improved their health literacy in prevention and control comparing the before and after implementation with a statistically significant difference of ( $p < 0.001$ ); Conclusion: The model developed for pickled fish production establishments by local participation was successful in many areas. This model should be expanded to other areas to improve prevention and control liver fluke infection especially to decrease the cases of Cholangiocarcinoma in Thailand.

**Keywords:** Local participation, pickled fish establishments, pickled fish, Cholangiocarcinoma

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## Introduction

One of the major sources of protein in human diet is fish especially in warm countries or tropical regions. Fish-borne parasitic zoonoses such as opisthokiasis are major causes of morbidity in Asia. Fish-borne parasitic zoonoses are commonly found in the northern and northeastern regions of Thailand. Several species of cyprinoid freshwater fish have been reported as secondary intermediate hosts. The consumption of cooked fish is an important factor in reducing liver fluke infection and Cholangiocarcinoma (CCA) deaths in people, especially in the northeast region of Thailand. The most risky foods with liver fluke infection are pickled fish and Koi Fish, most especially that pickled fish is very popular in all regions of Thailand. It has been exported to Asia, the European Union and the United States (Sukkho *et al.*, 1999). From the report of pickled fish production statistics, nationwide, it is found that the production of fermented fish ranges from 20,000 to 40,000 tons per year (Nantasarn and Phichai, 2013) while pickled fish has a production volume of 1.35 million kilograms per year. This production has an estimated value of over 60 million baht per year (Thabpla, 2013).

The production process of pickled fish still make use of the old methods from local knowledge which have problems in terms of microbial and chemical contamination in the product. If the people receives a large amount, it may be harmful to consumers particularly those products infected in the form of liver fluke. This type of parasite were found alive if the fermentation of fish with salt and glutinous rice for less than 3 days. However, if fermented for 6 days or more, the infected form of liver fluke would not be found (Prasongwatana *et al.*, 2013). The pickled fish sold in the market in the northeast region was found contaminated with liver fluke and the opportunity to infect people is high if eaten raw. The major production and sales locations throughout the northeast region are at one district in Khon Kaen Province (Onsurathum *et al.*, 2016). In addition, most of the pickled fish sold in the general market in the Northeast region are obtained from large production sources which is contaminated with liver fluke, depending on the water source and fish species used to produce pickled fish, such as contaminated fish that are produced from Ubonrat Dam (Pinlaor *et al.*, 2013) which were consistent with other studies (Aukkanimart, *et al.*, 2017). The survey of pickled fish from 20 provinces in the Northeast detected the infection of liver fluke (20.2%) with a density of

liver fluke between 1-268 mc/kg, consistent with the result of the studies in Udonthani and Kalasin which found the infected form of liver fluke in 9.1% of fermented fish and 42.9% of pickled fish (Labbunruang and Kulsantiwong, 2019).

From the survey of 12 pickled fish establishment relating to good criteria for primary food production and analysis of microbial contamination in the products, equipment and hand of the operators, it was found that of the total of 108 samples 83.3% of pickled fish establishments did not meet the criteria. The most common defect is the location of the production building and worker hygiene (Phumphphan and Inmuang, 2016) in line with other studies (Department of Health, Ministry of Public Health, 2018) found that the pickled fish establishments still have problems in many aspects. Therefore, to eliminate transmission of liver fluke from Thailand is to make fermented fish and pickled fish free from liver fluke. But the problem was how to make entrepreneurs realize the importance of clean and safe product. And how to involve people in the area to participate and provide support for continuity and sustainability.

The development of pickled fish establishments to be free of liver fluke should arise from awareness of the current situation of those involved, which will lead to better development with the belief that every person has the potential and the ability to develop themselves. And sustainable and effective development must result from the participation of those involved, in line with critical theory which believes that every human being has the potential to create. Each person must have mutual acceptance in order to liberate oneself from previous experiences. Relying on participatory learning processes in the principles of reflection, providing opportunities for relevant parties to express opinions, exchange experience and take action in an atmosphere of participatory learning that results from co-thinking, making decisions, making plans and taking action to solve problems that arise, causing learning together to lead to change. The result is realized and learning in one's own potential, be rational and can decide to choose self-practice. Therefore, the objectives of this study were 1) Situation analysis of pickled fish establishments in the study area. 2) Develop the pickled fish to be free of liver fluke through local participation. 3) Evaluate the development of pickled fish establishments by local participation. By aiming for those involved in the area to produce clean and safe pickled fish products.

## Material and Methods

This action research used the concept of Stringer, (2007). The study area were the Municipal and Sub-District Administrative Offices in Khon Kaen. Participants included the local administrators (2) entrepreneurs, pickled fish (22) local personnel (10) responsible staff for food safety of hospitals/ District health office (2) community leaders (22) Agricultural and Community Development Officers (4) Total was 60 people and study divided into 3 phases: 1) Studying the operating conditions of the pickled fish establishment in sub-district area. Data were collected by using evaluation form, health literacy of pickled fish entrepreneurs was survey, group meeting and reflect the results to the participants in the area. 2) Developing the Pickled fish establishment with local participation by organizing a brainstorming session to exchange and reflect various information and management in accordance with the context by allowing participants to plan and implement. 3) Evaluation data which collected by using the assessment form, interview and group meeting, participation observation. Interview form about health literacy was tested using Kuder-this Richardson 20 which got reliability of 0.7 regarded as quite high reliability (Kanchanawassri, 2009). The quantitative data was analyzed using percentage, mean, standard deviation, highest-lowest values. Qualitative data analyzed by content analysis. Trustworthiness of qualitative content use the guidelines of Lincoln and Guba, (1985) to verify data accuracy.

## Results and Discussion

### Situation Analysis of Pickled Fish Establishments in the Study Area

Of 22 pickled fish establishment, only 1 has license. 81.1 % are household establishments, 59.1% of the product produced are pickled fish with a quantity produce of 500-2,000 kg per month, 72.7% buy raw materials from other provinces, 59.1% sell within the province, 100% of water used in the pickled fish establishment are tap water (37.5% are village water supply and 62.5% are regional water supply) and 18.2% of water used for producing pickled fish are tank water (received FDA), 54.5% of garbage that occurs in the production process were put in bucket and waiting for the municipality to manage, 81.8% of waste water are drained into natural water sources and there are still no complaints about the smell caused by the preparation of pickled fish in the area (Figure 1).

From the randomized pickled fish samples for laboratory tests, *E. coli*, *Salmonella spp.* And

*Staphylococcus aureus* were found 100.0%, 37.5%, and 25.0% respectively. 60% of fish products were infected with fluke. Pickled fish establishments that have food production criteria according to sanitary food production facilities at good level was 4.5%, most of them at low level 77.3% (Table 3).

The needs of entrepreneurs are product certification 91.7%, distribution and public relations channels 66.7%, procedures for contacting the government for certification and registration 62.5%, investment budget 50.0% and knowledge of product development 33.3%.

Most of the entrepreneurs give less importance on registration for business licenses. The main reason that they do not want to register because they are afraid of revenue and do not want to invest. 54.2% of pickled fish entrepreneurs have moderate level of health literacy.

### Development of Pickled Fish Establishments with Local Participation

Participants set up brainstorming to exchange knowledge together, set up operational plan, following up, evaluating, reflecting the results to those involved in the area and get the process as follows: Figure 2.



Figure 1. Shows the operating condition of the establishments Para Pason

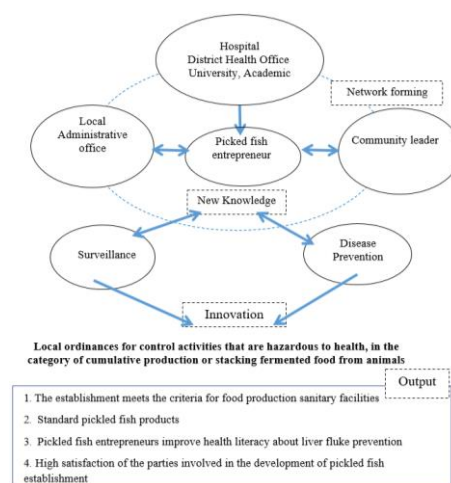
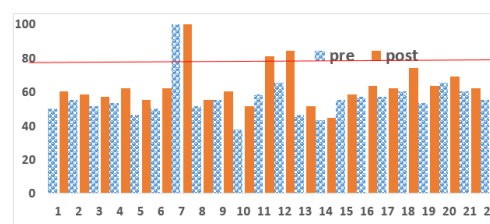


Figure 2. Shows development of pickled fish establishments by local participation Khon Kaen Province

1. Surveillance of liver fluke disease and contamination in pickled fish. Brainstorming and group discussions with local representatives, entrepreneurs, community leaders, agriculture, community development and research teams to search for prototypes and innovations in disease surveillance and contamination in pickled fish. The activities occurred were 2.1.1 randomly picking pickled fish for laboratory testing to check for liver fluke and microbiological quality of food and containers. 2.1.2 Prevention and control of liver fluke diseases including (1) collection of fish droppings that are discarded from production process to be used for compost and animal feed by the municipality (2) the container of raw fish products must specify the label "cooked before consumption" (3) Solving the problems of water used for cooking pickled fish (4) Encouraging entrepreneurs to use containers made of quality plastic. (5) Providing entrepreneurs with self-assessment on good criteria for food production and regularly visits to empower the establishment.

2. The network consists of local administration officer, community leaders, owner of pickled fish establishment and network had joined to learn the problems in the area by group meeting to exchange knowledge, learning both good and bad experiences in order to encourage stakeholders to learn from shared stories to raise awareness and give importance on surveillance for disease prevention.



**Figure 3.** Shows Pickled fish establishments had passed food sanitation standards and food production locations before-after operation by each establishments (n = 22)

After the operation, it was found that (1) there was an upgrade of the establishment to FDA certification and development. The original fish grinder for use in increasing the production of pickled fish in the area by requesting funding from the Science Park of Northeastern region Figure 3. (2) Local ordinances for control activities that are hazardous to health, in the category of cumulative production or stacking fermented foods from animals, 2020

#### Evaluation of the Development of Pickled Fish Establishments By Local Participation

1. Fermented fish and pickled fish products Before the operation, 60 % of them were infected with fluke and 100% did not meet the microbiological quality of food. After implementation, only 60% of the pickled fish were infected with

**Table 1.** Shows test of Pickled fish establishments for liver fluke and others

| Establishments | prasom | Pra-ra | Before      |                    | After       |                    |
|----------------|--------|--------|-------------|--------------------|-------------|--------------------|
|                |        |        | Liver fluke | others             | Liver fluke | others             |
| 1              | ✓      |        | -           | ✓ ferment 2 Day    | -           | ✓ ferment 1 Day    |
| 2              | ✓      |        | -           | ✓ ferment 1 Day    | -           | ✓ ferment 1 Day    |
| 3              | ✓      |        | -           | - ferment 1 Day    | -           | - ferment 1 Day    |
| 4              | ✓      |        | -           | ✓ ferment 4 Day    | -           | ✓ ferment 1 Day    |
| 5              | ✓      |        | -           | ✓ ferment 3 Day    | -           | ✓ ferment 1 Day    |
| 6              | ✓      |        | -           | ✓ ferment 2 Day    | -           | ✓ ferment 1 Day    |
| 7              | ✓      |        | -           | - ferment 1 Day    | -           | - ferment 1 Day    |
| 8              | ✓      |        | -           | - ferment 2 Day    | -           | - ferment 1 Day    |
| 9              |        | ✓      | -           | ✓ ferment 2 Months | -           | ✓ ferment 2 Months |
| 10             |        | ✓      | -           | - ferment 9 Months | -           | - ferment 9 Months |

Source: Regional Medical Sciences Center 7 Khon Kaen

**Table 2.** Shows Test of Pickled fish establishments for pathogens before-after operation

| Establishments | Pasom | Para | Before                          | After                  |
|----------------|-------|------|---------------------------------|------------------------|
| 1              | ✓     |      | E.coli exceeds                  | Passed                 |
| 2              | ✓     |      | E.coli exceeds                  | Passed                 |
| 3              | ✓     |      | E.coli / <i>Salmonella</i> spp. | <i>Salmonella</i> spp. |
| 4              | ✓     |      | E.coli exceeds                  | Passed                 |
| 5              | ✓     |      | E.coli exceeds                  | <i>Salmonella</i> spp. |
| 6              | ✓     |      | E.coli exceeds E.coli exceeds   | Passed                 |
| 7              | ✓     |      | E.coli /Staphylococcus aureus   | <i>Salmonella</i> spp. |
| 8              | ✓     |      | E.coli / <i>Salmonella</i> spp. | <i>Salmonella</i> spp. |
| 9              |       | ✓    | E.coli / Staphylococcus aureus  | <i>Salmonella</i> spp. |
| 10             |       | ✓    | E.coli / <i>Salmonella</i> spp. | Passed                 |

Source: Department of Parasitology, KKU

fluke and 50% of products passed the microbiological quality of food criteria (Tables 1 and 2).

2. More pickled fish establishments had passed food sanitation standards and food production locations (Table 3 and Figure 2).

3. The average score about health literacy on prevention and control of liver fluke and cholangiocarcinoma of the pickled fish entrepreneurs had increased with statistically significance ( $p < 0.001$ ) (Table 4).

4. The satisfaction level of those involved with this study was in moderate to very high.

5. Local administrative office had proposed draft ordinance to control activities that are hazardous to health in the category of cumulative production or stacking fermented foods from animals, such as pickled fish or other similar products, 2020.

## Discussion

Most of pickled fish establishments in this study were household establishments and sold their

product in the area and upcountry (Udon Thani, Nong Khai, Bangkok, etc.) consistent with other studies (Onsurathum *et al.*, 2016). However, only 1 establishments had a business license. Pickled fish establishments that have food production criteria according to sanitary food production facilities at good level was 4.5%, most of them at low level 77.3% because most of them afraid of the revenue and don't want to invest more to passed the criteria. The production process of pickled fish still use the old methods from local knowledge which causes problems of contamination of microbes and chemicals in the product (Thai Industrial Standards Institute, 2003; Pinlaor *et al.*, 2013; Prasongwatana *et al.*, 2013). Entrepreneurs do not prevent contamination during the production process resulting in microbial contamination including *E. coli*, *Salmonella spp.* and *Staphylococcus aureus* in pickled fish products. Consistent with other studies (Phumphan and Inmuang, 2016) entrepreneurs also lack the awareness of good hygiene practices, such as unclean clothing, no apron, hat, and nose cover, the water used for producing and cooking are tank water (only 18.2% meet the FDA). Most of establishment still give little importance to the

**Table 3. Shows Pickled fish establishments had passed food sanitation standards and food production locations (n = 22)**

| Level of pickled fish establishments | Before |         | After  |         |
|--------------------------------------|--------|---------|--------|---------|
|                                      | Number | Percent | Number | Percent |
| Good (score > 80%)                   | 1      | 4.5     | 3      | 13.64   |
| Fair (score 60-80 %)                 | 4      | 18.2    | 11     | 50.00   |
| Poor (score < 60%)                   | 17     | 77.3    | 8      | 36.36   |
| Total                                | 22     | 100.0   | 22     | 100.00  |

**Table 4. Shows the comparison of health literacy scores in prevention and control of liver fluke disease and bile duct cancer of the pickled fish entrepreneurs before-after operation (n = 22)**

|                                              | Mean  | Standard deviation | Mean-difference | 95% CI    | Paired t-test | p-value |
|----------------------------------------------|-------|--------------------|-----------------|-----------|---------------|---------|
| 1. Access to health information and services |       |                    |                 |           |               |         |
| Before                                       | 16.18 | 3.11               | 4.82            | 3.68-5.96 | 8.77          | <0.0001 |
| After                                        | 21.00 | 1.27               |                 |           |               |         |
| 2. Cognition                                 |       |                    |                 |           |               |         |
| Before                                       | 13.55 | 1.63               | 1.77            | 1.19-2.35 | 6.36          | <0.0001 |
| After                                        | 15.32 | 1.39               |                 |           |               |         |
| 3. Communication skills                      |       |                    |                 |           |               |         |
| Before                                       | 26.09 | 2.96               | 1.27            | 0.72-1.82 | 4.8           | <0.0001 |
| After                                        | 27.36 | 2.90               |                 |           |               |         |
| 4. Decision-making skills                    |       |                    |                 |           |               |         |
| Before                                       | 14.27 | 2.73               | 1.00            | 0.34-1.66 | 3.17          | 0.0023  |
| After                                        | 15.27 | 2.12               |                 |           |               |         |
| 5. Media literacy                            |       |                    |                 |           |               |         |
| Before                                       | 17.95 | 2.42               | 1.23            | 0.74-1.72 | 5.18          | <0.0001 |
| After                                        | 19.18 | 2.17               |                 |           |               |         |
| 6. Self-management                           |       |                    |                 |           |               |         |
| Before                                       | 26.18 | 3.25               | 1.64            | 0.66-2.61 | 3.49          | 0.0011  |
| After                                        | 27.82 | 2.95               |                 |           |               |         |
| 7. Behavior                                  |       |                    |                 |           |               |         |
| Before                                       | 50.59 | 6.68               | 5.82            | 3.89-7.75 | 6.27          | <0.0001 |
| After                                        | 56.41 | 2.84               |                 |           |               |         |

Note \* Statistical significance  $p$ -value < 0.001

correct production process according to the standards of the Ministry of Public Health because consumers pay more attention to food taste than cleanliness.

The development of pickled fish establishments by local participation used 3 steps consisting of 1. Situation analysis of entrepreneurs 2. Planning for joint operations. 3. Reflecting the results to the relevant participants for improvement and stimulated by the self-reflection process (Kimmis and McTaggart, 2005). The operational research process has a continuous spiral in each cycle, emphasizing all sides to look, think and act (Stringer, 2007). Starting with understanding their true situation, as well as the cause of the problem through dialogue to make all participants get information leading to the realization of their power and potential in taking care of themselves. Which is consistent with other study (Nilvarangkul *et al.*, 2012) that have similar processes, especially the learning process through reflection and participation from relevant participants.

Pickled fish establishments had passed food sanitation standards and food production at the high level was 13.6% and most of them at fair level was 77.3%, because Entrepreneurs began to recognize the importance of preparing pickled fish establishments to meet the standards. Most of establishment used clean water for cooking resulting in 50.0% more passing microbiological quality criteria. However, after development, it is still found that 60% of pickled fish products were infected with fluke because they are fermented for 1 day. If they use more than 6 day, the metacercaria of the intestinal will disappear (Prasongwatana *et al.*, 2013). The labeling "cook before consumption" in fermented fish and raw fish products should increase awareness of consumer.

After the development process, most of pickled fish entrepreneurs had a high level of health knowledge due to the educational activities, sharing experiences and solving problems together which is consistent with other studies (Satcha and Duangsong, 2008)

The success of the development to make the fish free from parasite depends on many factors such as the attitude, knowledge, and budget entrepreneurs themselves. The dedication and inspiration from all parts and importantly to drive stable and prosperous success and sustainability must rely on the leadership of local administrators was consistent with other study (Satcha and Duangsong, 2008). It was clear that leaders' policies affect operations and collaboration from all participants will increase as can be seen from the municipality and the sub-district administrative organizations participating in the project by supporting local operations such as

specimen collection and laboratory testing, solving the problems of clean water used in cooking pickled fish. In other sectors such as Northeastern Science Park had support the budget support for the development of a prototype fish grinder in order to increase the production as well as the preparation of the establishment to support the FDA. Participation of all sectors since joining together, making decisions together to solve problems allows relevant people to develop thinking skills, analytical skills and problem solving skill. Although some pickled fish products were still infected with the parasite, this may be due to the limitation of time of this study (12 months). To change the behavior of entrepreneurs, it takes more time and follow up, giving correct suggestions, and continuous monitoring of pickled fish products and production. But the important thing is everyone who participated in the activity had the opportunity to analyze themselves. Get to know their own strengths and weaknesses. This was an important foundation that leads to the development of problem solving skills (Reason, 2001; Tasniyom, 2003).

This study demonstrated the joint learning process from group dialogue, brainstorming to exchange knowledge as well as reflecting the views of the participants to make everyone understand the context of the problem and become aware of the effects until having a resolution in planning, conducting operations as well as following up and evaluating together. And continuous improvement of the operating guidelines until making local drafting ordinance for control activities that are hazardous to health B.E. 2020. The research team has expanded operations to other 6 local administration offices in health region 7. The policy administrators should adopt this model to determine the primary disease prevention policy by providing opportunities for relevant parties to participate in problem analysis, planning and joint operations as well as following up until the awareness arise and finally have the potential to control the liver fluke.

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